SECONDARY 1

Secondary (Express) Maths Topical Tests Worked Solutions

Chapter 1 Factors and Multiples

Class Test 1

1. (a)

2	54	144	198
3	27	72	99
3	9	24	33
	3	8	11

HCF of 54, 144 and 198
$= 2 \times 3^2$
$= 2 \times 9$
$= \mathbf{18}$ [1]

(b)

2	32	72	112
2	16	36	56
2	8	18	28
	4	9	14

HCF of 32, 72 and 112
$= 2 \times 2 \times 2$
$= \mathbf{8}$ [1]

2. (a)

2	70	294
7	35	147
	5	21

HCF of 70 and 294
$= 2 \times 7$
$= \mathbf{14}$ [1]
LCM of 70 and 294
$= 2 \times 5 \times 7 \times 21$
$= \mathbf{1470}$ [1]

(b)

3	495	726
11	165	242
	15	22

HCF of 495 and 726
$= 3 \times 11$
$= \mathbf{33}$ [1]

LCM of 495 and 726
$= 3 \times 11 \times 15 \times 22$
$= \mathbf{10\ 890}$ [1]

3. (a)

2	392	1452
2	196	726
	98	363

[1]

LCM of 392 and 1452
$= 2 \times 2 \times 98 \times 363$
$= \mathbf{142\ 296}$ [1]

(b)

2	23 716
2	11 858
7	5929
7	847
11	121
11	11
	1

$23\ 716 = 2^2 \times 7^2 \times 11^2$
$\sqrt{23\ 716} = \sqrt{2^2 \times 7^2 \times 11^2}$
$= 2 \times 7 \times 11$
$= 154$ [1]

2	140
2	70
5	35
7	7
	1

$140 = 2^2 \times 5 \times 7$
LCM of $\sqrt{23\ 716}$ and 140
$= 2^2 \times 5 \times 7 \times 11$
$= \mathbf{1540}$ [1]

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4. (a)

3	90	825	1815
5	30	275	605
	6	55	121

HCF of 90, 825 and 1815
$= 3 \times 5$
$= \mathbf{15}$ [1]

3	90	825	1815
5	30	275	605
11	6	55	121
2	6	5	11
3	3	5	11
5	1	5	11
11	1	1	11
	1	1	1

LCM of 90, 825 and 1815
$= 2 \times 3^2 \times 5^2 \times 11^2$
$= \mathbf{54\ 450}$ [1]

(b)

2	4356
2	2178
3	1089
3	363
11	121
11	11
	1

$4356 = 2^2 \times 3^2 \times 11^2$
$\sqrt{4356} = \sqrt{2^2 \times 3^2 \times 11^2}$
$= 2 \times 3 \times 11$ [1]

3	495
3	165
5	55
11	11
	1

$495 = 3^2 \times 5 \times 11$
HCF of $\sqrt{4356}$ and 495 $= 3 \times 11$
$= \mathbf{33}$ [1]
LCM of $\sqrt{4356}$ and 495 $= 2 \times 3^2 \times 5 \times 11$
$= \mathbf{990}$ [1]

5.

2	1764
2	882
3	441
3	147
7	49
7	7
	1

$1764 = 2^2 \times 3^2 \times 7^2$
$\sqrt{1764} = \sqrt{2^2 \times 3^2 \times 7^2}$
$= 2 \times 3 \times 7$ [1]

2	54
3	27
3	9
3	3
	1

$54 = 2 \times 3^3$
LCM of $\sqrt{1764}$ and 54
$= 2 \times 3^3 \times 7$
$= \mathbf{378}$ [1]

6. (a)

3	11 025
3	3675
5	1225
5	245
7	49
7	7
	1

[1]

$11\ 025 = 3^2 \times 5^2 \times 7^2$
$\sqrt{11\ 025} = \sqrt{3^2 \times 5^2 \times 7^2}$
$= 3 \times 5 \times 7$
$= \mathbf{105}$ [1]

(b)

$$\begin{array}{r|l} 2 & 1728 \\ \hline 2 & 864 \\ \hline 2 & 432 \\ \hline 2 & 216 \\ \hline 2 & 108 \\ \hline 2 & 54 \\ \hline 3 & 27 \\ \hline 3 & 9 \\ \hline 3 & 3 \\ \hline & 1 \end{array}$$ [1]

$1728 = 2^6 \times 3^3$

$\sqrt[3]{1728} = \sqrt[3]{2^6 \times 3^3}$

$= 2^2 \times 3$

$= 4 \times 3$

$= \mathbf{12}$ [1]

7. (a)

$$\begin{array}{r|l} 2 & 7056 \\ \hline 2 & 3528 \\ \hline 2 & 1764 \\ \hline 2 & 882 \\ \hline 3 & 441 \\ \hline 3 & 147 \\ \hline 7 & 49 \\ \hline 7 & 7 \\ \hline & 1 \end{array}$$

$7056 = 2^4 \times 3^2 \times 7^2$

$\sqrt{7056} = \sqrt{2^4 \times 3^2 \times 7^2}$

$= 2^2 \times 3 \times 7$

$= 4 \times 3 \times 7$

$= \mathbf{84}$ [1]

(b)

$$\begin{array}{r|l} 3 & 3375 \\ \hline 3 & 1125 \\ \hline 3 & 375 \\ \hline 5 & 125 \\ \hline 5 & 25 \\ \hline 5 & 5 \\ \hline & 1 \end{array}$$

$3375 = 3^3 \times 5^3$

$\sqrt[3]{3375} = \sqrt[3]{3^3 \times 5^3}$

$= 3 \times 5$

$= \mathbf{15}$ [1]

(c)

$$\begin{array}{r|ll} 3 & 84 & 15 \\ \hline & 28 & 5 \end{array}$$

(i) HCF of $\sqrt{7056}$ and $\sqrt[3]{3375}$

$= \mathbf{3}$ [1]

(ii) LCM of $\sqrt{7056}$ and $\sqrt[3]{3375}$

$= 3 \times 28 \times 5$

$= \mathbf{420}$ [1]

8. (a)

$$\begin{array}{r|l} 3 & 2025 \\ \hline 3 & 675 \\ \hline 3 & 225 \\ \hline 3 & 75 \\ \hline 5 & 25 \\ \hline 5 & 5 \\ \hline & 1 \end{array}$$

$2025 = 3^4 \times 5^2$

$\sqrt{2025} = \sqrt{3^4 \times 5^2}$

$= 3^2 \times 5$

$= 9 \times 5$

$= \mathbf{45}$ [1]

(b)

$$\begin{array}{r|l} 2 & 74\,088 \\ \hline 2 & 37\,044 \\ \hline 2 & 18\,522 \\ \hline 3 & 9261 \\ \hline 3 & 3087 \\ \hline 3 & 1029 \\ \hline 7 & 343 \\ \hline 7 & 49 \\ \hline 7 & 7 \\ \hline & 1 \end{array}$$

$74\,088 = 2^3 \times 3^3 \times 7^3$

$\sqrt[3]{74\,088} = \sqrt[3]{2^3 \times 3^3 \times 7^3}$

$= 2 \times 3 \times 7$

$= \mathbf{42}$ [1]

Secondary 1 • *Worked Solutions*

9. (a)

3	11 025
3	3675
5	1225
5	245
7	49
7	7
	1

$11\,025 = 3^2 \times 5^2 \times 7^2$

$\sqrt{11\,025} = \sqrt{3^2 \times 5^2 \times 7^2}$

$= 3 \times 5 \times 7$

$=$ **105** [1]

(b)

2	216
2	108
2	54
3	27
3	9
3	3
	1

$216 = 2^3 \times 3^3$

$\sqrt[3]{216} = \sqrt[3]{2^3 \times 3^3}$

$= 2 \times 3$

$=$ **6** [1]

10. (i)

2	3500
2	1750
5	875
5	175
5	35
7	7
	1

[1]

$3500 = 2^2 \times 5^3 \times 7$

Since $3500n$ is a perfect cube,

$n = 2 \times 7^2$

$= 2 \times 49$

$=$ **98** [1]

(ii) $\sqrt[3]{3500n} = \sqrt[3]{2^3 \times 5^3 \times 7^3}$ [1]

$= 2 \times 5 \times 7$

$=$ **70** [1]

11. (a)

2	300
2	150
3	75
5	25
5	5
	1

$300 = 2^2 \times 3 \times 5^2$ [1]

Smallest possible value of n

$= 2 \times 3^2 \times 5$

$= 2 \times 9 \times 5$

$=$ **90** [1]

(b) $300n = 2^2 \times 3 \times 5^2 \times 2 \times 3^2 \times 5$

$= 2^3 \times 3^3 \times 5^3$

$\sqrt[3]{300n} = \sqrt[3]{2^3 \times 3^3 \times 5^3}$

$= 2 \times 3 \times 5$

$=$ **30** [1]

12. (a) HCF of 8712 and 5940

$= 2^2 \times 3^2 \times 11$

$= 4 \times 9 \times 11$

$=$ **396** [1]

(b) LCM of 8712 and 5940

$= 2^3 \times 3^3 \times 5 \times 11^2$

$= 8 \times 27 \times 5 \times 121$

$=$ **130 680** [1]

13. (a) HCF of 15 435 and 1617

$= 3 \times 7^2$

$= 3 \times 49$

$=$ **147** [1]

(b) LCM of 15 435 and 1617

$= 3^2 \times 5 \times 7^3 \times 11$

$=$ **169 785** [1]

(c) (i) Smallest possible value of x

$= 5 \times 7$

$=$ **35** [1]

(ii) $\sqrt{15\,435x} = \sqrt{3^2 \times 5 \times 7^3 \times 5 \times 7}$

$= \sqrt{3^2 \times 5^2 \times 7^4}$

$= 3 \times 5 \times 7^2$

$=$ **735** [1]

14. (a) (i) HCF of 9075 and 9555
$= 3 \times 5$
$= \mathbf{15}$ [1]

(ii) LCM of 9075 and 9555
$= 3 \times 5^2 \times 7^2 \times 11^2 \times 13$
$= \mathbf{5\ 780\ 775}$ [1]

(b) (i) Smallest value of a
$= 3 \times 5 \times 13$
$= \mathbf{195}$ [1]

(ii) $9555a = 3 \times 5 \times 7^2 \times 13 \times 3 \times 5 \times 13$
$= 3^2 \times 5^2 \times 7^2 \times 13^2$
$\sqrt{9555a} = \sqrt{3^2 \times 5^2 \times 7^2 \times 13^2}$
$= 3 \times 5 \times 7 \times 13$
$= \mathbf{1365}$ [1]

15. (a) $\sqrt{213\ 444} = \sqrt{2^2 \times 3^2 \times 7^2 \times 11^2}$
$= 2 \times 3 \times 7 \times 11$
$= \mathbf{462}$ [1]

(b) (i) $231 = 3 \times 7 \times 11$
$588 = 2^2 \times 3 \times 7^2$ [1]
Smallest possible value of x
$= 3^2 \times 11^2$
$= \mathbf{1089}$ [1]

(ii) HCF of 231, 588 and 1089
$= \mathbf{3}$ [1]

Class Test 2

1. (a)

2	504
2	252
2	126
3	63
3	21
7	7
	1

$504 = \mathbf{2^3 \times 3^2 \times 7}$ [1]

(b) $6 = 2 \times 3$
$24 = 2 \times 2 \times 2 \times 3$
$= 2^3 \times 3$ [1]
$x = 3^2 \times 7$
$= \mathbf{63}$ [1]

2. (a)

2	1890
3	945
3	315
3	105
5	35
7	7
	1

$1890 = 2 \times 3^3 \times 5 \times 7$ [1]
$21 = 3 \times 7$
$126 = 2 \times 3 \times 3 \times 7$
$= 2 \times 3^2 \times 7$
Smallest possible value of n
$= 3^3 \times 5$
$= \mathbf{135}$ [1]

(b) HCF of 21, 126 and n
$= \mathbf{3}$ [1]

3. (a)

2	88 200
2	44 100
2	22 050
3	11 025
3	3675
5	1225
5	245
7	49
7	7
	1

$88\ 200 = \mathbf{2^3 \times 3^2 \times 5^2 \times 7^2}$ [1]

(b) $75 = 3 \times 5^2$
$252 = 2 \times 2 \times 3 \times 3 \times 7$
$= 2^2 \times 3^2 \times 7$ [1]
Smallest possible value of $x = 2^3 \times 7^2$
$= 8 \times 49$
$= \mathbf{392}$ [1]

Secondary 1 • Worked Solutions

4. (a)

2	84	108	48
2	42	54	24
3	21	27	12
	7	9	4

Greatest number of gift packets
$= 2 \times 2 \times 3$
$=$ **12** [1]

(b) Number of chocolate bars each gift packet had
$=$ **7** [1]

5. $18 = 2 \times 3 \times 3$
$= 2 \times 3^2$
$40 = 2 \times 2 \times 2 \times 5$
$= 2^3 \times 5$
$55 = 5 \times 11$ [1]
LCM of 18, 40 and 55 $= 2^3 \times 3^2 \times 5 \times 11$
$= 8 \times 9 \times 5 \times 11$
$= 3960$ [1]

3960 s $= 3960 \div 60$
$= 66$ min
$= 1$ h 6 min

Time at which all three lights flash simultaneously
$= 21\ 36 + 01\ 06$
$= 22\ 42$
$=$ **10.42 p.m.** [1]

6. (a)

2	450	396	126
3	225	198	63
3	75	66	21
	25	22	7

HCF of 450, 396 and 126
$= 2 \times 3 \times 3$
$= 18$ [1]
Maximum number of packets she can get
$=$ **18** [1]

(b) Number of blue buttons in each packet
$=$ **22** [1]

7. (a) $18 = 2 \times 3 \times 3$
$= 2 \times 3^2$
$15 = 3 \times 5$
$20 = 2^2 \times 5$ [1]
LCM of 18, 15 and 20
$= 2^2 \times 3^2 \times 5$ [1]
$= 180$
Number of days it will take $=$ **180** [1]

(b) Number of days left till end of January
$= 31 - 15$
$= 16$
Number of days in February $= 28$
Number of days in March $= 31$
Number of days in April $= 30$
Number of days in May $= 31$
Number of days in June $= 30$
Number of days to end of June
$= 16 + 28 + 31 + 30 + 31 + 30$
$= 166$ [1]
Number of days left after end of June
$= 180 - 166$
$= 14$
Date on which all three flowers will bloom again $=$ **14 July** [1]

8. (a)

2	280	924	126
7	140	462	63
	20	66	9

HCF of 280, 924 and 126
$= 2 \times 7$
$= 14$
Maximum length of each string
$=$ **14 cm** [1]

(b) Number of strings he would get
$= 20 + 66 + 9$
$=$ **95** [1]

9. (a) \$1.26 = 126¢
\$1.50 = 150¢

2	126	55	150
5	63	55	75
3	63	11	15
3	21	11	5
	7	11	5

LCM of 126, 55 and 150
$= 2 \times 3^2 \times 5^2 \times 7 \times 11$
$= 34\ 650$ [1]
Minimum amount of money he could earn
$= 34\ 650$¢
$=$ **$346.50** [1]

(b) Number of erasers he sold
$= 34\ 650 \div 55$
$= \mathbf{630}$ [1]

10. (a)

3	180	525	135
5	60	175	45
	12	35	9

HCF of 180, 525 and 135 $= 3 \times 5$
$= 15$ [1]
Maximum number of bags she can get
$= \mathbf{15}$ [1]

(b) Number of stamps in each bag $= \mathbf{35}$ [1]

Chapter 2 Real Numbers, Approximation and Estimation

Class Test 1

1. 21.853 [1]

2. −1.066 [1]

3. 9.469 [1]

4. (a) $-5\frac{7}{16} = -\frac{87}{16}$
$= -87 \div 16$
$= \mathbf{-5.4375}$ [1]

(b) $\frac{124}{11} = 124 \div 11$
$= 11.272\ 727\ldots$
$= \mathbf{11.\dot{2}\dot{7}}$ [1]

(c) $\frac{5}{12} = 5 \div 12$
$= 0.416\ 666\ldots$
$= \mathbf{0.41\dot{6}}$ [1]

5. (a) $6\frac{5}{36} = \frac{221}{36}$
$= 221 \div 36$
$= 6.138\ 888\ldots$
$= \mathbf{6.13\dot{8}}$ [1]

(b) $-\frac{451}{9} = -451 \div 9$
$= -50.111\ 111\ldots$
$= \mathbf{-50.\dot{1}}$ [1]

(c) $\frac{75}{8} = 75 \div 8$
$= \mathbf{9.375}$ [1]

6. (a) $\frac{171}{11} = 171 \div 11$
$= 15.545\ 454\ldots$
$= \mathbf{15.\dot{5}\dot{4}}$ [1]

(b) $\frac{19}{36} = 19 \div 36$
$= 0.527\ 777\ldots$
$= \mathbf{0.52\dot{7}}$ [1]

(c) $-5\frac{36}{54} = -5\frac{2}{3}$
$= -\frac{17}{3}$
$= -17 \div 3$
$= -5.666\ 666\ldots$
$= \mathbf{-5.\dot{6}}$ [1]

7. (a) $-3\frac{3}{8} = -\frac{27}{8}$
$= -27 \div 8$
$= \mathbf{-3.375}$ [1]

(b) $\frac{81}{11} = 81 \div 11$
$= 7.363\ 636\ldots$
$= \mathbf{7.\dot{3}\dot{6}}$ [1]

(c) $13\frac{31}{36} = \frac{499}{36}$
$= 499 \div 36$
$= 13.861\ 111\ldots$
$= \mathbf{13.86\dot{1}}$ [1]

8. Let 5.363 636... be n.
$100n = 536.3636\ldots$
$100n - n = 536.3636\ldots - 5.3636\ldots$
$= 531$ [1]
$99n = 531$
$n = \frac{531}{99}$
$= \frac{59}{11}$
$= 5\frac{4}{11}$
$\therefore 5.363\ 636\ldots = \mathbf{5\frac{4}{11}}$ [1]

9. (a) $5 \times \left[\frac{1}{2} - \left(-\frac{2}{3}\right) \div 5\right] \div (-2)^3$

$= 5 \times \left[\frac{1}{2} - \left(-\frac{2}{3}\right) \times \frac{1}{5}\right] \div (-8)$

$= 5 \times \left[\frac{1}{2} - \left(-\frac{2}{15}\right)\right] \times \left(-\frac{1}{8}\right)$

$= 5 \times \left[\frac{1}{2} + \frac{2}{15}\right] \times \left(-\frac{1}{8}\right)$

$= 5 \times \frac{19}{30} \times \left(-\frac{1}{8}\right)$

$= \frac{19}{6} \times \left(-\frac{1}{8}\right)$

$= -\mathbf{\frac{19}{48}}$ [1]

(b) $4^2 + [3 - (2 - \sqrt{64})] + [3 \times (-2)]$

$= 4^2 + [3 - (2 - 8)] + (-6)$

$= 16 + [3 - (-6)] - 6$

$= 16 + 9 - 6$

$= \mathbf{19}$ [1]

10. (a) $\frac{3}{21} \times \left(-\frac{56}{27}\right) \div \left[\frac{4}{3} - \left(\frac{8}{3} \div \sqrt[3]{27}\right)\right] \times (-11)$

$= -\frac{8}{27} \div \left[\frac{4}{3} - \left(\frac{8}{3} \div 3\right)\right] \times (-11)$

$= -\frac{8}{27} \div \left[\frac{4}{3} - \left(\frac{8}{3} \times \frac{1}{3}\right)\right] \times (-11)$

$= -\frac{8}{27} \div \left(\frac{4}{3} - \frac{8}{9}\right) \times (-11)$

$= -\frac{8}{27} \div \frac{4}{9} \times (-11)$ [1]

$= -\frac{8}{27} \times \frac{9}{4} \times (-11)$

$= -\frac{2}{3} \times (-11)$

$= \frac{22}{3}$

$= \mathbf{7\frac{1}{3}}$ [1]

(b) $\dfrac{\frac{2}{7} - \frac{3}{4} \div (-7)}{\frac{1}{5} \times \left(-\frac{5}{7}\right) + \frac{1}{2}} = \dfrac{\frac{2}{7} - \frac{3}{4} \times \left(-\frac{1}{7}\right)}{\left(-\frac{1}{7}\right) + \frac{1}{2}}$

$= \dfrac{\frac{2}{7} - \left(-\frac{3}{28}\right)}{\frac{5}{14}}$

$= \dfrac{\frac{11}{28}}{\frac{5}{14}}$ [1]

$= \frac{11}{28} \div \frac{5}{14}$

$= \frac{11}{28} \times \frac{14}{5}$

$= \frac{11}{10}$

$= \mathbf{1\frac{1}{10}}$ [1]

11. (a) $(-3)^3 - 15 \div [4 - (\sqrt{36} + 4)]$

$= -27 - 15 \div [4 - (6 + 4)]$

$= -27 - 15 \div (4 - 10)$

$= -27 - 15 \div (-6)$

$= -27 - 15 \times \left(-\frac{1}{6}\right)$

$= -27 + \frac{15}{6}$

$= -\frac{49}{2}$

$= \mathbf{-24\frac{1}{2}}$ [1]

(b) $5 \times [\sqrt{81} \times (3 - 7 \div \sqrt[3]{-64})] + (-13)$

$= 5 \times \{9 \times [3 - 7 \div (-4)]\} - 13$

$= 5 \times \left\{9 \times \left[3 - 7 \times \left(-\frac{1}{4}\right)\right]\right\} - 13$

$= 5 \times \left[9 \times \left(3 + \frac{7}{4}\right)\right] - 13$

$= 5 \times \left(9 \times \frac{19}{4}\right) - 13$

$= 5 \times \frac{171}{4} - 13$

$= \frac{855}{4} - 13$

$= \frac{803}{4}$

$= \mathbf{200\frac{3}{4}}$ [1]

12. $\frac{1.35}{0.15} \times [2 - (-0.2)^2] = \frac{135}{15} \times (2 - 0.04)$

$= 9 \times (2 - 0.04)$

$= (9 \times 2) - (9 \times 0.04)$

$= 18 - 0.36$

$= \mathbf{17.64}$ [1]

13. (a) $\dfrac{[3 \times (4^2 - 11)] - \sqrt[3]{(-27)} - 1}{2^2 \times \sqrt{\left(32 \div \frac{1}{\sqrt{4}}\right)}} = \dfrac{[3 \times (16 - 11)] - (-3) - 1}{4 \times \sqrt{\left(32 \div \frac{1}{2}\right)}}$

$= \dfrac{(3 \times 5) + 3 - 1}{4 \times \sqrt{32 \times 2}}$

$= \dfrac{(3 \times 5) + 3 - 1}{4 \times \sqrt{64}}$

$= \dfrac{15 + 3 - 1}{4 \times 8}$

$= \mathbf{\frac{17}{32}}$ [1]

(b) $\left(5 - 8 \div \frac{2}{3}\right) + 4 \times [5 - (-2)] \div \frac{4 + \sqrt{25}}{1 - 2^2}$

$= \left(5 - 8 \times \frac{3}{2}\right) + 4 \times (5 + 2) \div \frac{4 + 5}{1 - 4}$

$= (5 - 12) + 4 \times 7 \div \frac{9}{-3}$

$= -7 + 28 \div (-3)$

$= -7 + \left(-\frac{28}{3}\right)$

$= -7 - \frac{28}{3}$

$= -7 - 9\frac{1}{3}$

$= \mathbf{-16\frac{1}{3}}$ [1]

14. $\frac{1.32}{0.2 \times \sqrt[3]{-27}} - \frac{0.15 + \frac{3}{4}}{\sqrt{1.44}} = \frac{1.32}{0.2 \times (-3)} - \frac{0.15 + 0.75}{\sqrt{1.44}}$

$= \frac{1.32}{-0.6} - \frac{0.9}{1.2}$

$= -2.2 - 0.75$

$= \mathbf{-2.95}$ [1]

15. $\frac{7 \div 3\frac{1}{3}}{\sqrt{0.09}} + \frac{2^3 - 4^2}{\frac{1}{8} \times [1.8 - (-0.2 \times 7)]} - [0.7 + (2 \times 0.3)]$

$= \frac{7 \div \frac{10}{3}}{0.3} + \frac{8 - 16}{\frac{1}{8} \times [1.8 - (-1.4)]} - (0.7 + 0.6)$

$= \frac{7 \times \frac{3}{10}}{0.3} + \frac{0.5}{\frac{1}{8} \times (1.8 + 1.4)} - 1.3$

$= \frac{7 \times 0.3}{0.3} + \frac{0.5}{\frac{1}{8} \times 3.2} - 1.3$ [1]

$= 7 + (0.5 \div 0.4) - 1.3$

$= 7 + (5 \div 4) - 1.3$

$= 7 + 1.25 - 1.3$

$= \mathbf{6.95}$ [1]

Class Test 2

1. (a) $\left(\frac{-\sqrt{49}}{2^2} + \frac{4}{7 \times (\sqrt[3]{64})}\right) + \left(\frac{3}{4}\right)^2 - \left(-\frac{7}{4}\right)$

$= \left(\frac{-7}{4} + \frac{4}{7 \times 4}\right) + \frac{9}{16} + \frac{7}{4}$

$= \left(\frac{-7}{4} + \frac{4}{28}\right) + \frac{9}{16} + \frac{7}{4}$

$= -\frac{45}{28} + \frac{9}{16} + \frac{7}{4}$

$= -\frac{117}{112} + \frac{7}{4}$

$= \mathbf{\frac{79}{112}}$ [1]

(b) $\left\{7\frac{2}{3} - \left[\frac{4\sqrt{9}}{5} \div \frac{3 - \left(-4\frac{1}{5}\right)}{-6\frac{2}{3}}\right]\right\} + \left(5 \times \frac{2\frac{1}{4} - \frac{5}{6}}{3}\right)$

$= \left[7\frac{2}{3} - \left(\frac{4 \times 3}{5} \div \frac{7\frac{1}{5}}{-6\frac{2}{3}}\right)\right] + \left(5 \times \frac{\frac{9}{4} - \frac{5}{6}}{3}\right)$

$= \left[7\frac{2}{3} - \left(\frac{12}{5} \div \frac{\frac{36}{5}}{-\frac{20}{3}}\right)\right] + \left(5 \times \frac{\frac{17}{12}}{3}\right)$

$= \left\{7\frac{2}{3} - \left[\frac{12}{5} \div \left(\frac{36}{5} \times \frac{-3}{20}\right)\right]\right\} + \left[5 \times \left(\frac{17}{12} \div 3\right)\right]$

$= \left[7\frac{2}{3} - \left(\frac{12}{5} \div \frac{-27}{25}\right)\right] + \left[5 \times \left(\frac{17}{12} \times \frac{1}{3}\right)\right]$

$= \left[7\frac{2}{3} - \left(\frac{12}{5} \times \frac{-25}{27}\right)\right] + \left(5 \times \frac{17}{36}\right)$

$= \left(\frac{23}{3} - \frac{-20}{9}\right) + \frac{85}{36}$

$= \frac{69 + 20}{9} + \frac{85}{36}$

$= \frac{49}{4}$

$= \mathbf{12\frac{1}{4}}$ [1]

2. (a) $\frac{\left(\frac{2}{7}\right)^2 \div \left[\left(1\frac{1}{3} - \frac{5^2 - (-1)^3}{21}\right) \times \sqrt[3]{8}\right]}{\frac{4}{7} - \left(\frac{1}{2} \times \frac{2}{7}\right) + \left(\frac{5}{28} \div \frac{5}{6}\right)} = \frac{\frac{4}{49} \div \left[\frac{4}{3} - \left(\frac{25 + 1}{21}\right) \times 2\right]}{\frac{4}{7} - \frac{1}{7} + \left(\frac{5}{28} \times \frac{6}{5}\right)}$

$= \frac{\frac{4}{49} \div \left[\left(\frac{4}{3} - \frac{26}{21}\right) \times 2\right]}{\frac{3}{7} + \frac{3}{14}}$

$= \frac{\frac{4}{49} \div \left[\left(\frac{28 - 26}{21}\right) \times 2\right]}{\frac{6 + 3}{14}}$

$= \frac{\frac{4}{49} \div \left(\frac{2}{21} \times 2\right)}{\frac{9}{14}}$

$= \frac{\frac{4}{49} \div \frac{4}{21}}{\frac{9}{14}}$

$= \frac{\frac{4}{49} \times \frac{21}{4}}{\frac{9}{14}}$

$= \frac{3}{7} \div \frac{9}{14}$

$= \frac{3}{7} \times \frac{14}{9}$

$= \mathbf{\frac{2}{3}}$ [1]

(b) $\frac{\sqrt[3]{216}}{4} - \left(-4\frac{2}{3} \div 1\frac{3}{5}\right) + \left[-3\frac{1}{4} \times \left(\frac{1}{3} - 3\frac{1}{6}\right)\right] \div \frac{3}{4}$

$= \frac{6}{4} - \left(-\frac{14}{3} \div \frac{8}{5}\right) + \left[-3\frac{1}{4} \times \left(\frac{1}{3} - \frac{19}{6}\right)\right] \div \frac{3}{4}$

$= \frac{6}{4} - \left(-\frac{14}{3} \times \frac{5}{8}\right) + \left(-\frac{13}{4} \times \frac{2 - 19}{6}\right) \div \frac{3}{4}$

$= \frac{6}{4} - \left(-\frac{35}{12}\right) + \left(-\frac{13}{4} \times -\frac{17}{6}\right) \div \frac{3}{4}$ [1]

$= \frac{6}{4} + \frac{35}{12} + \frac{221}{24} \times \frac{4}{3}$

$= \frac{6}{4} + \frac{35}{12} + \frac{221}{18}$

$= \frac{54 + 105 + 442}{36}$

$= \frac{601}{36}$

$= \mathbf{16\frac{25}{36}}$ [1]

3. (a) $(-4)^3 \div [(3-5) + 2 \times 3^2] - (2 - \sqrt{169})$
$= -64 \div (-2 + 2 \times 9) - (2 - 13)$
$= -64 \div (-2 + 18) - (-11)$
$= -64 \div 16 + 11$
$= -4 + 11$
$= \mathbf{7}$ [1]

(b) $\dfrac{[3 - 48 \div (-4 \times 3)]^2 + [(4 - (\sqrt[3]{125} \times 3)]}{4^2 + (3 \times \sqrt{121} - 6) \div 3}$
$= \dfrac{[3 - 48 \div (-12)]^2 + [(4 - (5 \times 3)]}{16 + (3 \times 11 - 6) \div 3}$
$= \dfrac{[3 - (-4)]^2 + (4 - 15)}{16 + (33 - 6) \div 3}$
$= \dfrac{(3 + 4)^2 + (-11)}{16 + 27 \div 3}$ [1]
$= \dfrac{7^2 - 11}{16 + 9}$
$= \dfrac{49 - 11}{25}$
$= \dfrac{38}{25}$
$= \mathbf{1\frac{13}{25}}$ [1]

4. (a) $\dfrac{1\frac{2}{3} \div \frac{1}{\sqrt[3]{-8}} + \left[\left(\frac{2}{3}\right)^2 \times 6\right]}{3 - \left(\frac{3}{14} \times 8 + \frac{1}{7}\right) + \left(-\frac{4}{3} \div 1\frac{2}{5}\right)}$
$= \dfrac{\frac{5}{3} \div \frac{1}{-2} + \left(\frac{4}{9} \times 6\right)}{3 - \left(\frac{24}{14} + \frac{1}{7}\right) + \left(-\frac{4}{3} \div \frac{7}{5}\right)}$
$= \dfrac{\frac{5}{3} \times (-2) + \frac{24}{9}}{3 - \left(\frac{24 + 2}{14}\right) + \left(-\frac{4}{3} \times \frac{5}{7}\right)}$
$= \dfrac{\frac{-10}{3} + \frac{24}{9}}{3 - \frac{26}{14} + \left(-\frac{20}{21}\right)}$
$= \dfrac{\frac{-30 + 24}{9}}{3 - \frac{13}{7} - \frac{20}{21}}$ [1]
$= \dfrac{\frac{-6}{9}}{\frac{63 - 39 - 20}{21}}$
$= -\frac{6}{9} \div \frac{4}{21}$
$= -\frac{6}{9} \times \frac{21}{4}$
$= -\frac{7}{2}$
$= \mathbf{-3\frac{1}{2}}$ [1]

(b) $\left[\left(3 - 1\frac{2}{3}\right) \times \left(\frac{3}{2} \div 3\frac{3}{4}\right)\right] + 4 + \left(-2 \times 1\frac{4}{5}\right)$
$= \left[\left(3 - \frac{5}{3}\right) \times \left(\frac{3}{2} \div \frac{15}{4}\right)\right] + 4 + \left(-2 \times \frac{9}{5}\right)$
$= \left[\frac{4}{3} \times \left(\frac{3}{2} \times \frac{4}{15}\right)\right] + 4 + \left(-\frac{18}{5}\right)$
$= \left(\frac{4}{3} \times \frac{2}{5}\right) + 4 - \frac{18}{5}$
$= \frac{8}{15} + 4 - \frac{18}{5}$
$= \frac{8 + 60 - 54}{15}$
$= \mathbf{\frac{14}{15}}$ [1]

5. (a) Greatest possible value of $p + q = 6 + 15$
$= \mathbf{21}$ [1]

(b) Greatest possible value of $q - p = 15 - (-3)$
$= \mathbf{18}$ [1]

(c) Smallest possible value of $pq = -3 \times 15$
$= \mathbf{-45}$ [1]

(d) Smallest possible value of $p^2 + q^2 = 0^2 + 1^2$
$= \mathbf{1}$ [1]

6. (a) Greatest possible value of $y^2 - x^2 = 9.6^2 - 0^2$
$= \mathbf{92.16}$ [1]

(b) Smallest possible value of $x^2 + y^2 = 0^2 + 2^2$
$= \mathbf{4}$ [1]

(c) Greatest possible value of $y - x = 9.6 - (-4.2)$
$= \mathbf{13.8}$ [1]

(d) Smallest possible value of $xy = -4.2 \times 9.6$
$= \mathbf{-40.32}$ [1]

7. (a) Smallest possible value of $m + n$
$= -\frac{2}{3} + \frac{20}{7}$
$= \frac{-14 + 60}{21}$
$= \frac{46}{21}$
$= \mathbf{2\frac{4}{21}}$ [1]

(b) Smallest possible value of $mn = -\frac{2}{3} \times 9\frac{1}{5}$
$= -\frac{2}{3} \times \frac{46}{5}$
$= -\frac{92}{15}$
$= \mathbf{-6\frac{2}{15}}$ [1]

(c) Greatest possible value of $m - n = 5 - \frac{20}{7}$
$= \frac{35 - 20}{7}$
$= \frac{15}{7}$
$= \mathbf{2\frac{1}{7}}$ [1]

(d) Smallest possible value of $m^2 + n^2 = 0^2 + \left(\frac{20}{7}\right)^2$
$= \frac{400}{49}$
$= \mathbf{8\frac{8}{49}}$ [1]

8. (a) Difference in mass between the heaviest bag and the lightest bag
$= 4 - (-3)$
$= \mathbf{7\ g}$ [1]

(b)

Bag	1	2	3	4	5	6	7	8
Mass (g)	127	123.5	126.8	129	122.9	125	124.8	122

Average mass of the 8 bags of chips
$= (127 + 123.5 + 126.8 + 129 + 122.9 + 125 + 124.8 + 122) \div 8$
$= \frac{1001}{8}$
$= \mathbf{125.125\ g}$ [1]

9. (a) $-0.04 + 0.47 + 0.36 + (-0.61) + a + 0.44 + 0.21 = 0$
$-0.04 + 0.47 + 0.36 - 0.61 + a + 0.44 + 0.21 = 0$
$a + 0.83 = 0$
$a = \mathbf{-0.83}$ [1]

(b) Difference between the greatest and smallest distances
$= 0.47 - (-0.83)$
$= 0.47 + 0.83$
$= \mathbf{1.3\ m}$ [1]

(c) Average distance
$= \frac{(5.35 - 0.04) + (5.35 + 0.47) + (5.35 - 0.61)}{3}$
$= \frac{5.31 + 5.82 + 4.74}{3}$
$= \frac{15.87}{3}$
$= \mathbf{5.29\ m}$ [1]

10. (a) Difference between the greatest temperature and smallest temperature
$= 4.5 - (-5.5)$
$= 4.5 + 5.5$
$= \mathbf{10°C}$ [1]

(b) Total temperature in Beijing, Tokyo and Paris
$= (24.5 + 1.5) + (24.5 - 1.5) + (24.5 - 5.5)$
$= 26 + 23 + 19$
$= 68°C$
Average temperature of Beijing, Tokyo and Paris $= 68 \div 3$
$= \mathbf{22\frac{2}{3}°C}$ [1]

Chapter 3 Basic Algebra and Algebraic Manipulation

Class Test 1

1. (a) $2a(1 - x) + \frac{2}{3}x(3 + 2a)$
$= 2a - 2ax + 2x + \frac{4}{3}ax$
$= \mathbf{2a + 2x - \frac{2}{3}ax}$ [1]

(b) $28 - \left[\frac{1}{4}(3p - q) + 3(2p + 3)\right] + 7q$
$= 28 - \left(\frac{3}{4}p - \frac{1}{4}q + 6p + 9\right) + 7q$
$= 28 - \left(6\frac{3}{4}p - \frac{1}{4}q + 9\right) + 7q$
$= 28 - 6\frac{3}{4}p + \frac{1}{4}q - 9 + 7q$
$= \mathbf{-6\frac{3}{4}p + 7\frac{1}{4}q + 19}$ [1]

2. $\frac{14 + a}{7} - \frac{2a - 3}{3} = \frac{3(14 + a) - 7(2a - 3)}{21}$
$= \frac{42 + 3a - 14a + 21}{21}$ [1]
$= \frac{63 - 11a}{21}$
$= \frac{63}{21} - \frac{11a}{21}$
$= \mathbf{3 - \frac{11a}{21}}$ [1]

3. $\frac{2x(y + 3)}{7} + x - 1 - \frac{y(5 - 2x)}{7}$
$= \frac{2xy + 6x}{7} + x - 1 - \frac{5y - 2xy}{7}$
$= \frac{2xy + 6x + 7x - 7 - 5y + 2xy}{7}$
$= \mathbf{\frac{4xy + 13x - 5y - 7}{7}}$ [1]

4. (a) $8pq - 15ab + 5bp - 24aq$
$= 8pq - 24aq + 5bp - 15ab$
$= 8q(p - 3a) + 5b(p - 3a)$
$= \mathbf{(p - 3a)(8q + 5b)}$ [1]

(b) $3[3(x - 1) + x^2] - 4x\left(1 - \frac{1}{2}x\right) + 9$
$= 3(3x - 3 + x^2) - (4x - 2x^2) + 9$
$= 9x - 9 + 3x^2 - 4x + 2x^2 + 9$
$= 5x + 5x^2$
$= \mathbf{5x(1 + x)}$ [1]

5. $\frac{2}{5}a - \frac{1}{3}\left[4(b + 1) + \frac{3}{5}(-5a - 2)\right] + 13 - \frac{5}{3}b$
$= \frac{2}{5}a - \frac{1}{3}\left(4b + 4 - 3a - \frac{6}{5}\right) + 13 - \frac{5}{3}b$
$= \frac{2}{5}a - \frac{1}{3}\left(4b - 3a + \frac{14}{5}\right) + 13 - \frac{5}{3}b$ [1]
$= \frac{2}{5}a - \frac{4}{3}b + a - \frac{14}{15} + 13 - \frac{5}{3}b$
$= \mathbf{1\frac{2}{5}a - 3b + 12\frac{1}{15}}$ [1]

Secondary 1 • *Worked Solutions*

6. (a) $3(p-2r)+2[5(p-4)-3(3+2r)]$
$= 3p - 6r + 2(5p - 20 - 9 - 6r)$
$= 3p - 6r + 10p - 40 - 18 - 12r$
$= \mathbf{13p - 18r - 58}$ [1]

(b) $5a + 2\left[3\left(b + \frac{1}{3}a\right) - \frac{2}{3}(5a+b)\right] + \frac{1}{3}(a-9)$
$= 5a + 2\left(3b + a - \frac{10}{3}a - \frac{2}{3}b\right) + \frac{1}{3}a - 3$
$= 5a + 2\left(\frac{7}{3}b - \frac{7}{3}a\right) + \frac{1}{3}a - 3$
$= 5a + \frac{14}{3}b - \frac{14}{3}a + \frac{1}{3}a - 3$
$= \mathbf{\frac{2}{3}a + 4\frac{2}{3}b - 3}$ [1]

7. (a) $\frac{2}{3}p^3 - \frac{8}{3}p^2q + \frac{1}{3}p^2r - \frac{4}{3}pqr$
$= \frac{1}{3}p(2p^2 - 8pq + pr - 4qr)$
$= \frac{1}{3}p[2p(p-4q) + r(p-4q)]$
$= \mathbf{\frac{1}{3}p(p-4q)(2p+r)}$ [1]

(b) $-3x(y-4) - 9x(5-y) = -3xy + 12x - 45x + 9xy$
$= 6xy - 33x$
$= \mathbf{3x(2y-11)}$ [1]

8. $5(2a - b + 3c) - 2(b - 3a) + 4(2c + b)$
$= 10a - 5b + 15c - 2b + 6a + 8c + 4b$
$= \mathbf{16a - 3b + 23c}$ [1]

9. (a) $2(a - 3b + 1) - 3a(3 + b)$
$= 2a - 6b + 2 - 9a - 3ab$
$= \mathbf{2 - 7a - 6b - 3ab}$ [1]

(b) $4(3-2p) + 2[2(3q+p) - 3(5+q) + 4]$
$= 12 - 8p + 2(6q + 2p - 15 - 3q + 4)$
$= 12 - 8p + 2(3q + 2p - 11)$
$= 12 - 8p + 6q + 4p - 22$
$= \mathbf{6q - 4p - 10}$ [1]

(c) $\frac{1}{2}(a+3b) - 3\left[2\left(b + \frac{1}{3}\right) - 4(2a + b - 1)\right]$
$= \frac{1}{2}a + \frac{3}{2}b - 3\left(2b + \frac{2}{3} - 8a - 4b + 4\right)$
$= \frac{1}{2}a + \frac{3}{2}b - 3\left(\frac{14}{3} - 8a - 2b\right)$
$= \frac{1}{2}a + \frac{3}{2}b - 14 + 24a + 6b$
$= \mathbf{24\frac{1}{2}a + 7\frac{1}{2}b - 14}$ [1]

10. (a) $\frac{x+2y}{3} - \frac{2y+2(x-1)}{4} + \frac{3x+4}{6}$
$= \frac{4(x+2y)}{12} - \frac{3[2y+2(x-1)]}{12} + \frac{2(3x+4)}{12}$
$= \frac{4(x+2y) - 3[2y+2(x-1)] + 2(3x+4)}{12}$ [1]
$= \frac{4x + 8y - 3(2y + 2x - 2) + 6x + 8}{12}$
$= \frac{4x + 8y - 6y - 6x + 6 + 6x + 8}{12}$
$= \frac{4x + 2y + 14}{12}$
$= \frac{2(2x + y + 7)}{12}$
$= \mathbf{\frac{2x + y + 7}{6}}$ [1]

(b) $\frac{4\left[p - 2\left(1 + \frac{1}{4}q\right)\right]}{5} + 2p + q - \frac{3q - 2p + 2}{2}$
$= \frac{8\left[p - 2\left(1 + \frac{1}{4}q\right)\right]}{10} + \frac{10(2p+q)}{10} - \frac{5(3q - 2p + 2)}{10}$ [1]
$= \frac{8\left(p - 2 - \frac{1}{2}q\right) + 20p + 10q - 5(3q - 2p + 2)}{10}$
$= \frac{8p - 16 - 4q + 20p + 10q - 15q + 10p - 10}{10}$
$= \mathbf{\frac{38p - 26 - 9q}{10}}$ [1]

11. $15px - 30qx + 3py - 6qy$
$= 15x(p - 2q) + 3y(p - 2q)$
$= (p - 2q)(15x + 3y)$
$= \mathbf{3(p - 2q)(5x + y)}$ [1]

12. (a) $-3x(5 + 2x) + 2(1 + x) + 4x(2 + x)$
$= -15x - 6x^2 + 2 + 2x + 8x + 4x^2$
$= \mathbf{-5x - 2x^2 + 2}$ [1]

(b) $4\left[2x - \frac{1}{2}(3 + 5x)\right] - 3x + 2(1 + 4x)$
$= 4\left(2x - \frac{3}{2} - \frac{5}{2}x\right) - 3x + 2 + 8x$
$= 4\left(-\frac{3}{2} - \frac{1}{2}x\right) + 2 + 5x$
$= -6 - 2x + 2 + 5x$
$= \mathbf{3x - 4}$ [1]

(c) $3\left(p + \frac{1}{2}x\right) - 2\left[\frac{1}{4}(2 - 3x) + 4(1 - 2p)\right] + p$
$= 3p + \frac{3}{2}x - 2\left(\frac{1}{2} - \frac{3}{4}x + 4 - 8p\right) + p$
$= 3p + \frac{3}{2}x - 1 + \frac{3}{2}x - 8 + 16p + p$
$= \mathbf{20p + 3x - 9}$ [1]

13. $\frac{3}{2}(2a-1)+\frac{5a-3(b-2)}{4}+\frac{a+2b}{3}$

$= \frac{18(2a-1)}{12}+\frac{3[5a-3(b-2)]}{12}+\frac{4(a+2b)}{12}$ [1]

$= \frac{18(2a-1)+3[5a-3(b-2)]+4(a+2b)}{12}$

$= \frac{36a-18+3(5a-3b+6)+4a+8b}{12}$

$= \frac{36a-18+15a-9b+18+4a+8b}{12}$

$= \mathbf{\frac{55a-b}{12}}$ [1]

14. $\frac{x(x-2y+1)}{3}+\frac{3x(2y-3)}{2(x+y)}-4xy$

$= \frac{3\left[3-2\left(\frac{1}{2}\right)+1\right]}{3}+\frac{3(3)\left[2\left(\frac{1}{2}\right)-3\right]}{2\left(3+\frac{1}{2}\right)}-4\times 3\times \frac{1}{2}$

$= \frac{3(3-1+1)}{3}+\frac{9(1-3)}{2\left(\frac{7}{2}\right)}-6$ [1]

$= \frac{9}{3}+\frac{-18}{7}-6$

$= 3-\frac{18}{7}-6$

$= \mathbf{-5\frac{4}{7}}$ [1]

15. $24-\left\{2p+\frac{2}{5}(20p-15q)-\frac{1}{4}[3(4p+12q)-8]\right\}+5p$

$= 24-\left[2p+8p-6q-\frac{1}{4}(12p+36q-8)\right]+5p$

$= 24-(2p+8p-6q-3p-9q+2)+5p$

$= 24-2p-8p+6q+3p+9q-2+5p$

$= \mathbf{22-2p+15q}$ [1]

Class Test 2

1. (a) $3x^2-2(y-3)+4xy$

$= 3\left(\frac{2}{3}\right)^2-2(5-3)+4\left(\frac{2}{3}\right)(5)$

$= \frac{4}{3}-4+\frac{40}{3}$

$= \frac{4-12+40}{3}$

$= \frac{32}{3}$

$= \mathbf{10\frac{2}{3}}$ [1]

(b) $\frac{2[3(x-2y)+4xy]}{7x^2+2} = \frac{2\left\{3\left[\frac{2}{3}-2(5)\right]+4\left(\frac{2}{3}\right)(5)\right\}}{7\left(\frac{2}{3}\right)^2+2}$

$= \frac{2\left[3\left(\frac{2}{3}-10\right)+\frac{40}{3}\right]}{7\left(\frac{4}{9}\right)+2}$

$= \frac{2\left[3\left(-\frac{28}{3}\right)+\frac{40}{3}\right]}{\frac{28}{9}+2}$

$= \frac{2\left(-28+\frac{40}{3}\right)}{\frac{46}{9}}$ [1]

$= \frac{2\left(-\frac{44}{3}\right)}{\frac{46}{9}}$

$= \frac{-\frac{88}{3}}{\frac{46}{9}}$

$= -\frac{88}{3}\div\frac{46}{9}$

$= -\frac{88}{3}\times\frac{9}{46}$

$= -\frac{132}{23}$

$= \mathbf{-5\frac{17}{23}}$ [1]

2. (a) $\frac{4p-1}{2}+\frac{p(3-p)}{6}+\frac{p(7p-5)+3(p+3)}{2}$

$= \frac{3(4p-1)}{6}+\frac{p(3-p)}{6}+\frac{3p(7p-5)+9(p+3)}{6}$ [1]

$= \frac{3(4p-1)+p(3-p)+3p(7p-5)+9(p+3)}{6}$

$= \frac{12p-3+3p-p^2+21p^2-15p+9p+27}{6}$

$= \mathbf{\frac{20p^2+9p+24}{6}}$ [1]

(b) $\frac{20p^2+9p+24}{6} = \frac{9\left(\frac{1}{2}\right)+20\left(\frac{1}{2}\right)^2+24}{6}$

$= \frac{\frac{20}{4}+\frac{9}{2}+24}{6}$

$= \frac{9\frac{1}{2}+24}{6}$

$= 33\frac{1}{2}\div 6$

$= \frac{67}{2}\times\frac{1}{6}$

$= \frac{67}{12}$

$= \mathbf{5\frac{7}{12}}$ [1]

3. $\dfrac{3p(q-2)+4q^2(r+1)}{\frac{pqr}{2(p-1)}} = \dfrac{3(3)(1-2)+4(1)^2(5+1)}{\frac{3\times1\times5}{2(3-1)}}$

$= \dfrac{9(-1)+4(6)}{\frac{15}{2(2)}}$ [1]

$= \dfrac{-9+24}{\frac{15}{4}}$

$= 15 \div \dfrac{15}{4}$

$= 15 \times \dfrac{4}{15}$

$= \mathbf{4}$ [1]

4. (a) Total cost of the flowers

$= \$69(x+2) + \$46(2y-1)$

$= \$(69x + 138 + 92y - 46)$

$= \mathbf{\$(69x + 92y + 92)}$ [1]

(b) Number of bouquets she made $= 69 \div 3$

$= 23$

Total amount of money collected

$= 23 \times \$(3x + 5y)$

$= \mathbf{\$(69x + 115y)}$ [1]

(c) Total amount of money earned

$= \$(69x + 115y) - \$(69x + 92y + 92)$

$= \$(69x + 115y - 69x - 92y - 92)$

$= \mathbf{\$(23y - 92)}$ [1]

5. (a) Time taken to reach the petrol station from his house = 09 26 – 09 10

$= \dfrac{16}{60}$ h

$= \dfrac{4}{15}$ h [1]

Distance between his house and the petrol station $= p(2+q) \times \dfrac{4}{15}$

$= \dfrac{4p(2+q)}{15}$

$= \mathbf{\dfrac{8p + 4pq}{15}}$ **km** [1]

(b) Time taken to reach his office from the petrol station $= \dfrac{1}{3}p(q-5) \div p(2+q)$

$= \dfrac{p(q-5)}{3} \times \dfrac{1}{p(2+q)}$

$= \dfrac{q-5}{3(2+q)}$

Total time taken

$= \dfrac{q-5}{3(2+q)} + \dfrac{4}{15}$

$= \dfrac{15(q-5)+12(2+q)}{45(2+q)}$

$= \dfrac{15q - 75 + 24 + 12q}{45(2+q)}$

$= \dfrac{27q - 51}{45(2+q)}$

$= \dfrac{3(9q-17)}{45(2+q)}$

$= \mathbf{\dfrac{9q-17}{15(2+q)}}$ **h** [1]

6. (a) Total age of Kai, Abby and Kamal

$= 3 \times 2a(3+b)$

$= 3 \times (6a + 2ab)$

$= (18a + 6ab)$ years

Total age of Abby and Kamal

$= 18a + 6ab - 6a$

$= \mathbf{(12a + 6ab)}$ **years** [1]

(b) Kamal's age $= \dfrac{2}{3} \times (12a + 6ab)$

$= \mathbf{(8a + 4ab)}$ **years** [1]

(c) Kamal's age $= 8a + 4ab$

$= 8(3) + 4(3)(1)$

$= 24 + 12$

$= 36$ years

Abby's age $= \dfrac{1}{2} \times 36$

$= \mathbf{18}$ **years** [1]

7. (a) Anna's age $= 2 \times (2x + 1)$

$= (4x + 2)$ years

Benny's age $= 4x + 2 - 5$

$= (4x - 3)$ years [1]

Difference between Benny's and Hafiz's ages

$= (4x - 3) - (2x + 1)$

$= 4x - 3 - 2x - 1$

$= \mathbf{(2x - 4)}$ **years** [1]

(b) Total age in 6 years' time

$= 4x + 2 + 6 + 4x - 3 + 6 + 2x + 1 + 6$

$= \mathbf{(10x + 18)}$ **years** [1]

8. (a) Cost of a senior citizen ticket = $\$(x + 2y - 3.5)$

Cost of a child ticket = $\frac{1}{2} \times \$(x + 2y)$

$= \$\left(\frac{1}{2}x + y\right)$ [1]

Total cost of the tickets

$= 3 \times \$(x + 2y) + 2 \times \$(x + 2y - 3.5) + 3 \times \$\left(\frac{1}{2}x + y\right)$

$= \$\left(3x + 6y + 2x + 4y - 7 + \frac{3}{2}x + 3y\right)$

$= \mathbf{\$\left(6\frac{1}{2}x + 13y - 7\right)}$ [1]

(b) Total cost of the tickets

$= \$\left(6\frac{1}{2}x + 13y - 7\right)$

$= \$\left[6\frac{1}{2}(2) + 13(3) - 7\right]$

$= \$\left[\frac{13}{2}(2) + 39 - 7\right]$

$= \$(13 + 39 - 7)$

$= \$45$

Amount of change they get back = $100 – $45

= **$55** [1]

9. (a) Time taken by Terry = $x + 3 + 2.2$

$= (x + 5.2)$ s [1]

Time taken by Ahmad

$= [3(x + y) + 10] - (x + 3) - (x + 5.2) - (2x - y)$

$= 3x + 3y + 10 - x - 3 - x - 5.2 - 2x + y$

$= \mathbf{(4y - x + 1.8)}$ **s** [1]

(b) Total time taken = $3(x + y) + 10$

$= 3(9.4 + 5) + 10$

$= 3(14.4) + 10$

$= 43.2 + 10$

$= 53.2$ s

Since Ahmad's team took 53.2 s to complete the relay, they **did not win** the competition. [1]

(c) Time taken by Ahmad = $4y - x + 1.8$

$= 4(5) - 9.4 + 1.8$

$= 20 - 9.4 + 1.8$

$= 12.4$ s

Time taken by Ravi = $2x - y$

$= 2(9.4) - 5$

$= 13.8$ s

Time taken by Terry = $x + 5.2$

$= 9.4 + 5.2$

$= 14.6$ s

Terry is the slowest runner. [1]

10. (a) Number of packets of yarn = $45 \div 5$

$= 9$

Cost of each packet of yarn = $\$\frac{4y + 5}{9}$ [1]

Amount of money she earns from each packet of yarn = $\$(y + 0.4) - \$\frac{4y + 5}{9}$

$= \$\frac{9y + 9(0.4) - (4y + 5)}{9}$

$= \$\frac{9y + 3.6 - 4y - 5}{9}$

$= \mathbf{\$\frac{5y - 1.4}{9}}$ [1]

(b) Total amount of money she earns from each packet of yarn = $9 \times \$\frac{5y - 1.4}{9}$

$= \$(5y - 1.4)$

$= \$[5(1) - 1.4]$

$= \mathbf{\$3.60}$ [1]

Chapter 4 Linear Equations

Class Test 1

1. (a)
$$\begin{aligned} 4(a - 2) + 3 &= 3a - 1 \\ 4a - 8 + 3 &= 3a - 1 \\ 4a - 5 &= 3a - 1 \\ 4a - 3a &= -1 + 5 \\ a &= \mathbf{4} \end{aligned}$$
[1]

(b)
$$\begin{aligned} 2 - 3(x + 4) &= -9(2x + 1) + 4 \\ 2 - 3x - 12 &= -18x - 9 + 4 \\ -3x - 10 &= -18x - 5 \\ -3x + 18x &= -5 + 10 \\ 15x &= 5 \\ x &= \frac{5}{15} \\ &= \mathbf{\frac{1}{3}} \end{aligned}$$
[1]

2. (a)
$$\begin{aligned} 5(2 - u) - 3u &= 4(1 - 3u) \\ 10 - 5u - 3u &= 4 - 12u \\ 10 - 8u &= 4 - 12u \\ -8u + 12u &= 4 - 10 \\ 4u &= -6 \\ u &= -\frac{6}{4} \\ &= \mathbf{-1\frac{1}{2}} \end{aligned}$$
[1]

Secondary 1 • *Worked Solutions*

(b)
$$\begin{aligned}
\tfrac{2}{3}\left[2+5\left(u+\tfrac{4}{5}\right)\right]-\tfrac{1}{6}(3-4u)&=0\\
4\left[2+5\left(u+\tfrac{4}{5}\right)\right]-(3-4u)&=0\\
8+20u+16-3+4u&=0\\
21+24u&=0\\
24u&=-21\\
u&=\tfrac{-21}{24}\\
&=-\tfrac{7}{8} \qquad [1]
\end{aligned}$$

3. (a)
$$\begin{aligned}
\tfrac{1}{4}(3p+8)+2(1-p)&=9\\
(3p+8)+8(1-p)&=36\\
3p+8+8-8p&=36\\
-5p+16&=36\\
5p&=16-36\\
&=-20\\
p&=\tfrac{-20}{5}\\
&=\mathbf{-4} \qquad [1]
\end{aligned}$$

(b)
$$\begin{aligned}
3\left[\tfrac{4-3x}{5}+2(x+1)\right]&=\tfrac{2(x+6)}{3}+15\\
\tfrac{12-9x}{5}+6(x+1)&=\tfrac{2(x+6)}{3}+15\\
3(12-9x)+90(x+1)&=10(x+6)+225 \qquad [1]\\
36-27x+90x+90&=10x+60+225\\
63x+126&=10x+285\\
63x-10x&=285-126\\
53x&=159\\
x&=\tfrac{159}{53}\\
&=\mathbf{3} \qquad [1]
\end{aligned}$$

4. (a)
$$\begin{aligned}
\tfrac{1}{4}[16+2(3x-4)]+3(x-3)&=11\\
[16+2(3x-4)]+12(x-3)&=44\\
16+6x-8+12x-36&=44\\
18x-28&=44 \qquad [\tfrac{1}{2}]\\
18x&=44+28\\
&=72\\
x&=\tfrac{72}{18}\\
&=\mathbf{4} \qquad [\tfrac{1}{2}]
\end{aligned}$$

(b)
$$\begin{aligned}
\tfrac{3a-1}{4}+2(3-a)+\tfrac{1}{12}&=5\\
3(3a-1)+24(3-a)+1&=60\\
9a-3+72-24a+1&=60\\
-15a+70&=60 \qquad [\tfrac{1}{2}]\\
15a&=70-60\\
&=10\\
a&=\tfrac{10}{15}\\
&=\mathbf{\tfrac{2}{3}} \qquad [\tfrac{1}{2}]
\end{aligned}$$

5.
$$\begin{aligned}
\tfrac{3(2y-1)}{4}-\tfrac{2(4-y)}{3}&=\tfrac{\frac{1}{2}(3y+5)}{6}\\
3[3(2y-1)]-4[2(4-y)]&=2\left[\tfrac{1}{2}(3y+5)\right]\\
18y-9-32+8y&=3y+5 \qquad [1]\\
26y-41&=3y+5\\
26y-3y&=5+41\\
23y&=46\\
y&=\tfrac{46}{23}\\
&=\mathbf{2} \qquad [1]
\end{aligned}$$

6.
$$\begin{aligned}
\tfrac{9-5x}{5}-\tfrac{3x-4}{2}&=2x+\tfrac{1}{5}\\
2(9-5x)-5(3x-4)&=20x+2 \qquad [1]\\
18-10x-15x+20&=20x+2\\
38-25x&=20x+2\\
20x+25x&=38-2 \qquad [1]\\
45x&=36\\
x&=\tfrac{36}{45}\\
&=\mathbf{\tfrac{4}{5}} \qquad [1]
\end{aligned}$$

7.
$$\begin{aligned}
\tfrac{4p-1}{3}+2(p-1)-\tfrac{3p-1}{6}&=p+7\\
2(4p-1)+12(p-1)-(3p-1)&=6(p+7) \qquad [1]\\
8p-2+12p-12-3p+1&=6p+42\\
17p-13&=6p+42\\
17p-6p&=42+13 \qquad [1]\\
11p&=55\\
p&=\tfrac{55}{11}\\
&=\mathbf{5} \qquad [1]
\end{aligned}$$

8.
$$\begin{aligned}
\tfrac{2(a+7)-1}{3}-3\tfrac{5}{6}&=\tfrac{a}{2}\\
4(a+7)-2-23&=3a \qquad [\tfrac{1}{2}]\\
4a+28-2-23&=3a\\
4a+3&=3a \qquad [\tfrac{1}{2}]\\
4a-3a&=-3\\
a&=\mathbf{-3} \qquad [1]
\end{aligned}$$

9.
$$\begin{aligned}
\tfrac{2(3x+1)}{5}-\tfrac{2x-3}{5}+2(1-x)&=0\\
2(3x+1)-(2x-3)+10(1-x)&=0\\
6x+2-2x+3+10-10x&=0\\
-6x+15&=0\\
6x&=15\\
x&=\tfrac{15}{6}\\
&=\mathbf{2\tfrac{1}{2}} \qquad [1]
\end{aligned}$$

10. $3 - \frac{3y-2}{3} = y - \frac{3(7y+2)+18y}{4}$

$36 - 4(3y-2) = 12y - 3[3(7y+2) + 18y]$ [1]

$36 - 12y + 8 = 12y - 3(21y + 6 + 18y)$

$44 - 12y = 12y - 63y - 18 - 54y$

$44 - 12y = -105y - 18$ [1]

$-12y + 105y = -18 - 44$

$93y = -62$

$y = \frac{-62}{93}$

$= -\frac{2}{3}$ [1]

11. $\frac{25a+2}{2c} - \frac{5a+c}{2b+1} = -\frac{1}{5}$

When $b = 2$, $c = 5$,

$\frac{25a+2}{2(5)} - \frac{5a+5}{2(2)+1} = -\frac{1}{5}$ [1]

$\frac{25a+2}{10} = \frac{5a+5}{5} - \frac{1}{5}$

$25a + 2 = 2(5a+5) - 2$

$25a + 2 = 10a + 8$ [1]

$25a - 10a = 8 - 2$

$15a = 6$

$a = \frac{6}{15}$

$= \frac{2}{5}$ [1]

12. $\frac{b(2a-1)+c}{23d} = 5(a - 2d)$

When $b = 3$, $c = 4$ and $d = \frac{1}{5}$,

$\frac{3(2a-1)+4}{23\left(\frac{1}{5}\right)} = 5\left[a - 2\left(\frac{1}{5}\right)\right]$ [1]

$\frac{6a+1}{\frac{23}{5}} = 5a - 2$

$6a + 1 = \frac{23}{5}(5a - 2)$

$6a + 1 = 23a - \frac{46}{5}$ [1]

$23a - 6a = 1 + \frac{46}{5}$

$17a = \frac{51}{5}$

$a = \frac{\frac{51}{5}}{17}$

$= \frac{3}{5}$ [1]

13. $\frac{2b(b+c)-3a}{d+1} = \frac{4}{3a} + c$

When $a = 2$, $b = 1$ and $d = 4$,

$\frac{2(1)(1+c)-3(2)}{4+1} = \frac{4}{3(2)} + c$

$\frac{2c-4}{5} = \frac{2}{3} + c$

$3(2c - 4) = 10 + 15c$ [1]

$6c - 12 = 10 + 15c$

$15c - 6c = -12 - 10$

$9c = -22$

$c = \frac{-22}{9}$

$= -2\frac{4}{9}$ [1]

14. (a) $\frac{p(3q+r)}{s-p} - p^2 + 2q = 2(1+q)$

If $p = 2$, $r = 1$ and $s = 5$,

$\frac{2(3q+1)}{5-2} - 2^2 + 2q = 2(1+q)$

$\frac{2}{3}(3q+1) - 4 + 2q = 2 + 2q$

$2(3q+1) - 12 + 6q = 6 + 6q$

$6q + 2 - 12 + 6q = 6 + 6q$

$6q + 6q - 6q = 6 - 2 + 12$ [$\frac{1}{2}$]

$6q = 16$

$q = \frac{16}{6}$

$= 2\frac{2}{3}$ [$\frac{1}{2}$]

(b) $\frac{p(3q+r)}{s-p} - p^2 + 2q = 2(1+q)$

If $p = 4$, $q = -2\frac{1}{3}$ and $s = 1$,

$\frac{4\left[3\left(-2\frac{1}{3}\right)+r\right]}{1-4} - 4^2 + 2\left(-2\frac{1}{3}\right) = 2\left[1 + \left(-2\frac{1}{3}\right)\right]$

$-\frac{4}{3}(r - 7) - 16 - \frac{14}{3} = -\frac{8}{3}$

$-4(r - 7) - 48 - 14 = -8$

$-4r + 28 - 62 = -8$ [$\frac{1}{2}$]

$4r = 28 - 62 + 8$

$= -26$

$r = \frac{-26}{4}$

$= -6\frac{1}{2}$ [$\frac{1}{2}$]

15. $\frac{2p-3q}{4q-p} = -\frac{1}{2}$

$2(2p - 3q) = -(4q - p)$

$4p - 6q = -4q + p$

$4p - p = -4q + 6q$

$3p = 2q$

$p = \frac{2q}{3}$ [1]

$\frac{p}{2q} = \frac{\frac{2q}{3}}{2q}$

$= \frac{2q}{3} \times \frac{1}{2q}$

$= \frac{1}{3}$ [1]

Class Test 2

1. $\frac{27p+4q}{3} - 2(3q+p) = 0$

$\frac{27p+4q}{3} = 2(3q+p)$

$27p + 4q = 3[2(3q+p)]$

$27p + 4q = 18q + 6p$

$27p - 6p = 18q - 4q$

$21p = 14q$

$p = \frac{14q}{21}$

$= \frac{2}{3}q$ [1]

$\frac{p}{3q} = \frac{\frac{2}{3}q}{3q}$

$= \frac{2}{3} \times \frac{1}{3}$

$= \mathbf{\frac{2}{9}}$ [1]

2. $\frac{b-3a}{5a-2b} = -\frac{1}{5}$

$\frac{5b-15a}{5a-2b} = -1$

$5b - 15a = (-1)(5a-2b)$

$5b - 15a = -5a + 2b$

$5b - 2b = -5a + 15a$

$3b = 10a$

$b = \frac{10a}{3}$ [1]

$\frac{2a}{b} = \frac{2a}{\frac{10a}{3}}$

$= 2 \times \frac{3}{10}$

$= \mathbf{\frac{3}{5}}$ [1]

3. $\frac{6x+y}{3y-4x} = 1$

$6x + y = 3y - 4x$ [1]

$6x + 4x = 3y - y$

$10x = 2y$

$\frac{y}{x} = \frac{10}{2}$

$= \mathbf{5}$ [1]

4. Let the digit in the tens place of the number be x.

Digit in the ones place $= 2x$

Number $= 10x + 2x$

$= 12x$

Digit in the ones place of the reversed number $= x$

Digit in the tens place of the reversed number $= 2x$

Reversed number $= 20x + x$

$= 21x$

$12x + 21x = 132$

$33x = 132$

$x = \frac{132}{33}$

$= 4$ [1]

Number $= 12(4)$

$= \mathbf{48}$ [1]

5. (a) Let the time she took for the first part of the journey be x h.

Her average speed in the first part of the journey

$= \frac{225}{x}$ km/h [$\frac{1}{2}$]

Her average speed in the second part of the journey $= \frac{375-225}{x-1\frac{40}{60}}$

$= \frac{150}{x-1\frac{2}{3}}$ km/h

$\frac{225}{x} = \frac{150}{x-1\frac{2}{3}}$

$225 = \frac{150x}{x-1\frac{2}{3}}$

$225\left(x - 1\frac{2}{3}\right) = 150x$

$225x - 375 = 150x$

$225x - 150x = 375$

$75x = 375$

$x = \frac{375}{75}$

$= 5$ [$\frac{1}{2}$]

Her average speed for the first part of the journey $= \frac{225}{5}$

$= \mathbf{45\ km/h}$ [1]

(b) Total time she took to complete the journey

$= x + \left(x - 1\frac{2}{3}\right)$

$= 5 + \left(5 - 1\frac{2}{3}\right)$

$= \mathbf{8\frac{1}{3}\ h}$ [1]

6. Total cost of the apples $= \frac{35}{5} \times \$(2p+1)$

$= \$7(2p+1)$

Amount he received for the sale of his remaining apples $= \frac{35-3}{4} \times \$(4p+0.5)$

$= \$8(4p+0.5)$

Profit received $= \$8(4p+0.5) - \$7(2p+1)$

$= \$(32p + 4 - 14p - 7)$

$= \$(18p - 3)$

$18p - 3 = 7.8$ [1]

$18p = 7.8 + 3$

$= 10.8$

$p = \frac{10.8}{18}$

$= \mathbf{0.6}$ [1]

7. (a) Total cost of the notebooks = 35 × \$$m$
= **\$35m** [1]

(b) Total cost of the pens = $\frac{20}{5}$ × \$8
= \$32

$\frac{2}{5}$ of her remaining money ⟶ \$32

$\frac{5}{5}$ of her remaining money ⟶ $\frac{5}{2}$ × \$32
= \$80

Amount of remaining money = \$150 – \$35m
= \$(150 – 35m)

$150 - 35m = 80$ [$\frac{1}{2}$]
$35m = 150 - 80$
$= 70$
$m = \frac{70}{35}$
$= \mathbf{2}$ [$\frac{1}{2}$]

(c) Fraction of her remaining money left
$= 1 - \frac{2}{5}$
$= \frac{3}{5}$

Amount of money Erika had left = $\frac{3}{5}$ × \$80
= **\$48** [1]

8. (a) Let the number of eggs Alan bought be x.
Total cost of the eggs = $\frac{x}{5}$ × \$$p$
= **\$$\frac{px}{5}$** [1]

(b) Cost of each egg = \$$\frac{p}{5}$

Selling price of each egg sold at \$0.80 profit
= \$$\frac{p}{5}$ + \$0.80
= \$$\frac{p+4}{5}$

Amount collected from $\frac{2}{3}$ of the eggs
= $\frac{2}{3}x$ × \$$\frac{p+4}{5}$
= \$$\frac{2x(p+4)}{15}$
= \$$\frac{2px+8x}{15}$ [$\frac{1}{2}$]

Selling price of each egg sold at \$0.50 profit
= \$$\frac{p}{5}$ + \$0.50
= \$$\frac{p+2.5}{5}$

Amount collected from $\frac{1}{3}$ of the eggs
= $\frac{1}{3}x$ × \$$\frac{p+2.5}{5}$
= \$$\frac{px+2.5x}{15}$ [$\frac{1}{2}$]

Total amount collected from the sale of the eggs = \$$\frac{2px+8x}{15}$ + \$$\frac{px+2.5x}{15}$
= **\$$\frac{3px+10.5x}{15}$** [1]

(c) Profit = \$$\frac{3px+10.5x}{15}$ – \$$\frac{px}{5}$

$\frac{3px+10.5x}{15} - \frac{px}{5} = 31.5$
$(3px + 10.5x) - 3px = 472.5$
$10.5x = 472.5$
$x = 45$

Number of eggs he bought = **45** [1]

9. Let the denominator of the fraction be x.
Numerator of the fraction = $x - 5$
Fraction = $\frac{x-5}{x}$
New fraction = $\frac{(x-5)-2}{x-2}$
$= \frac{x-7}{x-2}$

$\frac{x-7}{x-2} = \frac{1}{2}$ [1]
$2(x-7) = x - 2$
$2x - 14 = x - 2$
$2x - x = -2 + 14$
$x = 12$

Fraction = $\frac{12-5}{12}$
$= \mathbf{\frac{7}{12}}$ [1]

10. (a) Let Robin's current age be x years.
Tina's current age = $2x$ years
Robin's age 3 years ago = $(x - 3)$ years
Zac's age 3 years ago = $2 \times (x-3)$
= $(2x - 6)$ years
Zac's current age = $(2x - 6) + 3$
= $(2x - 3)$ years

Their current total age
= $x + 2x + (2x - 3)$
= $(5x - 3)$ years [$\frac{1}{2}$]

Their total age in 6 years' time
= $(5x - 3) + 3(6)$
= $(5x + 15)$ years [$\frac{1}{2}$]

Average age of Tina, Zac and Robin in 6 years' time = $\frac{5x+15}{3}$ years

Tina's age next year = $(2x + 1)$ years

$\frac{5x+15}{3} = 2x + 1$

$5x + 15 = 3(2x + 1)$

$5x + 15 = 6x + 3$ [$\frac{1}{2}$]

$6x - 5x = 15 - 3$

$x = 12$

Robin's current age = **12 years** [$\frac{1}{2}$]

(b) Their current total age

$= 5x - 3$

$= 5(12) - 3$

$= 57$ years

Their total age in five years' time

$= 57 + 3(5)$

$=$ **72 years** [1]

Chapter 5 Functions and Linear Graphs

Class Test 1

1. (a) Line *GH*.
Line *GH* slopes downwards from left to right, therefore it has a negative gradient. [$\frac{1}{2}$]

(b) Line *CD*.
Horizontal lines have 0 gradient. [$\frac{1}{2}$]

(c) Line *EF*.
Line *AB* and line *EF* slopes upwards from left to right, therefore both lines have a positive gradient. Since line *EF* has a gentler slope than line *AB*, the absolute value of its gradient is smaller. [$\frac{1}{2}$]

(d) Line *AB*.
Since line *AB* has a steeper slope than line *EF*, the absolute value of its gradient is greater. [$\frac{1}{2}$]

2. (a) When $x = 2.5$ and $y = 8$,

$2(8 - 2.5a) = 6$

$8 - 2.5a = 3$

$2.5a = 5$

$a = \mathbf{2}$ [1]

(b) When $x = 0$,

$2(y - 0) = 6$

$y = 3$

Coordinates of the point: **(0, 3)** [1]

3. (a) Gradient of line *CD* $= \frac{-1-7}{0-2}$

$= \frac{-8}{-2}$

$= 4$

Equation of line *CD*: $\mathbf{y = 4x - 1}$ [1]

(b) Gradient of line *FG* = 4

Equation of line *FG*: $\mathbf{y = 4x + 7}$ [1]

4. (a) When $x = 2$ and $y = \frac{1}{5}$,

$5\left(\frac{1}{5}\right) = a(2) - 15$

$1 = 2a - 15$

$2a = 16$

$a = \mathbf{8}$ [1]

(b) When $x = 0$,

$5y = 8(0) - 15$

$5y = -15$

$y = -3$

∴ y-intercept: **(0, –3)** [1]

5. (a) Equation of line *XY*: $\mathbf{y = -\frac{5}{6}x + 7}$ [1]

(b) (i) When $x = 2$,

$y = -\frac{5}{6}(2) + 7$

$= 5\frac{1}{3}$

∴ Coordinates of the point: $\mathbf{\left(2, 5\frac{1}{3}\right)}$ [1]

(ii) When $y = -\frac{4}{3}$,

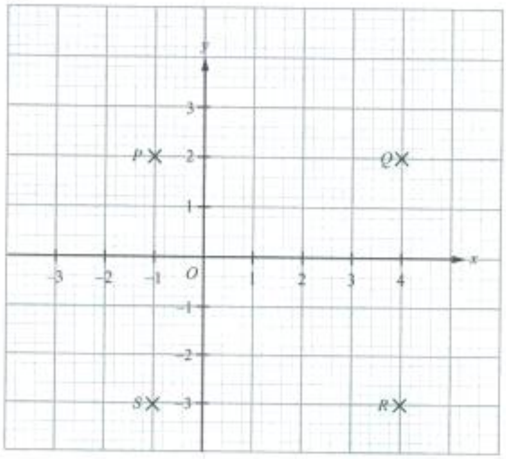
$-\frac{4}{3} = -\frac{5}{6}x + 7$

$\frac{5}{6}x = 8\frac{1}{3}$

$x = 10$

∴ Coordinates of the point: $\mathbf{\left(10, -\frac{4}{3}\right)}$ [1]

6.



[1]

(a) $S(-1, -3)$ [1]

(b) Length of each side $= 4 - (-1)$
$= 5$ units
Area of $PQRS = 5 \times 5$
$=$ **25 units²** [1]

(c) (i) Gradient of $QS = \frac{-3-2}{-1-4}$
$= \frac{-5}{-5}$
$= \mathbf{1}$ [1]

(ii) Gradient of $PR = \frac{-3-2}{4-(-1)}$
$= \frac{-5}{5}$
$= \mathbf{-1}$ [1]

7. (a) (i) $y = \frac{4}{3}x + 4$ [1]

(ii) When $x = 9$ and $y = q$,
$q = \frac{4}{3}(9) + 4$
$= \mathbf{16}$ [1]

(b) Gradient of line $RS = \frac{14-0}{6-\left(-4\frac{1}{2}\right)}$
$= \frac{14}{10\frac{1}{2}}$
$= \frac{4}{3}$

Since the gradients of line PQ and line RS are equal, they are parallel. (proven) [1]

8. (a) (i) Points on line PQ: $(-3, 0)$ and $(0, 1.5)$
Gradient of line $PQ = \frac{1.5-0}{0-(-3)}$
$= \frac{1.5}{3}$
$= \frac{1}{2}$ [1]

(ii) Equation of line PQ: $\mathbf{y = \frac{1}{2}x + 1.5}$ [1]

(b) When $x = a$ and $y = 2$,
$2 = \frac{1}{2}a + 1.5$
$\frac{1}{2}a = 0.5$
$a = \mathbf{1}$ [1]

(c) Points on line AB: $(1, 2)$ and $(0, -1)$
Gradient of line $AB = \frac{-1-2}{0-1}$
$= \frac{-3}{-1}$
$= 3$
Equation of line AB: $\mathbf{y = 3x - 1}$ [1]

9. Gradient of the line $= \frac{6-(-4)}{2-(-3)}$
$= \frac{10}{5}$
$= 2$
y-intercept $= 2$ [1]
Equation of the line: $\mathbf{y = 2x + 2}$ [1]

10. (a) (i) From the graph, when $x = 7$,
$y = 8.8$
Cost of using 7 units of electricity
$=$ **\$8.80** [1]

(ii) From the graph, when $x = 12$,
$y = 15$
Cost of using 12 units of electricity
$=$ **\$15** [1]

(b) (i) Gradient of $OA = \frac{8.8-0}{7-0}$
$=$ **1.26** (3 s.f.)
The gradient represents the cost per unit of electricity used from 7 units and less, i.e. \$1.26. [1]

(ii) Gradient of $AB = \frac{15-8.8}{12-7}$
$= \frac{6.2}{5}$
$=$ **1.24**
The gradient represents the cost per unit of electricity used between 7 and 12 units, i.e. \$1.24. [1]

Secondary 1 • Worked Solutions

11. (a) (i) Points on line AB: (0, 4) and (3, –5)

Gradient of line $AB = \frac{-5-4}{3-0}$

$= -\frac{9}{3}$

$= \mathbf{-3}$ [1]

(ii) Equation of line AB: $\mathbf{y = -3x + 4}$ [1]

(iii) When $x = -2$,

$y = -3(-2) + 4$

$= 10$

$\therefore$ $\mathbf{a = 10}$ [1]

(b) (i) $C(-2, -5)$ [1]

(ii) Base length of $\triangle ABC = 3 - (-2)$

$= 5$ units

Height of $\triangle ABC = 10 - (-5)$

$= 15$ units

Area of $\triangle ABC = \frac{1}{2} \times 5 \times 15$

$= \mathbf{37.5\ units^2}$ [1]

12. (a) (i) Gradient of $NP = \mathbf{0}$

Gradient of $RS = \mathbf{0}$

The gradient represents Alicia's cycling speed. She is resting between point N and point P, and between point R and point S since the gradient is 0 for both. [1]

(ii) Gradient of $PQ = \frac{55-20}{2.5}$

$= \frac{35}{2.5}$

$= \mathbf{14}$

The gradient represents Alicia's cycling speed between point P and point Q, i.e. 14 km/h. [1]

(b) Total time taken = 16 00 – 06 00

= 10 00 h

= 10 h

Alicia's average speed $= \frac{2 \times 55}{10}$

$= \mathbf{11\ km/h}$ [1]

13. (a) $C = 45x + 20$

x	0	2	4	6	8	10
C	20	110	200	290	380	470

Refer to Appendix 2. [2]

(b) The graph starts at $C = 20$, this means that regardless of how many days a car is rented, \$20 is included in the total cost of rental. \$20 may be a compulsory administrative fee. [1]

(c) (i) From the graph, when $x = 8$,

$C = 380$

Cost of renting a car for 8 days = **\$380** [1]

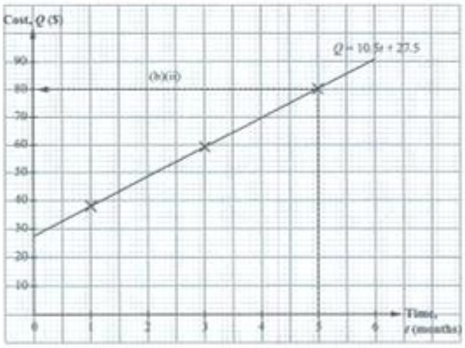
(ii) From the graph, when $C = 200$,

$x = 4$

Number of days Tina can rent a car = **4** [1]

14. (a)

Q	1	3	5
t	38	59	80



[2]

(b) (i) From the graph, when $t = 0$,

$Q = 27.5$

The graph starts at $Q = 27.5$, this means that \$27.50 may be a compulsory administrative fee, regardless of how many months of cable television subscribed. [1]

(ii) From the graph, when $t = 5$,

$Q = 80$

Cost of subscription = **\$80** [1]

15. (a) $P = 800 + 125m$

m	0	5	10
P	800	1425	2050

Refer to Appendix 7. [2]

(b) (i) From the graph, when $m = 8$,
$P = 1800$
Salary for the month he sells 8 television sets = **\$1800** [1]

(ii) From the graph, when $P = 1175$,
$m = 3$
Number of television sets he sells that month = **3** [1]

Class Test 2

1. (a) (i) Refer to Appendix 3. [2]

(ii) Gradient of line $PQ = \frac{-5-5}{3-(-2)}$

$= \frac{-10}{5}$

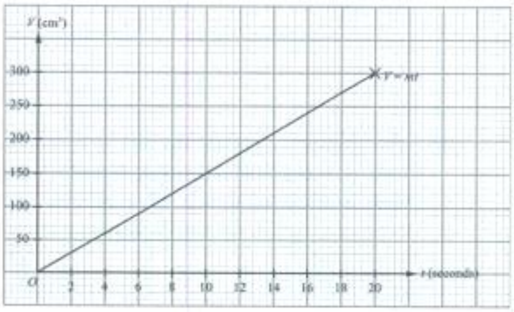
$= \mathbf{-2}$ [1]

(iii) y-intercept: **(0, 1)** [1]
Equation of line PQ: $\mathbf{y = -2x + 1}$ [1]

(b) Refer to Appendix 3. [2]

(c) Base length of the triangle $= 1.5 - (-4)$
$= 5.5$ units
Height of the triangle $= 9 - (-2)$
$= 11$ units
Area of the triangle $= \frac{1}{2} \times 5.5 \times 11$
$= \mathbf{30.25\ units^2}$ [1]

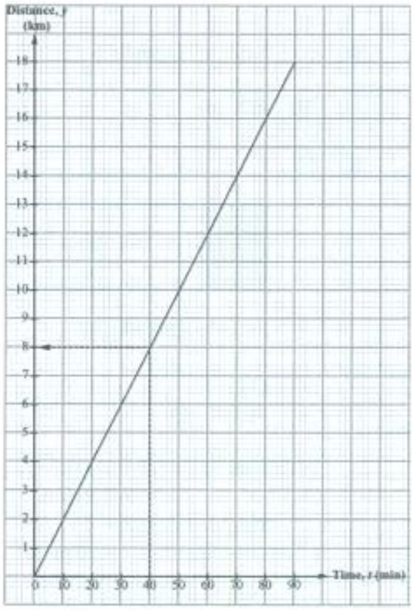
2. (a) When $t = 0$, $V = 0$.
When $t = 20$, $V = 300$. [2]



(b) Gradient of the graph $= \frac{300-0}{20-0}$
$= \mathbf{15}$
The gradient represents the rate at which the tank is being filled, i.e. 15 cm^3/s. [1]

(c) Equation of the line: $V = 15t$
When $t = 160$,
$V = 15 \times 160$
$= 2400$
Capacity of the tank = $\mathbf{2400\ cm^3}$ [1]

3. (a)



[2]

(b) From the graph, when $t = 40$,
$D = 8$
Distance she cycles 40 minutes after leaving her home = **8 km** [1]

(c) Gradient of the graph $= \frac{8-0}{40-0}$
$= \mathbf{0.2}$
The gradient represents Tina's cycling speed, i.e. 0.2 km/min. [1]

Secondary 1 • Worked Solutions

4. $y = -5x + 4$

x	–3	0	4
y	19	4	–16

Refer to Appendix 6. [2]

(a) (i) From the graph, when $x = 3.3$, $y = \mathbf{-12.5}$ [1]

(ii) From the graph, when $y = 17$, $x = \mathbf{-2.6}$ [1]

(b) (i) Refer to Appendix 6. [1]

(ii) $P(2, -6)$ [1]

(c) (i) $y = 4x + 4$

x	–3	0	4
y	–8	4	20

Refer to Appendix 6. [1]

(ii) $Q(0, 4)$ [1]
$R(-2.5, -6)$ [1]

(iii) Base of $\triangle PQR = 2 - (-2.5)$
$= 4.5$ units
Height of $\triangle PQR = 4 - (-6)$
$= 10$ units
Area of $\triangle PQR = \frac{1}{2} \times 4.5 \times 10$
$= \mathbf{22.5\ units^2}$ [1]

5. Gradient of line $CD = \dfrac{6\frac{1}{2} - 2}{6 - 0}$
$= \dfrac{4\frac{1}{2}}{6}$
$= \dfrac{3}{4}$ [$\frac{1}{2}$]

Gradient of line $FG = \dfrac{-1 - \left(-2\frac{1}{2}\right)}{0 - (-3)}$
$= \dfrac{1\frac{1}{2}}{3}$
$= \dfrac{1}{2}$ [$\frac{1}{2}$]

Since the absolute values of the gradient of line CD is greater than the gradient of line FG, line CD is steeper than line FG. (proven) [1]

6. $2y = -3x - 2$
$y = -\frac{3}{2}x - 1$

x	–4	0	4
y	5	–1	–7

Refer to Appendix 8. [2]

(a) (i) From the graph, when $y = -6.1$, $x = \mathbf{3.4}$ [1]

(ii) From the graph, when $x = -1.8$, $y = \mathbf{1.7}$ [1]

(b) Refer to Appendix 8. [1]

(c) (i) Refer to Appendix 8. [1]

(ii) To find the base length of the triangle, we need to find points P and Q.
From the graph,
Coordinates of P: (2, 3)
From the graph,
Coordinates of Q: (2, –4)

Base length of the triangle $= 3 - (-4)$
$= 7$ units [1]

Height of the triangle $= 2 - \left(-\frac{3}{2}\right)$
$= 3\frac{1}{2}$ units

Area of the triangle $= \frac{1}{2} \times 7 \times 3\frac{1}{2}$
$= \mathbf{12\frac{1}{4}\ units^2}$ [1]

7. (a) (i) Gradient of $PQ = \dfrac{49 - 25}{6 - 0}$
$= \dfrac{24}{6}$
$= \mathbf{4}$ [1]

(ii) Gradient of $QR = \dfrac{69 - 49}{14 - 6}$
$= \dfrac{20}{8}$
$= \mathbf{2\frac{1}{2}}$ [1]

(b) The gradients represent the rate at which the tank is being filled. Between P and Q, the tank is filled at a rate of 4 m^3/min, and between Q and R, the tank is filled at a rate of $2\frac{1}{2}$ m^3/min. [1]

8. (a) (i) Points on line AC: (0, 3) and (−3, 0)

Gradient of line $AC = \frac{0-3}{-3-0}$

$= \frac{-3}{-3}$

$= 1$

Equation of line AC: $\mathbf{y = x + 3}$ [1]

(ii) When $x = 6$,

$y = 6 + 3$

$= 9$

$\therefore p = \mathbf{9}$ [1]

When $y = -3$,

$x = -3 - 3$

$= -6$

$\therefore q = \mathbf{-6}$ [1]

(b) Gradient of line $AB = \frac{-3-9}{\frac{2}{3}-6}$

$= \frac{-12}{-5\frac{1}{3}}$

$= \mathbf{\frac{9}{4}}$ [1]

(c) Base length of $\triangle ABC$ = Length of BC

$= \frac{2}{3} - (-6)$

$= 6\frac{2}{3}$ units

Vertical height of $\triangle ABC = 9 - (-3)$

$= 12$ units

Area of $\triangle ABC = \frac{1}{2} \times 6\frac{2}{3} \times 12$

$= \mathbf{40\ units^2}$ [1]

9. (a) From the graph,

Distance he drove before reaching the resting stop = **90 km** [1]

(b) (i) Gradient of $PQ = \frac{90-0}{1.5}$

$= \mathbf{60}$

The gradient represents the speed he travelled from P to Q, i.e. 60 km/h. [1]

(ii) Gradient of QR = **0**

The gradient is 0 as Thomas was at the resting stop, thus his speed was 0 km/h. [1]

(iii) Gradient of $RS = \frac{210-90}{3}$

$= \mathbf{40}$

The gradient represents the speed he travelled at from R to S, i.e. 40 km/h. [1]

(c) Total time taken = 14 00 − 08 30

= 05 30 h

= 5.5 h

Average speed for the whole journey

= 210 ÷ 5.5

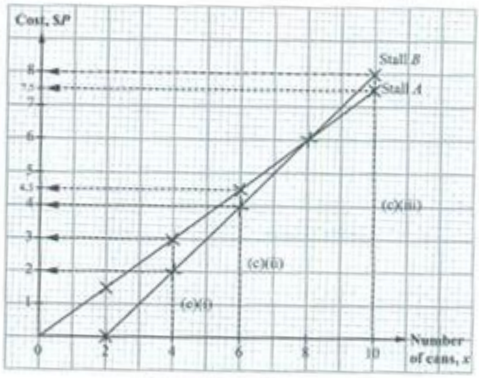
= **38.2 km/h** (1 d.p.) [1]

10. (a)

Stall	x	2	4	6	8	10
A	\$$P$	1.5	3	4.5	6	7.5
B	\$$P$	0	2	4	6	8

[2]

(b)



[2]

(c) (i) Cost of 4 cans of drinks from stall A = \$3

Cost of 4 cans of drinks from stall B = \$2

Difference between the amount of money she pays = \$3 − \$2

= **\$1** [1]

(ii) From the graph, when $x = 6$, the graph of stall B is below the graph of stall A.

Therefore, she should buy from **stall B** as it is cheaper. [1]

(iii) From the graph, when $x = 10$, the graph of stall A is below the graph of stall B.

Therefore, he should buy from **stall A** as it is cheaper. [1]

Chapter 6 Number Patterns

Class Test 1

1. When $n = 1, 2, 3$ and 4,

$T_1 = \frac{3(1-1)}{4(1+1)}$

$= \mathbf{0}$ $[\frac{1}{2}]$

$T_2 = \frac{3(2-1)}{4(2+1)}$

$= \frac{3}{12}$

$= \mathbf{\frac{1}{4}}$ $[\frac{1}{2}]$

$T_3 = \frac{3(3-1)}{4(3+1)}$

$= \frac{6}{16}$

$= \mathbf{\frac{3}{8}}$ $[\frac{1}{2}]$

$T_4 = \frac{3(4-1)}{4(4+1)}$

$= \mathbf{\frac{9}{20}}$ $[\frac{1}{2}]$

2. (a) $T_1 = 7 = 7 + 5 \times 0$

$T_2 = 12 = 7 + 5 \times 1$

$T_3 = 17 = 7 + 5 \times 2$

$\therefore$ General term, $T_n = 7 + 5 \times (n - 1)$

$= 7 + 5n - 5$

$= \mathbf{5n + 2}$ [1]

(b) (i) When $n = 27$,

$T_{27} = 5(27) + 2$

$= \mathbf{137}$ [1]

(ii) $T_n = 242$

$5n + 2 = 242$

$5n = 240$

$n = 48$

The **48th** term gives a value of 242. [1]

3. (a) $T_1 = 3^2 + 4 = (1 + 2)^2 + (1 + 3)$

$T_2 = 4^2 + 5 = (2 + 2)^2 + (2 + 3)$

$T_3 = 5^2 + 6 = (3 + 2)^2 + (3 + 3)$

$\therefore$ General term, $T_n = (n + 2)^2 + (n + 3)$

$= \mathbf{(n + 2)^2 + n + 3}$ [1]

(b) When $n = 98$,

$T_{98} = (98 + 2)^2 + 98 + 3$

$= \mathbf{10\ 101}$ [1]

4. (a)

Figure 4 Figure 5

Number of dots in figure 4 = **17** $[\frac{1}{2}]$

Number of dots in figure 5 = **21** $[\frac{1}{2}]$

(b) $T_1 = 5 = 5 + (0 \times 4)$

$T_2 = 9 = 5 + (1 \times 4)$

$T_3 = 13 = 5 + (2 \times 4)$

$\therefore$ General term, $T_n = 5 + [(n - 1) \times 4]$

$= 5 + 4n - 4$

$= \mathbf{4n + 1}$ [1]

(c) When $n = 101$,

$T_{101} = 4(101) + 1$

$= \mathbf{405}$ [1]

5. (a) $T_1 = 1^3 + 4$

$T_2 = 2^3 + 4$

$T_3 = 3^3 + 4$

$\therefore$ General term, $T_n = n^3 + 4$

When $n = 10$,

$T_{10} = \mathbf{10^3 + 4}$ [1]

(b) $n^3 + 4 = 3379$

$n^3 = 3375$

$n = \mathbf{15}$ [1]

6. (a) $T_1 = 33 = 33 - 0 \times 1\frac{2}{3}$

$T_2 = 31\frac{1}{3} = 33 - 1 \times 1\frac{2}{3}$

$T_3 = 29\frac{2}{3} = 33 - 2 \times 1\frac{2}{3}$

$T_4 = 28 = 33 - 3 \times 1\frac{2}{3}$

$\therefore$ General term, $T_n = 33 - (n - 1) \times 1\frac{2}{3}$

$= 33 - 1\frac{2}{3}n + 1\frac{2}{3}$

$= \mathbf{34\frac{2}{3} - 1\frac{2}{3}n}$ [1]

(b) When $n = 11$,

$T_{11} = 34\frac{2}{3} - 1\frac{2}{3}(11)$

$= \mathbf{16\frac{1}{3}}$ [1]

(c) When $n = p$, $T_p = 34\frac{2}{3} - 1\frac{2}{3}p$

$34\frac{2}{3} - 1\frac{2}{3}p = -13\frac{2}{3}$

$1\frac{2}{3}p = 48\frac{1}{3}$

$p = 48\frac{1}{3} \div 1\frac{2}{3}$

$= \mathbf{29}$ [1]

7. (a)

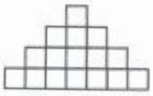


Figure 4

Figure 5

[1]

(b) (i) $P_1 = 1 = 1 + 0 \times 2$
$P_2 = 3 = 1 + 1 \times 2$
$P_3 = 5 = 1 + 2 \times 2$
$\therefore$ General formula, $P_n = 1 + (n - 1) \times 2$
$= 1 + 2n - 2$
$= \mathbf{2n - 1}$ [1]

(ii) $Q_1 = 1 = 1^2$
$Q_2 = 4 = 2^2$
$Q_3 = 9 = 3^2$
$\therefore$ General formula, $Q_n = \mathbf{n^2}$ [1]

(c) When $n = k$, $P_k = 2k - 1$
$2k - 1 = 51$
$2k = 52$
$k = \mathbf{26}$ $[\frac{1}{2}]$

When $k = 26$,
$Q_{26} = 26^2$
$= \mathbf{676}$ $[\frac{1}{2}]$

8. (a) (i) When $n = 27$,
$T_{27} = 27(27 - 3)$
$= \mathbf{648}$ [1]

(ii) When $n = 50$,
$T_{50} = 50(50 - 3)$
$= \mathbf{2350}$ [1]

(b) Since $k^2 - 144$ is a term in the sequence,
$n(n - 3) = k^2 - 144$ [1]
$n^2 - 3n = k^2 - 144$
Comparing coefficients:
$3n = 144$
$n = 48$
$k = n$
$= \mathbf{48}$ [1]

When $n = 48$,
$T_{48} = 48(48 - 3)$
$= \mathbf{2160}$ [1]

9. (a) When $n = 23$,
$T_{23} = 2(23) + \frac{(23-1)^3}{2}$
$= 46 + \frac{22^3}{2}$
$= \mathbf{5370}$ [1]

(b) (i) When $n = p$, $T_p = 2p + \frac{(p-1)^3}{2}$
$2p + \frac{(p-1)^3}{2} = 142 + \frac{(p-1)^3}{2}$
Comparing coefficients:
$2p = 142$
$p = \mathbf{71}$ [1]

(ii) When $n = 71$,
$T_{71} = 142 + \frac{(71-1)^3}{2}$
$= \mathbf{171\ 642}$ [1]

10. (a)

Sequence	T_4	T_5
Q	**15**	**24**
R	**–4**	**–11**

[1]

(b) (i) $P_1 = 5 = 5 + 0 \times 2$
$P_2 = 7 = 5 + 1 \times 2$
$P_3 = 9 = 5 + 2 \times 2$
$\therefore$ General term, $P_n = 5 + (n - 1) \times 2$
$= 5 + 2n - 2$
$= \mathbf{2n + 3}$ [1]

(ii) $R_1 = 5 = 5 - 0$
$R_2 = 4 = 7 - 3$
$R_3 = 1 = 9 - 8$
$\therefore$ General term, $R_n = P_n - Q_n$
$= (2n + 3) - (n^2 - 1)$
$= \mathbf{2n - n^2 + 4}$ [1]

(c) (i) When $n = 20$,
$R_{20} = 2(20) - 20^2 + 4$
$= \mathbf{-356}$ [1]

(ii) $n^2 - 1 = 4095$
$n^2 = 4096$
$n = 64$

When $n = 64$,
$P_{64} = 2(64) + 3$
$= \mathbf{131}$ [1]

$R_{64} = 2(64) - 64^2 + 4$
$= \mathbf{-3964}$ [1]

11. (a) When $n = 38$,
$T_{38} = \frac{2}{5}(38)(38 - 1)$
$= \mathbf{562\frac{2}{5}}$ [1]

(b) When $n = k$, $T_k = \frac{2}{5}k(k - 1)$
$\frac{2}{5}k(k - 1) = 688\frac{4}{5}$
$k^2 - k = 1722$
$k^2 - k - 1722 = 0$
$(k - 42)(k + 41) = 0$
$k - 42 = 0$ or $k + 41 = 0$
$k = \mathbf{42}$ or $k = -41$ (rejected) [1]

12. (a) $T_1 = 1 = 1^2$
$T_2 = 9 = 3^2$
$T_3 = 25 = 5^2$
$\therefore$ General term, $T_n = [n + (n - 1)]^2$
$= (2n - 1)^2$

When $n = 15$,
$T_{15} = [2(15) - 1]^2$
$= 29^2$
$= \mathbf{841}$ [1]

(b) $(2n - 1)^2 = 4761$
$2n - 1 = 69$
$2n = 70$
$n = 35$
There are 4761 squares in figure **35**. [1]

13. (a) $T_1 = 4$
$T_2 = 9 = T_1 + 5$
$T_3 = 14 = T_2 + 5$

$T_4 = T_3 + 5$
$= 14 + 5$
$= \mathbf{19}$ [1]

$T_5 = T_4 + 5$
$= 19 + 5$
$= \mathbf{24}$ [1]

(b) All the terms in the sequence end with 4 or 9 since they have a difference of 5. Therefore, 283 is not a term in the sequence. [1]

14. (a) When $n = 21$,
$T_{21} = \frac{1 - (21 - 5)^2}{2}$
$= -\frac{\mathbf{255}}{\mathbf{2}}$ [1]

(b) When $n = x$, $T_x = \frac{1 - (x - 5)^2}{2}$
$\frac{1 - (x - 5)^2}{2} = -511\frac{1}{2}$ [1]
$1 - (x - 5)^2 = -1023$
$(x - 5)^2 = 1024$
$x - 5 = 32$ or $x - 5 = -32$ (rejected)
$x = \mathbf{37}$ [1]

15. (a) 35 cm = 0.35 m
$\therefore$ General term, $T_n = \mathbf{1.35 + 0.35}\boldsymbol{n}$ [1]

(b) $1.35 + 0.35n = 8$
$0.35n = 6.65$
$n = 19$
It takes **19** years for the tree to reach a height of 8 m. [1]

Class Test 2

1. (a) $T_1 = 2 \times 3 + 4$
$= (1 + 1) \times (1 + 2) + (1 + 3)$
$= 10$
$T_2 = 3 \times 4 + 5$
$= (2 + 1) \times (2 + 2) + (2 + 3)$
$= 17$
$T_3 = 4 \times 5 + 6$
$= (3 + 1) \times (3 + 2) + (3 + 3)$
$= 26$
$\therefore$ General term,
$T_n = (n + 1) \times (n + 2) + (n + 3)$

When $n = 17$,
$T_{17} = (17 + 1) \times (17 + 2) + (17 + 3)$
$= 18 \times 19 + 20$
$= \mathbf{362}$ [1]

(b) When $n = p$, $T_p = (p + 1) \times (p + 2) + (p + 3)$
$(p + 1) \times 22 + (p + 3) = m$
Comparing coefficients:
$p + 2 = 22$
$p = \mathbf{20}$ [$\frac{1}{2}$]
Substitute $p = 20$ into the equation:
$m = (20 + 1) \times 22 + (20 + 3)$
$= 21 \times 22 + 23$
$= \mathbf{485}$ [$\frac{1}{2}$]

2. (a) (i) Numerator of $T_1 = 1 = 1^2$
Numerator of $T_2 = 4 = 2^2$
Numerator of $T_3 = 9 = 3^2$
Numerator of $T_4 = 16 = 4^2$
$\therefore$ Numerator of $T_n = \mathbf{n^2}$ $[\frac{1}{2}]$

(ii) Denominator of $T_1 = 5 = 1^2 + 4$
Denominator of $T_2 = 8 = 2^2 + 4$
Denominator of $T_3 = 13 = 3^2 + 4$
Denominator of $T_4 = 20 = 4^2 + 4$
$\therefore$ Denominator of $T_n = \mathbf{n^2 + 4}$ $[\frac{1}{2}]$

(b) (i) $T_n = \frac{n^2}{n^2+4}$
$T_r = \frac{a}{b}$, where $b = a + 4$ from the general terms we have found in (a).
$\therefore \frac{a}{a+4} = \frac{16}{17}$ [1]
$16(a + 4) = 17a$
$16a + 64 = 17a$
$a = \mathbf{64}$ [1]

(ii) Since the numerator, $a = 64$,
$r^2 = 64$
$r = \mathbf{8}$ [1]

3. (a) Number of squares
$T_1 = 1$
$T_2 = 2$
$T_3 = 3$
$\therefore$ General term, $T_n = n$
When $n = 15$,
$a = \mathbf{15}$ $[\frac{1}{2}]$

Number of dots
$T_1 = 4 = 1 \times 2 + 2$
$T_2 = 6 = 2 \times 2 + 2$
$T_3 = 8 = 3 \times 2 + 2$
$\therefore$ General term, $T_n = 2n + 2$
When $n = 15$,
$b = 2(15) + 2$
$= \mathbf{32}$ $[\frac{1}{2}]$

Total number of squares and dots
$T_1 = 5 = 1 + 4$
$T_2 = 8 = 2 + 6$
$T_3 = 11 = 3 + 8$
$\therefore$ General term, $T_n = n + 2n + 2$
$= 3n + 2$
When $n = 15$,
$c = 3(15) + 2$
$= \mathbf{47}$ $[\frac{1}{2}]$

(b) $52 = 2n + 2$
$2n = 50$
$n = 25$
When $n = 25$, number of squares = **25** [1]

(c) (i) When $T_n = 161$,
$3n + 2 = 161$
$3n = 159$
$n = 53$
Number of squares in this figure = **53** [1]

(ii) Number of dots in this figure
$= 161 - 53$
$= \mathbf{108}$ $[\frac{1}{2}]$

4. (a) When $n = 1, 2, 3$ and 4,
$T_1 = \frac{1}{2} - (1 + 3)^2 + 1$
$= \mathbf{-14\frac{1}{2}}$ $[\frac{1}{2}]$
$T_2 = \frac{1}{2} - (2 + 3)^2 + 2$
$= \mathbf{-22\frac{1}{2}}$ $[\frac{1}{2}]$
$T_3 = \frac{1}{2} - (3 + 3)^2 + 3$
$= \mathbf{-32\frac{1}{2}}$ $[\frac{1}{2}]$
$T_4 = \frac{1}{2} - (4 + 3)^2 + 4$
$= \mathbf{-44\frac{1}{2}}$ $[\frac{1}{2}]$

(b) When $n = p$, $T_p = \frac{1}{2} - (p + 3)^2 + p$
$\frac{1}{2} - (p + 3)^2 + p = \frac{1}{2} - 24^2 + p$
Comparing coefficients:
$p + 3 = 24$
$p = 21$
Substitute $p = 21$ into the equation:
$T_{21} = \frac{1}{2} - (21 + 3)^2 + 21$
$= \mathbf{-554\frac{1}{2}}$ [1]

5. (a) (i) Number of toothpicks added
$T_1 = 3 = 1 \times 3$
$T_2 = 6 = 2 \times 3$
$T_3 = 9 = 3 \times 3$
$\therefore$ General term, $T_n = 3n$ [1]

When $n = 14$,
$T_{14} = 3(14)$
$= 42$
Number of toothpicks added = **42** [1]

(ii) Number of small triangles

$T_1 = 1 = 1^2$

$T_2 = 4 = 2^2$

$T_3 = 9 = 3^2$

$\therefore$ General term, $T_n = n^2$

When $n = 14$,

$T_{14} = 14^2$

$= 196$

Number of small triangles formed = **196** [1]

(b) When $n = x$, $T_x = 3x$

$3x = 69$

$x = 23$

Number of small triangles in figure 23 = 23^2

= **529** [1]

6\. (a) $T_1 = \frac{2 \times 3}{5} = \frac{(1+1)(1+2)}{5+2\times 0}$

$T_2 = \frac{3 \times 4}{7} = \frac{(2+1)(2+2)}{5+2\times 1}$

$T_3 = \frac{4 \times 5}{9} = \frac{(3+1)(3+2)}{5+2\times 2}$

$\therefore$ General term, $T_n = \frac{(n+1)(n+2)}{5+2\times(n-1)}$

$= \frac{(n+1)(n+2)}{5+2n-2}$

$= \mathbf{\frac{(n+1)(n+2)}{3+2n}}$ [1]

(b) When $n = p$, $T_p = \frac{(p+1)(p+2)}{3+2p}$

$\frac{(p+1)(p+2)}{3+2p} = \frac{18(p+2)}{3+2p}$

Comparing coefficients:

$p + 1 = 18$

$p = 17$

Substitute $p = 17$ into the equation:

$T_{17} = \frac{(17+1)(17+2)}{3+2(17)}$

$= \frac{18 \times 19}{37}$

$= \mathbf{9\frac{9}{37}}$ [1]

7\. (a) (i) When $n = 8$,

$T_8 = \frac{(8+1)(8+2)}{2}$

= **45** [1]

(ii) When $n = 22$,

$T_{22} = \frac{(22+1)(22+2)}{2}$

= **276** [1]

(b) When $n = p$, $T_p = \frac{(p+1)(p+2)}{2}$

$\frac{(p+1)(p+2)}{2} = \frac{17(p+1)}{2}$

Comparing coefficients:

$p + 2 = 17$

$p = 15$

Substitute $p = 15$ into the equation:

$T_{15} = \frac{(15+1)(15+2)}{2}$

= **136** [1]

8\. (a) $T_4 = \frac{2 \times 3 \times 4}{6}$

= **4**

$T_5 = \frac{3 \times 4 \times 5}{7}$

$= \mathbf{\frac{60}{7}}$ [1]

(b) $T_1 = \frac{-1 \times 0 \times 1}{3} = \frac{(1-2)\times(1-1)\times 1}{1+2}$

$T_2 = \frac{0 \times 1 \times 2}{4} = \frac{(2-2)\times(2-1)\times 2}{2+2}$

$T_3 = \frac{1 \times 2 \times 3}{5} = \frac{(3-2)\times(3-1)\times 3}{3+2}$

$\therefore$ General term, $T_n = \mathbf{\frac{(n-2)\times(n-1)\times n}{n+2}}$ [1]

(c) When $n = 14$,

$T_{14} = \frac{(14-2)\times(14-1)\times 14}{14+2}$

$= \frac{12 \times 13 \times 14}{16}$

$= \mathbf{\frac{273}{2}}$ [1]

9\. (a)

Set	Number of white beads	Number of black beads	Number of dotted beads	Total number of beads
4	9	4	8	21
5	11	5	10	26

[2]

(b) White beads

$T_1 = 3 = 3 + 0 \times 2$

$T_2 = 5 = 3 + 1 \times 2$

$T_3 = 7 = 3 + 2 \times 2$

$\therefore$ General term, $T_n = 3 + (n-1) \times 2$

$= 3 + 2n - 2$

$= 2n + 1$ [$\frac{1}{2}$]

When $n = 30$,

Number of white beads = 2(30) + 1

= **61** [$\frac{1}{2}$]

<u>Black beads</u>
$T_1 = 1$
$T_2 = 2$
$T_3 = 3$
General term, $T_n = n$ [$\frac{1}{2}$]

When $n = 30$,
Number of black beads = **30** [$\frac{1}{2}$]

<u>Dotted beads</u>
$T_1 = 2 = 1 \times 2$
$T_2 = 4 = 2 \times 2$
$T_3 = 6 = 3 \times 2$
General term, $T_n = 2n$ [$\frac{1}{2}$]

When $n = 30$,
Number of dotted beads $= 2(30)$
$= \mathbf{60}$ [$\frac{1}{2}$]

(c) Total number of beads in each set
$= 2n + 1 + n + 2n$
$= 5n + 1$
When $n = k$,
$5k + 1 = 106$
$5k = 105$
$k = 21$

When $k = 21$,
Number of dotted beads $= 2(21)$
$= \mathbf{42}$ [1]

10. (a)

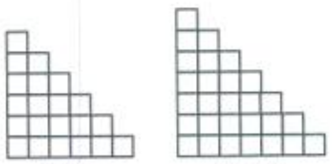


Figure 4 Figure 5 [1]

(b) (i) $p = \frac{(n+2)(n+3)}{2}$ [1]

(ii) $q = 2 \times \left[\frac{(n+2)(n+3)}{2}\right] + 2(n-1)$
$= \mathbf{(n + 2)(n + 3) + 2n - 2}$ [1]

(c) (i) When $n = 15$,
$p = \frac{(15+2)(15+3)}{2}$
$= \mathbf{153}$ [1]

(ii) When $n = 21$,
$q = (21 + 2)(21 + 3) + 2(21) - 2$
$= \mathbf{592}$ [1]

Chapter 7 Percentage

Class Test 1

1. Number of girls = 45% × 320
= 144
Number of boys = 320 − 144
= 176
Number of girls who passed the test = 75% × 144
= 108
Number of boys who passed the test = 50% × 176
= 88
Overall percentage of students who passed the test
$= \frac{108 + 88}{320} \times 100\%$
$= \frac{196}{320} \times 100\%$
= **61.25%** [1]

2. $Q = 40\% \times P$
$= 0.4P$
78% of $P = 0.78P$
117% of $Q = 1.17Q$
$0.78P - 1.17Q = 23.4$ [1]
Substitute $Q = 0.4P$ into the equation:
$0.78P - 1.17(0.4P) = 23.4$
$0.78P - 0.468P = 23.4$
$0.312P = 23.4$
$P = \mathbf{75}$ [1]
$Q = 0.4(75)$
$= \mathbf{30}$ [1]

3. Value of $X = (100\% + 35\%) \times Y$
$= 135\% \times Y$
$= 1.35Y$ [$\frac{1}{2}$]
$X + Y = 141$
$1.35Y + Y = 141$
$2.35Y = 141$
$Y = 60$ [$\frac{1}{2}$]
$X = 141 - 60$
$= \mathbf{81}$ [1]

4. Commission received for the first $25 000
= 3% × $25 000
= $750 [½]
Commission received for the remaining selling price
= $10 288 – $750
= $9538
2% of the remaining selling price ⟶ $9538
100% of the remaining selling price
⟶ $100 \times \frac{\$9538}{2}$
= $476 900 [½]
Selling price of the property = $25 000 + $476 900
= **$501 900** [1]

5. (a) 75% ⟶ 48 items
100% ⟶ $100 \times \frac{48}{75}$
= 64 items
Number of shuttlecocks = 64 [½]
100% ⟶ 48 items
50% ⟶ 48 ÷ 2
= 24 items
Number of squash balls = 24 [½]
Total number of items in the bag
= 48 + 64 + 24
= **136** [1]

(b) Percentage increase in the number of squash balls = $\frac{15}{24} \times 100\%$
= **62.5%** [1]

6. 100% ⟶ $280
(100% + 38% =) 138% ⟶ $138 \times \frac{\$280}{100}$
= $386.40
Total amount of money collected
= $386.40 + $204.40
= $590.80
Profit earned = $590.80 – (2 × $280)
= $30.80 [1]
Required percentage = $\frac{\$30.80}{\$560} \times 100\%$
= **5.5%** [1]

7. (a) (100% + 30% =) 130% ⟶ $5.20
30% ⟶ $30 \times \frac{\$5.20}{130}$
= $1.20
Amount of profit he made = 1560 × $1.20
= **$1872** [1]

(b) (i) Percentage decrease
= $\frac{1560 - 1248}{1560} \times 100\%$
= $\frac{312}{1560} \times 100\%$
= **20%** [1]

(ii) Amount of profit he should earn for each plate = $\frac{\$1872}{1248}$
= $1.50
Cost price of each plate = $5.20 – $1.20
= $4
Selling price of each plate he should have sold at = $4 + $1.50
= **$5.50** [1]

8. (a) After 7% GST
(100% + 7% =) 107% ⟶ $105.93
100% ⟶ $100 \times \frac{\$105.93}{107}$
= $99
After 10% service charge
(100% + 10% =) 110% ⟶ $99
100% ⟶ $100 \times \frac{\$99}{110}$
= $90
Marked price of the meal = **$90** [1]

(b) Final cost of the meal
= (100% – 8%) × $105.93
= 92% × $105.93
= **$97.46** (nearest cent) [1]

9. (a) (100% – 47% =) 53% ⟶ 2862 ml
(65% – 47% =) 18% ⟶ $18 \times \frac{2862}{53}$
= 972 ml
Volume of water used in that hour = **972 ml** [1]

(b) 65% ⟶ $100 \times \frac{972}{18}$
= 3510 ml
Volume of water in the water cooler at 11 a.m.
= 3510 ml
Required percentage = $\frac{972}{3510} \times 100\%$
= **27.7%** (1 d.p.) [1]

10. (a) Discounted price = (100% – 40%) × \$8.50
= 60% × \$8.50
= \$5.10
(100% – 15% =) 85% ⟶ \$5.10
100% ⟶ $100 \times \frac{\$5.10}{85}$
= \$6
Cost price of each book = **\$6** [1]

(b) Loss incurred for each book = \$6 – \$5.10
= \$0.90
Number of books he sold = \$55.80 ÷ \$0.90
= **62** [1]

11. Amount of commission earned = \$1464.82 – \$850
= \$614.82
6% ⟶ \$614.82
100% ⟶ $100 \times \frac{\$614.82}{6}$
= \$10 247
Her sales for that month = **\$10 247** [1]

12. (a) Commission received on the first \$3000
= 2% × \$3000
= \$60 [$\frac{1}{2}$]
Remaining sales after the first \$3000
= \$12 866 – \$3000
= \$9866
Commission received on the remaining sales
= 3.5% × \$9866
= \$345.31 [$\frac{1}{2}$]
Total commission she received
= \$60 + \$345.31
= **\$405.31** [1]

(b) Remaining sales after the first \$3000
= \$14 765 – \$3000
= \$11 765
Commission received on the remaining sales
= 3.5% × \$11 765
= \$411.78 (nearest cent) [$\frac{1}{2}$]
Total commission she received in July
= \$60 + \$411.78
= \$471.78 [$\frac{1}{2}$]
Percentage increase in commission
$= \frac{\$471.78 - \$405.31}{\$405.31} \times 100\%$
$= \frac{\$66.47}{\$405.31} \times 100\%$
= **16.4%** (3 s.f.) [1]

13. (a) Let t be the number of Tamil books in the end.
Number of Malay books in the end
= (100% + 25%) × t
= 125% × t
= $1.25t$
$1.25t + t = 117$
$2.25t = 117$
$t = 52$
Number of Tamil books in the end = 52
(100% + 30% =) 130% ⟶ 52 books
100% ⟶ $100 \times \frac{52}{130}$
= 40 books
Number of Tamil books at first = **40** [1]

(b) 100% ⟶ 40 books
(100% + 20% =) 120% ⟶ $120 \times \frac{40}{100}$
= 48 books
Number of Malay books at first = **48** [1]

(c) Number of Mandarin books at first = 2 × 40
= **80** [1]

14. (a) (100% + 30% =) 130% ⟶ 91 beads
100% ⟶ $100 \times \frac{91}{130}$
= 70 beads
Number of black beads = 70 [$\frac{1}{2}$]
(100% – 20% =) 80% ⟶ $80 \times \frac{70}{100}$
= 56 beads
Number of red beads = 56 [$\frac{1}{2}$]
Total number of beads she has = 91 + 70 + 56
= **217** [1]

(b) Percentage increase $= \frac{70 - 56}{56} \times 100\%$
$= \frac{14}{56} \times 100\%$
= **25%** [1]

15. (a) 100% ⟶ 64 marks
56.25% ⟶ $56.25 \times \frac{64}{100}$
= 36 marks
x = **36** [1]

(b) Total possible marks for all subjects
= 64 + 56 + 60
= 180
100% ⟶ 180 marks
70% ⟶ $70 \times \frac{180}{100}$
= 126 marks
Number of marks he needs to obtain for his Science examination = 126 – 36 – 42
= **48** [1]

Secondary 1 • *Worked Solutions*

Class Test 2

1. After spending on food
(100% – 50% =) 50% ⟶ \$691.20
100% ⟶ 2 × \$691.20
= \$1382.40 [$\frac{1}{2}$]

After spending on transport
(100% – 20% =) 80% ⟶ \$1382.40
100% ⟶ $100 \times \frac{\$1382.40}{80}$
= \$1728 [$\frac{1}{2}$]

At first
(100% – 28% =) 72% ⟶ \$1728
100% ⟶ $100 \times \frac{\$1728}{72}$
= \$2400

Her monthly salary = **\$2400** [1]

2. (a) Percentage scored for English = $\frac{48}{75} \times 100\%$
= 64% [$\frac{1}{2}$]

Percentage scored for Science = $\frac{42}{70} \times 100\%$
= 60% [$\frac{1}{2}$]

Percentage scored for Mathematics
= $\frac{52}{80} \times 100\%$
= 65% [$\frac{1}{2}$]

She scored the highest percentage in **Mathematics**. [$\frac{1}{2}$]

(b) Average percentage scored
= $\frac{64\% + 60\% + 65\%}{3}$
= $\frac{189\%}{3}$
= 63%

She performed **worse** than the average. [1]

3. (a) Selling price of each T-shirt
= (100% + 75%) × \$3.20
= 175% × \$3.20
= **\$5.60** [1]

(b) (i) Sale price = (100% – 20%) × \$3.20
= 80% × \$3.20
= \$2.56

Number of T-shirts he sold at sale price
= 120 – 65
= 55

Total amount he collected
= 65 × \$5.60 + 55 × \$2.56
= \$504.80

Total cost of all the T-shirts = 120 × \$3.20
= \$384

His total profit = \$504.80 – \$384
= **\$120.80** [1]

(ii) Percentage profit = $\frac{\$120.80}{\$384} \times 100\%$
= **31.46%** (2 d.p.) [1]

4. (a) After repaying a loan
(100% – 50% =) 50% ⟶ \$2520
100% ⟶ 2 × \$2520
= \$5040

After buying a new computer
(100% – 30% =) 70% ⟶ \$5040
100% ⟶ $100 \times \frac{\$5040}{70}$
= \$7200

Amount of savings he had at first = **\$7200** [1]

(b) Percentage increase
= $\frac{\$3225.60 - \$2520}{\$2520} \times 100\%$
= $\frac{\$705.60}{\$2520} \times 100\%$
= **28%** [1]

5. (a) Percentage profit = $\frac{\$1122 - \$680}{\$680} \times 100\%$
= $\frac{\$442}{\$680} \times 100\%$
= **65%** [1]

(b) Sale price before GST
= (100% – 15%) × \$1122
= 85% × \$1122
= \$953.70 [$\frac{1}{2}$]

Sale price after GST = (100% + 7%) × \$953.70
= 107% × \$953.70
= **\$1020.46** (nearest cent) [$\frac{1}{2}$]

6. (a) Let the cost price of each raisin bun be \$$x$.

$75\% = \frac{\$1.40 - \$x}{\$x} \times 100\%$

$\frac{75}{100} = \frac{1.4 - x}{x}$

$0.75x = 1.4 - x$

$1.75x = 1.4$

$x = 0.8$

Cost price of each raisin bun = **\$0.80** [1]

(b) Sale price of each raisin bun
= (100% – 15%) × \$1.40
= 85% × \$1.40
= **\$1.19** [1]

(c) (i) Number of raisin buns sold at the original selling price = 65% × 160
= 104

Number of raisin buns sold at the sale price = 160 – 104
= 56

Amount of money collected from selling all the raisin buns
= (104 × $1.40) + (56 × $1.19)
= $212.24

Total cost price of all the raisin buns
= 160 × $0.80
= $128 [1]

Total profit the bakery made from the sale of the raisin buns
= $212.24 – $128
= **$84.24** [1]

(ii) Percentage profit = $\frac{\$84.24}{\$128} \times 100\%$
= **65.8%** (1 d.p.) [1]

7. (a) Amount of commission earned
= $2475.80 – $1200
= $1275.80

2.5% of total sales ⟶ $1275.80

100% of total sales ⟶ $100 \times \frac{\$1275.80}{2.5}$
= $51 032

Total sales he made that month = **$51 032** [1]

(b) New basic monthly salary
= (100% + 15%) × $1200
= 115% × $1200
= $1380

Amount of commission earned
= $2111.60 – $1380
= $731.60 [1]

2.5% of total sales ⟶ $731.60

100% of total sales ⟶ $100 \times \frac{\$731.60}{2.5}$
= $29 264

Percentage decrease in his total sales from the previous month
= $\frac{\$51\,032 - \$29\,264}{\$51\,032} \times 100\%$
= $\frac{\$21768}{\$51032} \times 100\%$
= **42.7%** (1 d.p.) [1]

8. (a) (100% – 36% =) 64% ⟶ 35.2 *l*

(47% – 36% =) 11% ⟶ $11 \times \frac{35.2}{64}$
= 6.05 *l*

Volume of petrol used in 2 hours of driving
= **6.05 *l*** [1]

(b) Cost of 35.2 *l* of petrol = 35.2 × $2.15
= $75.68

Amount of money he paid in the end
= (100% – 25%) × $75.68
= 75% × $75.68
= **$56.76** [1]

9. (a) 60% of the remainder ⟶ $1008

100% of the remainder ⟶ $100 \times \frac{\$1008}{60}$
= $1680 [$\frac{1}{2}$]

(100% – 20% =) 80% of his salary ⟶ $1680

100% of his salary ⟶ $100 \times \frac{\$1680}{60}$
= $2100

Monthly salary in March = **$2100** [$\frac{1}{2}$]

(b) Amount of money he saved in March
= 40% × $1680
= $672

Percentage of his salary he saved in March
= $\frac{\$672}{\$2100} \times 100\%$
= 32% [$\frac{1}{2}$]

Monthly salary in April
= (100% – 15%) × $2100
= 85% × $2100
= $1785 [$\frac{1}{2}$]

Amount of money he saved in April
= 32% × $1785
= **$571.20** [1]

10. (a) Cost price of each apple = $1.80 ÷ 5
= $0.36

Selling price of each apple = $1.35 ÷ 3
= $0.45

Percentage profit of each apple
= $\frac{\$0.45 - \$0.36}{\$0.36} \times 100\%$
= $\frac{\$0.09}{\$0.36} \times 100\%$
= **25%** [1]

(b) (i) Selling price of each apple after discount
$= \$0.81 \div 3$
$= \$0.27$
Percentage discount on the original marked price
$= \frac{\$0.45 - \$0.27}{\$0.45} \times 100\%$
$= \frac{\$0.18}{\$0.45} \times 100\%$
= **40%** [1]

(ii) Number of remaining apples = 240 – 150
= 90
Loss incurred for each apple
= \$0.36 – \$0.27
= \$0.09
Total loss for the remaining apples
= 90 × \$0.09
= **\$8.10** [1]

(c) (i) Profit earned for the first 150 apples
= 150 × \$0.09
= \$13.50
Total profit on all 240 apples
= \$13.50 – \$8.10
= **\$5.40** [1]

(ii) Total cost price of 240 apples
= 240 × \$0.36
= \$86.40
Overall percentage profit
$= \frac{\$5.40}{\$86.40} \times 100\%$
= **6.25%** [1]

Chapter 8 Ratio, Rate And Speed

Class Test 1

1. (a) Volume of petrol the car needs
$= 756 \times \frac{35}{441}$
= **60 *l*** [1]

(b) Distance the car can travel $= 42.5 \times \frac{441}{35}$
= **535.5 km** [1]

2. Amount of interest earned = \$13 056 – \$12 750
= \$306

$\$306 = \frac{(\$12\ 750)(R)\left(\frac{9}{12}\right)}{100}$

$R = \frac{(\$306)(100)}{(\$12\ 750)\left(\frac{9}{12}\right)}$
= 3.2
Bank's interest rate = **3.2%** [1]

3. Amount of Japanese Yen she exchanged for
$= \frac{S\$7392}{S\$1.32} \times ¥100$
= ¥560 000 [1]
Amount of Japanese Yen she had left after the trip
= ¥560 000 – ¥486 000
= ¥74 000
Amount of Singapore dollars she had in the end
$= \frac{¥74\ 000}{¥100} \times S\$1.27$
= **S\$939.80** [1]

4. (a) Her swimming speed $= 3.5 \div \frac{42}{60}$
= **5 km/h** [1]

(b) Time she took to cycle = 15 ÷ 25
$= \frac{3}{5}$ h
= 36 min
Total time she took to complete the biathlon
= 36 + 42
= 78 min
$= \mathbf{1\frac{3}{10}}$ **h** [1]

(c) Total distance she covered in the biathlon
= 15 + 3.5
= 18.5 km
Average speed for the entire biathlon
$= 18.5 \div 1\frac{3}{10}$
= **14.2 km/h** (1 d.p.) [1]

5. (a) The number of tennis balls remained unchanged.
Before 8 : 5 : 11 = 24 : 15 : 33
After 3 : 3 : 5 = 15 : 15 : 25
(24 – 15 =) 9 units ⟶ 9 items [1]
1 unit ⟶ $\frac{9}{9}$
= 1 item
(24 + 15 + 33 =) 72 units ⟶ 72 × 1
= 72 items
Total number of items in the box at first = **72** [1]

(b) 33 units ⟶ 33 × 1
= 33 items
Number of squash balls in the box at first = **33** [1]

6. Amount of interest earned for the first \$5600 over 4 years $= \frac{(\$5600)(3.5)(4)}{100}$
$= \$784$ [$\frac{1}{2}$]
Amount of interest earned for the next \$1200 over $2\frac{1}{2}$ years $= \frac{(\$1200)(3.5)(2.5)}{100}$
$= \$105$ [$\frac{1}{2}$]
Amount of money he will have 4 years after his first deposit = \$5600 + \$1200 + \$784 + \$105
= **\$7689** [1]

7. (a) (i) Cost of 1 kg of rice $= 1 \times \frac{\$1.44}{0.4}$
= **\$3.60** [1]

(ii) Cost of 1 kg of green beans $= 2 \times \frac{\$3.60}{3}$
= \$2.40
Cost of 1.2 kg of green beans
= 1.2 × \$2.40
= **\$2.88** [1]

(b) (i) New cost of 1 kg of rice $= 7 \times \frac{\$2.40}{6}$
= **\$2.80** [1]

(ii) Cost of 5.6 kg of rice = 5.6 × \$2.80
= \$15.68
Cost of 600 g of green beans = \$2.88 ÷ 2
= \$1.44
Total cost = \$15.68 + \$1.44
= **\$17.12** [1]

8. (a) The number of pens remained unchanged.
<u>Before</u> 4 : 6 : 3 = 12 : 18 : 9
<u>After</u> 6 : 5 : 3 = 12 : 10 : 6
(18 – 10 =) 8 units ⟶ 32 items [1]
1 unit ⟶ $\frac{32}{8}$
= 4 items
18 units ⟶ 18 × 4
= 72 items
Number of erasers at first = **72** [1]

(b) Total number of pens = 12 × 4
= 48
Total number of pencils = 9 × 4
= 36
Total amount of money the shopkeeper would collect
= (48 × \$1.20) + (72 × \$0.50) + (36 × \$0.90)
= **\$126** [1]

9. (a) 24 m*l* = 0.024 *l*
Time taken for the container to be emptied
$= \frac{1.48}{0.024}$
$= 61\frac{2}{3}$ min
= **61 min 40 s** [1]

(b) Volume of water leaked in the first 28 minutes
= 28 × 24
= 672 m*l*
Volume of water left in the container
= 1480 – 672
= 808 m*l*
Time taken for the container to be emptied when the second leak happened
= 53 min 15 s – 28 min
= 25 min 15 s
$= 25\frac{1}{4}$ min [1]
Total rate of both leaks $= 808 \div 25\frac{1}{4}$
= 32 m*l*/min
Rate of the second leak = 32 – 24
= **8 m*l*/min** [1]

10. (a) Required ratio = 176 : 96 : 112
= **11 : 6 : 7** [1]

(b) (i) The number of yellow beads remained unchanged.
<u>Before</u> 11 : 6 : 7
<u>After</u> 8 : 9 : 7
7 units ⟶ 112 beads [1]
1 unit ⟶ $\frac{112}{7}$
= 16 beads
(11 – 8 =) 3 units ⟶ 3 × 16
= 48 beads
Number of red beads removed = **48** [1]

(ii) (9 – 6 =) 3 units ⟶ 48 beads
Number of blue beads added = **48** [1]

11. (a) Distance between Wendy's home and the shopping centre = $52 \times \frac{21}{60}$
= **18.2 km** [1]

(b) Total distance of both journeys = 2×18.2
= 36.4 km
Time taken for both journeys = $36.4 \div 56$
= $\frac{13}{20}$ h
= 39 min [1]
Time taken to drive home = $39 - 21$
= **18 min** [1]

12. (a) First part of the journey = $\frac{1}{3} \times 345$
= 115 km
Remaining journey = $345 - 115$
= 230 km
Second part of the journey = $\frac{2}{5} \times 230$
= 92 km [1]
Speed for the second part of the journey
= $92 \div \frac{69}{60}$
= **80 km/h** [1]

(b) Time taken for the first part of the journey
= $115 \div 92$
= $1\frac{1}{4}$ h
Distance travelled for the last part of the journey = $230 - 92$
= 138 km
Time taken for the last part of the journey
= $138 \div 92$
= $1\frac{1}{2}$ h [1]
Total time he took to travel from Singapore to Kuala Lumpur = $1\frac{1}{4} + \frac{69}{60} + 1\frac{1}{2}$
= $3\frac{9}{10}$ h
= **3 h 54 min** [1]

(c) Average speed of the whole journey
= $345 \div 3\frac{9}{10}$
= **88.5 km/h** (1 d.p.) [1]

13. (a) Ratio of boys to girls = 9 : 7
= 54 : 42
Ratio of girls to teachers = 6 : 1
= 42 : 7
(54 − 7 =) 47 units ⟶ 282 people [1]
1 unit ⟶ $\frac{282}{47}$
= 6 people
7 units ⟶ 7×6
= 42 people
Number of teachers in the school = **42** [1]

(b) (54 + 42 =) 96 units ⟶ 96×6
= 576 people
Total number of students = 576
12 parts ⟶ 576 people
1 part ⟶ $\frac{576}{12}$
= 48 people
Number of additional teachers the school need
= $48 - 42$
= **6** [1]

14. (a) Time taken to cycle to the store
= 13 39 − 13 23
= 00 16 h
= 16 min
Distance she cycled to the store = $13.5 \times \frac{16}{60}$
= 3.6 km [1]
Total distance she cycled to and from the store
= 2×3.6
= 7.2 km
Time taken for the whole trip = $7.2 \div 9.6$
= $\frac{3}{4}$ h
= **45 min** [1]

(b) Time taken to cycle back home
= $\frac{3}{4} - \frac{16}{60} - \frac{9}{60}$
= $\frac{1}{3}$ h [1]
Cycling speed on the way home = $3.6 \div \frac{1}{3}$
= **10.8 km/h** [1]

15. (a) Duration from 3.25 p.m. to 5 p.m.
= 17 00 – 15 25
= 01 35 h
= 95 min
Duration from 5 p.m. to 5.45 p.m.
= 17 45 – 17 00
= 00 45 h
= 45 min
Required parking fees
= (95 × \$0.055) + (45 × \$0.08)
= **\$8.83** (nearest cent) [1]

(b) Duration from 7.50 p.m. to 9 p.m. = 21 00 – 19 50
= 01 10 h
= 70 min
Cost of parking fees from 7.50 p.m. to 9 p.m.
= 70 × \$0.08
= \$5.60 [$\frac{1}{2}$]
Remaining parking fees after 9 p.m.
= \$11.06 – \$5.60
= \$5.46
Time parked in the car park after 9 p.m.
= \$5.46 ÷ \$0.035
= 156 min
= 02 36 h [$\frac{1}{2}$]
Time she left the car park = 21 00 + 02 36
= 23 36
= **11.36 p.m.** [1]

Class Test 2

1. (a) (8 – 2 =) 6 units ⟶ 1620 spectators
1 unit ⟶ $\frac{1620}{6}$
= 270 spectators
5 units ⟶ 5 × 270
= 1350 spectators
Number of women at the match = **1350** [1]

(b) (i) 8 units ⟶ 8 × 270
= 2160 spectators
Number of men at the match at first
= 2160
Number of children at the match at first
= 2160 – 1620
= 540 [1]
9 parts ⟶ 2160 spectators
1 part ⟶ $\frac{2160}{9}$
= 240 spectators
3 parts ⟶ 3 × 240
= 720 spectators
Number of additional children who came to the match = 720 – 540
= **180** [1]

(ii) (9 + 7 + 3 =) 19 parts ⟶ 19 × 240
= 4560 spectators
Total number of spectators at the match
= **4560** [1]

2. (a) Total time taken = 15 15 – 09 30
= 05 45 h
= $5\frac{3}{4}$ h
Total distance travelled = 86 × $5\frac{3}{4}$
= 494.5 km [1]
Distance he travelled before reaching the resting stop = $\frac{3}{5}$ × 494.5
= **296.7 km** [1]

(b) Distance he travelled after the resting stop
= 494.5 – 296.7
= 197.8 km
Time he left the resting stop = 12 30 + 00 45
= 13 15
Time taken to travel the second part of his journey = 15 15 – 13 15
= 02 00 h [1]
Average speed for the second part of his journey
= 197.8 ÷ 2
= **98.9 km/h** [1]

3. (a) Total rate of water flow from both taps per minute = 3.7 + 1.8
= 5.5 *l*
Time it takes to fill the tank = 2750 ÷ 5.5
= **500 min** [1]

(b) 3 h 40 min = 220 min
Total rate of water flow from all three taps per minute = 2750 ÷ 220
= 12.5 *l*
Rate of water flow from the third tap
= 12.5 – 5.5
= **7 *l*/min** [1]

4. (a) (i) Cost of 500 g of flour for brand *X*
= 0.5 × $\frac{\$6.60}{1.2}$
= **\$2.75** [1]

(ii) Cost of 500 g of flour for brand *Y*
= 500 × $\frac{\$5.80}{800}$
= **\$3.55** [1]

(b) **Brand X** offers better value for money, as it is cheaper than brand Y. [1]

5. (a) (i) Remaining amount after downpayment
= \$2240 – \$650
= \$1590
Amount of interest = $\frac{(\$1590)(6)(1.5)}{100}$
= \$143.10 [1]
Total amount of money to be paid as instalments = \$1590 + \$143.10
= \$1733.10
Amount of monthly instalment at store A
= \$1733.10 ÷ 18
= **\$96.28** (nearest cent) [1]

(ii) Remaining amount after downpayment
= \$2108 – \$421
= \$1687
Amount of interest = $\frac{(\$1687)(8)(2)}{100}$
= \$269.92 [1]
Total amount of money to be paid as instalments = \$1687 + \$269.92
= \$1956.92
Amount of monthly instalment at store B
= \$1956.92 ÷ (2 × 12)
= **\$81.54** (nearest cent) [1]

(b) Total cost of the television set at store A
= \$2240 + \$143.10
= \$2383.10 [1]
Total cost of the television set at store B
= \$2108 + \$269.92
= \$2377.92
Dylan should purchase the television set from **store B**. [1]

6. Number of cakes baked in the first 6 hours
= $\frac{6}{15}$ × 80
= 32
Number of cakes left to bake = 80 – 32
= 48 [1]
Since 4 chefs would take 15 hours to bake 80 cakes, 6 chefs would take $\left(6 \times \frac{15}{4} =\right)$ 10 hours to bake 80 cakes.
Time 6 chefs took to bake 48 cakes= $\frac{48}{80}$ × 10
= 6 h [1]
Total time all the chefs took to bake 80 cakes
= 6 + 6
= **12 h** [1]

7. (a) Total amount of monthly instalments
= 2 × 12 × \$91.45
= \$2194.80
Total cost of the refrigerator by hire purchase
= \$445 + \$2194.80
= \$2639.80 [1]
Additional amount she paid in total for hire purchase = \$2639.80 – \$2305
= **\$334.80** [1]

(b) Remaining amount after downpayment
= \$2305 – \$445
= \$1860
Amount of interest = \$334.80 [1]
$\$334.80 = \frac{(\$1860)(R)(2)}{100}$
$R = \frac{(\$334.80)(100)}{(\$1860)(2)}$
= 9
Interest rate of the monthly instalments = **9%** [1]

8. (a) Remaining amount of money after downpayment
= 80% × \$7250
= \$5800
Let n be the number of years of monthly instalments to be paid.
Amount of interest = $\frac{(\$5800)(6.5)(n)}{100}$
= \$377n [1]
Total amount to be paid including interest
= \$5800 + \$377n
Total amount of monthly instalments he pays
= n × 12 × \$224.75
= \$2697n [1]
\$5800 + \$377n = \$2697n
2320n = 5800
n = 2.5
Number of months he have to pay his monthly instalments for = 2.5 × 12
= **30** [1]

9. Amount of interest earned for the first \$5200 over 3 years = $\frac{(\$5200)(3)(3)}{100}$
= \$468 [1]
Amount of interest earned for the next \$2800 over 1.5 years = $\frac{(\$2800)(3.5)(1.5)}{100}$
= \$147 [1]
Amount of money he will have in total after 3 years
= \$5200 + \$468 + \$2800 + \$147
= **\$8615** [1]

10. (a) (i) Amount of New Taiwan dollars he received $= \frac{S\$3672.20}{S\$4.27} \times NT\$100$
$= \textbf{NT\$86 000}$ [1]

(ii) Amount of Singapore dollars he had to exchange $= \frac{NT\$12\,000}{NT\$100} \times S\$4.27$
$= \textbf{S\$512.40}$ [1]

(b) Amount of New Taiwan dollars he had left
= NT\$86 000 + NT\$12 000 − NT\$67 000
= NT\$31 000
Amount of Singapore dollars he received
$= \frac{NT\$31\,000}{NT\$100} \times S\$4.15$
$= \textbf{S\$1286.50}$ [1]

Chapter 9 Angles and Parallel Lines

Class Test 1

1. $2x° + 124° = 180°$ (adj. ∠s on a st. line)
$2x = 56$
$x = \mathbf{28}$ [1]
$y° + x° = 180°$ (adj. ∠s on a st. line)
$y + 28 = 180$
$y = \mathbf{152}$ [1]

2. (a) $\angle RMO = 180° - 24° - 90°$ (∠ sum of △)
$= 66°$
$\angle XMS = 180° - 66°$ (adj. ∠s on a st. line)
$= \mathbf{114°}$ [1]

(b) $\angle TMS = \angle RMO$ (vert. opp. ∠s)
$= 66°$
Let $\angle TSM$ be $x°$.
$\angle MTS = 2x°$
$66° + x° + 2x° = 180°$ (∠ sum of △) [1]
$3x = 114$
$x = 38$
$\angle MTS = 2 \times 38°$
$= \mathbf{76°}$ [1]

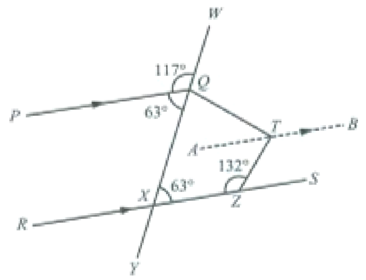
3. (a) $\angle BDE = \angle ABC$ (alt. ∠s, BA // ED)
$= 76°$
$\angle CED = 180° - 84° - 76°$ (∠ sum of △)
$= \mathbf{20°}$ [1]

(b) $\angle BAC = \angle CED$ (alt. ∠s, BA // ED)
$= 20°$
$\angle FAC = 180° - 20°$ (adj. ∠s on a st. line)
$= \mathbf{160°}$ [1]

(c) $\angle DEG = \angle BDE$ (alt. ∠s, EG // BD)
$= 76°$
Reflex $\angle CEG = 360° - 76° - 20°$ (∠s at a pt.)
$= \mathbf{264°}$ [1]

4. (a) $\angle PQX = 180° - 117°$ (adj. ∠s on a st. line)
$= 63°$
$\angle QXZ = \angle PQX$ (alt. ∠s, PQ // XZ)
$= \mathbf{63°}$ [1]

(b) Draw a line through T parallel to PQ and RS.



$\angle XQT = \frac{2}{3} \times 117°$
$= 78°$
$\angle QTA = 180° - 63° - 78°$ (int. ∠s, PQ // AT)
$= 39°$
$\angle ATZ = 180° - 132°$ (int. ∠s, AT // XZ)
$= 48°$ [1]
Reflex $\angle QTZ = 360° - 39° - 48°$ (∠s at a pt.)
$= \mathbf{273°}$ [1]

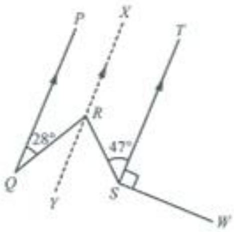
5. (a) Since AB // CD and $MG \perp CD$, $MG \perp AB$.
$\angle FMB = 90°$
$\angle FGN = 180° - 90° - 75°$ (∠ sum of △)
$= \mathbf{15°}$ [1]

(b) $\angle EFG = \angle FGN$ (alt. ∠s, EF // GN)
$= 15°$
$\angle EFM = 180° - 15°$ (adj. ∠s on a st. line)
$= \mathbf{165°}$ [1]

6. $(2a + 6)° + 144° = 180°$ (adj. ∠s on a st. line)
$2a + 150 = 180$
$2a = 30$
$a = \mathbf{15}$ [1]
$(2b + 2)° + (5a + 3)° = 180°$ (adj. ∠s on a st. line)
$2b + 5a + 5 = 180$
$2b + 5(15) + 5 = 180$ [1]
$2b + 80 = 180$
$2b = 100$
$b = \mathbf{50}$ [1]

7. (a) Reflex $\angle RSW = 360° - 47° - 90°$ (∠s at a pt.)
$= \mathbf{223°}$ [1]

(b) Draw a line through R parallel to QP and ST.



$\angle QRY = \angle PQR$ (alt. ∠s, QP // YR)
$= 28°$
$\angle YRS = \angle RST$ (alt. ∠s, YR // ST)
$= 47°$
$\angle QRS = 28° + 47°$
$= \mathbf{75°}$ [1]

8. (a) $\angle QOP = 360° - 276°$ (∠s at a pt.)
$= 84°$
$\angle BPR = \angle QOP$ (corr. ∠s, OQ // PR)
$= 84°$
$\angle GPB = 180° - 84°$ (adj. ∠s on a st. line)
$= \mathbf{96°}$ [1]

(b) $\angle GRQ = \angle EQC$ (corr. ∠s, PR // OQ)
$= 97°$
$\angle QRH = 180° - 97°$ (adj. ∠s on a st. line)
$= \mathbf{83°}$ [1]

9. $\angle RWQ = \angle PWX$ (vert. opp. ∠s)
$= 96°$
$b° + 96° + 27° = 180°$ (∠ sum of △)
$b = \mathbf{57}$ [1]
$\angle YRS = \angle RWQ$ (corr. ∠s, WQ // RS)
$= 96°$
$2a° + a° = 96°$
$3a = 96$
$a = \mathbf{32}$ [1]

10. (a) $\angle CDE = 180° - 131°$ (int. ∠s, AE // CD)
$= 49°$
$\angle EDG = 180° - 49° - 63°$ (adj. ∠s on a st. line)
$= \mathbf{68°}$ [1]

(b) $\angle EDB = 68° \div 2$
$= 34°$
$\angle DBG = \angle EDB$ (alt. ∠s, ED // BG)
$= \mathbf{34°}$ [1]

11. (a) $\angle POC = \angle EPA$ (corr. ∠s, CO // AP)
$= 37°$
$\angle DOF = \angle POC$ (vert. opp. ∠s)
$= \mathbf{37°}$ [1]

(b) $\angle QOC = \angle BQO$ (alt. ∠s, QB // CO)
$= 115°$
$\angle POQ = 115° - 37°$
$= \mathbf{78°}$ [1]

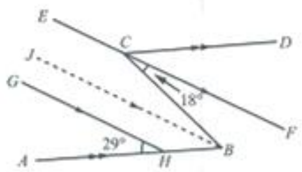
(c) $\angle COH = 180° - 115°$ (adj. ∠s on a st. line)
$= \mathbf{65°}$ [1]

12. (a) $\angle ZRS = 180° - 131°$ (adj. ∠s on a st. line)
$= 49°$
$\angle PZY = \angle ZRS$ (alt. ∠s, PZ // RS)
$= 49°$
Reflex $\angle PZY = 360° - 49°$ (∠s at a pt.)
$= \mathbf{311°}$ [1]

(b) $\angle WQZ = 180° - 49°$ (int. ∠s, WQ // YZ)
$= 131°$
$\angle PQX = \angle WQZ$ (vert. opp. ∠s)
$= \mathbf{131°}$ [1]

13. $38° + (4a + 2)° = 180°$ (adj. ∠s on a st. line)
$4a + 40 = 180$
$4a = 140$
$a = \mathbf{35}$ [1]
$(3a + 8)° + (2b + 7)° = 180°$ (adj. ∠s on a st. line)
$3a + 2b + 15 = 180$
$3a + 2b = 165$
$3(35) + 2b = 165$
$2b = 60$
$b = \mathbf{30}$ [1]

14. (a) Draw a line at B parallel to EF and GH.



$\angle CBJ = \angle FCB$ (alt. ∠s, CF // JB)
$= 18°$
$\angle JBH = \angle GHA$ (corr. ∠s, JB // GH)
$= 29°$
$\angle ABC = 18° + 29°$
$= \mathbf{47°}$ [1]

(b) $\angle BCD = \angle ABC$ (alt. $\angle$s, $CD // AB$)
$= 47°$
$\angle FCD = 47° - 18°$
$= \mathbf{29°}$ [1]

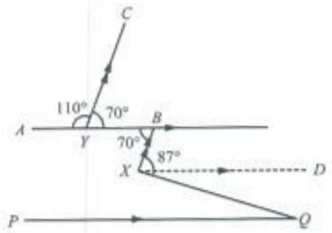
15. (a) $\angle RSX = \angle YST$ (vert. opp. $\angle$s)
$= 78°$
$\angle PQX = \angle RSX$ (corr. $\angle$s, $QP // SR$)
$= \mathbf{78°}$ [1]

(b) $\angle RQS = 180° - 22° - 78°$ ($\angle$ sum of $\triangle$)
$= \mathbf{80°}$ [1]

Class Test 2

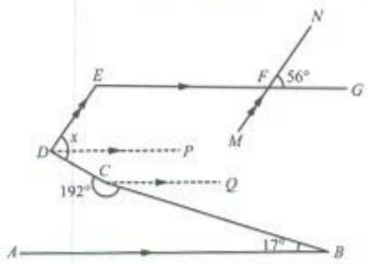
1. (a) $\angle CYB = 180° - 110°$ (adj. $\angle$s on a st. line)
$= 70°$
$\angle ABX = \angle CYB$ (alt. $\angle$s, $YC // XB$)
$= \mathbf{70°}$ [1]

(b) Draw a line parallel to AB and PQ.



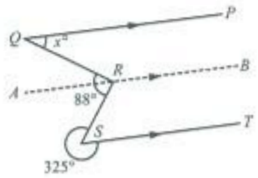
$\angle BXD = \angle YBX$ (alt. $\angle$s, $AB // XD$)
$= 70°$
$\angle DXQ = 87° - 70°$
$= 17°$ [1]
$\angle PQX = \angle DXQ$ (alt. $\angle$s, $XD // PQ$)
$= 17°$
Reflex $\angle PQX = 360° - 17°$ ($\angle$s at a pt.)
$= \mathbf{343°}$ [1]

2. (a) Draw lines at C and D parallel to EG and AB.



$\angle EFM = \angle NFG$ (vert. opp. $\angle$s)
$= 56°$
$\angle FED = 180° - 56°$ (int. $\angle$s, $DE // MF$)
$= 124°$ [1]
$\angle EDP = 180° - 124°$ (int. $\angle$s, $EF // DP$)
$= 56°$
$\angle BCQ = \angle ABC$ (alt. $\angle$s, $CQ // AB$)
$= 17°$
$\angle DCQ = 360° - 192° - 17°$ ($\angle$s at a pt.)
$= 151°$
$\angle CDP = 180° - 151°$ (int. $\angle$s, $DP // CQ$)
$= 29°$
$x° = 56° + 29°$
$x = \mathbf{85}$ [1]

(b) Draw a line through point R parallel to QP and ST.



$\angle RST = 360° - 325°$ ($\angle$s at a pt.)
$= 35°$
$\angle ARS = \angle RST$ (alt. $\angle$s, $AR // ST$)
$= 35°$ [1]
$\angle ARQ = 88° - 35°$
$= 53°$
$\angle PQR = \angle ARQ$ (alt. $\angle$s, $QP // AB$)
$x° = 53°$
$x = \mathbf{53}$ [1]

3. (a) $\angle ABG = 180° - 48°$ (adj. $\angle$s on a st. line)
$= 132°$
$\angle BGM = \angle ABG$ (alt. $\angle$s, $GM // AB$)
$= \mathbf{132°}$ [1]

(b) $\angle BNP = 360° - 220°$ ($\angle$s at a pt.)
$= 140°$
$\angle FBG = 180° - 140°$ (int. $\angle$s, $BG // NP$)
$= 40°$ [1]
$\angle FGB = 180° - 132°$ (adj. $\angle$s on a st. line)
$= 48°$
$\angle BFG = 180° - 40° - 48°$ ($\angle$ sum of $\triangle$)
$= 92°$
$\angle NFG = 180° - 92°$ (adj. $\angle$s on a st. line)
$= \mathbf{88°}$ [1]

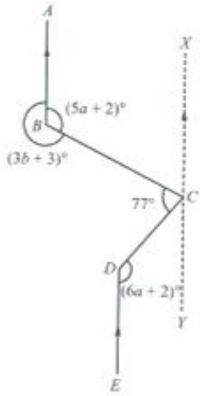
Secondary 1 • *Worked Solutions*

4. (a) $\angle BGD = 180° - 121°$ (adj. ∠s on a st. line)
$= 59°$
$\angle ABE = \angle BGD$ (alt. ∠s, $BA // DG$)
$= \mathbf{59°}$ [1]

(b) $\angle GDF = 180° - 121°$ (int. ∠s, $GE // DF$)
$= 59°$
$\angle GDB = 360° - 232° - 59°$ (∠s at a pt.)
$= \mathbf{69°}$ [1]

(c) $\angle GBD = 180° - 59° - 69°$ (∠ sum of △)
$= \mathbf{52°}$ [1]

5. Draw a line through C parallel to BA and ED.

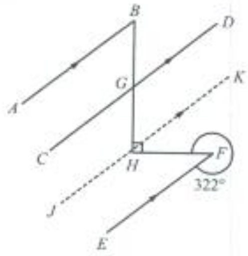


$\angle BCX = 180° - (5a + 2)°$ (int. ∠s, $BA // CX$)
$= (178 - 5a)°$
$\angle DCY = 180° - (6a + 2)°$ (int. ∠s, $ED // YC$)
$= (178 - 6a)°$
$(178 - 5a)° + 77° + (178 - 6a)° = 180°$ (adj. ∠s on a st. line) [1]

$433 - 11a = 180$
$11a = 253$
$a = \mathbf{23}$ [1]

$(3b + 3)° + (5a + 2)° = 360°$ (∠s at a pt.) [1]
$3b + 5a + 5 = 360$
$3b + 5a = 355$
$3b + 5(23) = 355$
$3b = 240$
$b = \mathbf{80}$ [1]

6. (a) Draw a line through H parallel to AB, CD and EF.



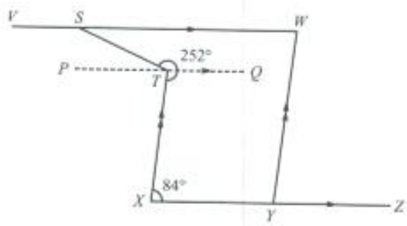
$\angle HFE = 360° - 322°$ (∠s at a pt.)
$= 38°$
$\angle KHF = \angle HFE$ (alt. ∠s, $HK // EF$)
$= 38°$ [1]
$\angle GHK = 90° - 38°$
$= 52°$
$\angle DGH = 180° - 52°$ (int. ∠s, $GD // HK$)
$= \mathbf{128°}$ [1]

(b) $\angle BGC = \angle DGH$ (vert. opp. ∠s)
$= 128°$
$\angle ABG = 180° - 128°$ (int. ∠s, $AB // CG$)
$= \mathbf{52°}$ [1]

7. (a) $\angle BCO = 180° - 118°$ (adj. ∠s on a st. line)
$= 62°$
$\angle ABC = \angle BCO$ (alt. ∠s, $AB // CO$)
$= \mathbf{62°}$ [1]

(b) $\angle ABO = \angle BOD$ (alt. ∠s, $AB // OD$)
$= 95°$
$\angle CBG = 95° - 62°$
$= 33°$
$\angle BGH = \angle CBG$ (alt. ∠s, $CB // GH$)
$= \mathbf{33°}$ [1]

8. (a) Draw a line through T parallel to VW and XZ.



$\angle XTQ = 180° - 84°$ (int. ∠s, $TQ // XY$)
$= 96°$
$\angle STQ = 252° - 96°$
$= 156°$
$\angle VST = \angle STQ$ (alt. ∠s, $VS // TQ$)
$= \mathbf{156°}$ [1]

(b) $\angle WYZ = \angle TXY$ (corr. ∠s, $XT // YW$)
$= 84°$
$\angle SWY = \angle WYZ$ (alt. ∠s, $SW // YZ$)
$= \mathbf{84°}$ [1]

9. (a) $\angle GPB = 180° - 28°$ (adj. ∠s on a st. line)
$= 152°$
$\angle GCR = \angle GPB$ (corr. ∠s, $PB // CR$)
$= \mathbf{152°}$ [1]

(b) $\angle OPQ = \angle HPB$ (vert. opp. ∠s)
$= 28°$
$\angle OQP = 180° - 71° - 28°$ (∠ sum of △)
$= 81°$ [1]
$\angle OQC = 180° - 81°$ (adj. ∠s on a st. line)
$= \mathbf{99°}$ [1]

10. (a) $\angle RWX = 180° - 24° - 87°$ (∠ sum of △)
$= 69°$
$\angle QWV = 180° - 69°$ (adj. ∠s on a st. line)
$= \mathbf{111°}$ [1]

(b) $\angle TQX = 180° - 87°$ (int. ∠s, $TQ // RX$)
$= 93°$
$\angle VTP = \angle WQT$ (corr. ∠s, $VT // WQ$)
$= \mathbf{93°}$ [1]

(c) Reflex $\angle WQT = 360° - 93°$ (∠s at a pt.)
$= \mathbf{267°}$ [1]

Chapter 10 Triangles, Quadrilaterals and Polygons

Class Test 1

1. (a) $\angle ADE = (180° - 28°) \div 2$ (base ∠s of isos. △)
$= \mathbf{76°}$ [1]

(b) $\angle AED = \angle ADE$ (base ∠s of isos. △)
$= 76°$
$\angle AEC = 180° - 76°$ (adj. ∠s on a st. line)
$= \mathbf{104°}$ [1]

(c) $\angle BAE = 180° - 104°$ (int. ∠s, $AB // EC$)
$= \mathbf{76°}$ [1]

2. (a) $\angle VPT = \angle TRS$ (alt. ∠s, $PV // SR$)
$= 34°$
$\angle PTV = 180° - 105°$ (adj. ∠s on a st. line)
$= 75°$ [1]
$\angle PVT = 180° - 34° - 75°$ (∠ sum of △)
$= \mathbf{71°}$ [1]

(b) $\angle VPQ = 180° - 71°$ (int. ∠s, $PQ // VS$)
$= 109°$
$\angle PQY = \angle VPQ$ (alt. ∠s, $PV // YQ$)
$= \mathbf{109°}$ [1]

3. (a) Since $PQRSTU$ is part of a regular polygon,
$\angle STU = \angle QRS$
$= 162°$
$\angle VWT = \angle STU$ (corr. ∠s, $VW // ST$)
$= \mathbf{162°}$ [1]

(b) $(n - 2) \times 180° = n \times 162°$ (∠ sum of polygon)
$180°n - 360° = 162°n$
$18°n = 360°$
$n = \mathbf{20}$ [1]

4. (a) $\angle TWV = 112° - 90°$ (ext. ∠ of △)
$= \mathbf{22°}$ [1]

(b) $\angle VWS = 180° - 112°$ (int. ∠s, $VQ // WS$)
$= 68°$
$\angle VXY = 68° + 36°$ (ext. ∠ of △)
$= \mathbf{104°}$ [1]

Secondary 1 • Worked Solutions

5. (a) $\angle BCE = 180° - 112°$ (int. ∠s, GB // EC)
$= 68°$
$\angle CEF = \angle BCE$ (alt. ∠ s, BC // EF)
$= 68°$
$\angle CEH = 180° - 68° - 45°$ (adj. ∠ s on a st. line)
$= \mathbf{67°}$ [1]

(b) $\angle ABG = 180° - 112°$ (adj. ∠s on a st. line)
$= 68°$
$\angle BAG = \angle ABG$ (base ∠s of isos. △)
$= 68°$
$\angle GDE = 180° - 68°$ (int. ∠s, AC // DF)
$= \mathbf{112°}$ [1]

6. (a) $\angle RTW = 60°$ (∠s of equil. △)
$\angle QTR = 180° - 90° - 42°$ (∠ sum of △)
$= 48°$
$\angle STQ = 180° - 60° - 48°$ (adj. ∠s on a st. line)
$= \mathbf{72°}$ [1]

(b) $\angle RTV = \angle TRQ$ (alt. ∠s, VT // RQ)
$= 42°$
$\angle VTW = 60° - 42°$
$= \mathbf{18°}$ [1]

7. (a) $\angle CAF = 180° - 47° - 71°$ (∠ sum of △)
$= \mathbf{62°}$ [1]

(b) $\angle EFG = \angle AFC$ (vert. opp. ∠s)
$= 71°$
$\angle EAB = \angle EFG$ (corr. ∠s, AB // FD)
$= 71°$ [1]
$\angle ABG = \angle EAB$ (base ∠s of isos. △)
$= 71°$
$\angle BGD = \angle ABG$ (alt. ∠s, AB // GD)
$= \mathbf{71°}$ [1]

8. (a) $\angle XYW = 180° - 101° - 37°$ (int. ∠s, XY // PQ)
$= \mathbf{42°}$ [1]

(b) $\angle XYZ = 42° + 37°$
$= 79°$
$\angle RZY = \angle XYZ$ (alt. ∠s, XY // ZR)
$= \mathbf{79°}$ [1]

9. (a) $\angle RQX = 180° - 116°$ (adj. ∠s on a st. line)
$= 64°$
$\angle QXR = 180° - 132°$ (adj. ∠s on a st. line)
$= 48°$
$\angle QRX = 180° - 64° - 48°$ (∠ sum of △)
$= \mathbf{68°}$ [1]

(b) $\angle RYZ = \angle QRY$ (alt. ∠s, QR // YZ)
$= 68°$
$\angle YZW = \angle RYZ$ (alt. ∠s, WZ // YR)
$= \mathbf{68°}$ [1]

10. (a) $\angle PRQ = 60°$ (∠s of equil. △)
$\angle SVR = 180° - 60°$ (int. ∠s, VS // RX)
$= \mathbf{120°}$ [1]

(b) $\angle PXS = \angle PRQ$ (corr. ∠s, SX // QR)
$= 60°$
Reflex $\angle PXT = 60° + 180°$
$= \mathbf{240°}$ [1]

11. (a) $\angle EOF = \angle HEO$ (alt. ∠s, HE // OF)
$= 82°$
$\angle OEF = (180° - 82°) \div 2$ (base ∠s of isos. △)
$= 49°$
$\angle AEF = 180° - 82° - 49°$ (adj. ∠s on a st. line)
$= \mathbf{49°}$ [1]

(b) $\angle EFO = \angle OEF$ (base ∠s of isos. △)
$= 49°$
$\angle ODF = 180° - 49° - 49° - 37°$ (∠ sum of △)
$= \mathbf{45°}$ [1]

12. (a) $\angle CGE = \angle FGB$ (vert. opp. ∠s)
$= 87°$
$\angle GED = 40° + 87°$ (ext. ∠ of △)
$= \mathbf{127°}$ [1]

(b) $\angle BDC = 180° - 127°$ (int. ∠s, BD // GE)
$= 53°$
Reflex $\angle BDC = 360° - 53°$ (∠s at a pt.)
$= \mathbf{307°}$ [1]

13. $\angle ECB = 180° - 118°$ (int. ∠s, FE // BC)
$= 62°$
$(4x + 2)° + (3x + 4)° + 62° = 180°$ (∠ sum of △) [1]
$7x + 68 = 180$
$7x = 112$
$x = \mathbf{16}$ [1]

$(6x - 2)° + 2y + 62° = 180°$ (int. ∠s, ED // BC) [1]
$6x + 2y + 60 = 180$
$6(16) + 2y + 60 = 180$
$2y + 156 = 180$
$2y = 24$
y = **12** [1]

14. ∠BCE = ∠ADE (corr. ∠s, BC // AD)
= 32° [1]
∠KGC = ∠GCE (alt. ∠s, GK // EC)
= 32°
∠KJG = 121° – 32° (ext. ∠ of △)
= **89°** [1]

15. ∠VSR = 180° – 58° – 90° (∠ sum of △)
= 32° [1]
∠SVR = ∠VSR (base ∠s of isos. △)
= 32°
∠VRW = 58° – 32° (ext. ∠ of △)
= **26°** [1]

Class Test 2

1. (a) ∠AKG = 180° – 48° (int. ∠s, AB // EF)
= 132°
∠KGB = ∠JGH (vert. opp. ∠s)
= 87°
∠KBG = 132° – 87° (ext. ∠ of △)
= **45°** [1]

(b) ∠GHC = ∠HFE (corr. ∠s, CH // EF)
= 48°
∠JCH = 180° – 48° (int. ∠s, JC // GH)
= 132°
Reflex ∠JCH = 360° – 132° (∠s at a pt.)
= **228°** [1]

2. (a) ∠BAE = 180° – 72° – 36° (∠ sum of △)
= **72°** [1]

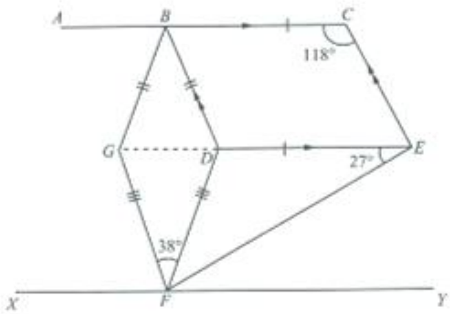
(b) Sum of interior angles of a pentagon
= (5 – 2) × 180°
= 540°
∠FEC = 540° ÷ 5
= 108° [1]
∠HFE = (180° – 108°) ÷ 2 (base ∠s of isos. △)
= **36°** [1]

(c) ∠BDE = 180° – 108° (int. ∠s, AB // ED)
= **72°** [1]

3. (a) ∠TSY = (180° – 40°) ÷ 2 (base ∠s of isos. △)
= 70°
∠RSY = 90° (rt. ∠ of rectangle)
∠RST = 70° + 90°
= 160° [1]
$(n - 2) \times 180° = n \times 160°$ (∠ sum of polygon)
$180°n - 360° = 160°n$
$20°n = 360°$
n = **18** [1]

(b) ∠ZUV = 180° – 160° (adj. ∠s on a st. line)
= **20°** [1]

4. Draw a straight line extending from ED to G.



(a) ∠BDE = ∠BCE (opp. ∠s of parallelogram)
= 118°
∠BDG = 180° – 118° (adj. ∠s on a st. line)
= 62°
∠BGD = ∠BDG (base ∠s of isos. △)
= 62°
∠FGD = (180° – 38°) ÷ 2 (base ∠s of isos. △)
= 71° [1]
∠BGF = 62° + 71°
= **133°** [1]

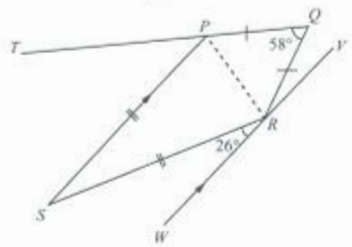
(b) ∠GDF = ∠FGD (base ∠s of isos. △)
= 71°
∠EDF = 180° – 71° (adj. ∠s on a st. line)
= **109°** [1]

(c) ∠DFE = 180° – 109° – 27° (∠ sum of △)
= **44°** [1]

Secondary 1 • Worked Solutions

5. $\angle EBF = \angle FEB$ (base $\angle$s of isos. $\triangle$)
$= x°$
$x° + x° + (5x - 9)° = 180°$ ($\angle$ sum of $\triangle$)
$7x - 9 = 180$
$7x = 189$
$x = \mathbf{27}$ [1]
$\angle BDC = \angle ABD$ (alt. $\angle$s, $AB // DC$)
$= (3y + 4)°$
$x° + (3y + 4)° + (6y + 5)° = 180°$ ($\angle$ sum of $\triangle$) [1]
$x + 9y + 9 = 180$
$27 + 9y + 9 = 180$
$9y = 144$
$y = \mathbf{16}$ [1]
$z° = 58° + (3y + 4)°$ (ext. $\angle$ of $\triangle$)
$z = 62 + 3y$
$= 62 + 3(16)$
$= \mathbf{110}$ [1]

6. Draw a line connecting P and R.



(a) $\angle PSR = \angle SRW$ (alt. $\angle$s, $SP // WR$)
$= 26°$
$\angle SPR = (180° - 26°) \div 2$ (base $\angle$s of isos $\triangle$)
$= 77°$
$\angle QPR = (180° - 58°) \div 2$ (base $\angle$s of isos $\triangle$)
$= 61°$ [1]
$\angle SPT = 180° - 77° - 61°$ (adj. $\angle$s on a st. line)
$= \mathbf{42°}$ [1]

(b) $\angle QRP = \angle QPR$ (base $\angle$s of isos. $\triangle$)
$= 61°$
$\angle PRS = \angle SPR$ (base $\angle$s of isos. $\triangle$)
$= 77°$
$\angle SRQ = 61° + 77°$
$= 138°$
$\angle QRV = 180° - 138° - 26°$ (adj. $\angle$s on a st. line)
$= \mathbf{16°}$ [1]

7. (a) $n = 360° \div 15°$ (sum of ext. $\angle$s of polygon)
$= \mathbf{24}$ [1]

(b) $\angle XOY = 360° \div 24$ ($\angle$s at a pt.)
$= \mathbf{15°}$ [1]

(c) $\angle XYO = (180° - 15°) \div 2$ (base $\angle$s of isos. $\triangle$)
$= 82.5°$
$\angle OYZ = 180° - 82.5° - 15°$ (adj. $\angle$s on a st. line)
$= \mathbf{82.5°}$ [1]

8. (a) $\angle SRT = \angle RST$ (base $\angle$s of isos. $\triangle$)
$= 36°$ [1]
$\angle RTS = 180° - 36° - 36°$ ($\angle$ sum of $\triangle$)
$= 108°$
$\angle VTX = 108° - 90°$
$= \mathbf{18°}$ [1]

(b) $\angle PRS = \angle RST$ (alt. $\angle$s, $RP // XS$)
$= 36°$
$\angle XQT = 180° - 90° - 36°$ ($\angle$ sum of $\triangle$)
$= \mathbf{54°}$ [1]

9. (a) Sum of interior angles in a regular hexagon
$= (6 - 2) \times 180°$
$= 720°$ [1]
$\angle QPV = 720° \div 6$ (int. $\angle$s of regular hexagon)
$= 120°$
$\angle PQV = (180° - 120°) \div 2$ (base $\angle$s of isos. $\triangle$)
$= \mathbf{30°}$ [1]

(b) $\angle WRS = \angle WSR$
$= 360° \div 6$ (ext. $\angle$s of regular hexagon)
$= 60°$
$\angle RWS = 180° - 60° - 60°$ ($\angle$ sum of $\triangle$)
$= \mathbf{60°}$ [1]

(c) Since each interior angle in $\triangle RWS$ is 60°, $\triangle RWS$ is an **equilateral triangle**. [1]

10. (a) $\angle ADC = \angle ABC$ (opp. $\angle$s of parallelogram)
$= 52°$
$\angle DAC = 180° - 81° - 52°$ ($\angle$ sum of $\triangle$)
$= \mathbf{47°}$ [1]

(b) (i) $\angle AEC = 180° - 128°$ (adj. $\angle$s on a st. line)
$= 52°$
$\angle CAE = 81° - 52°$ (ext. $\angle$ of $\triangle$)
$= \mathbf{29°}$ [1]

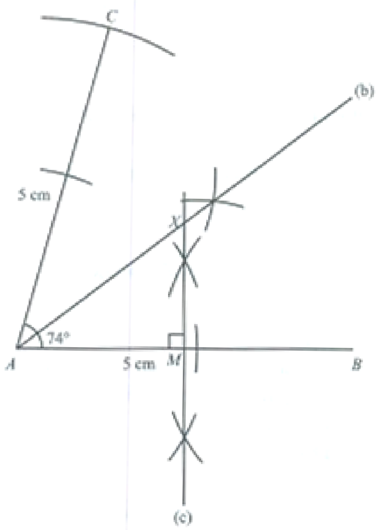
(ii) $\angle DAE = 47° + 29°$
$= 76°$
$\angle AFB = \angle DAF$ (alt. $\angle$s, $DA // FB$)
$= 76°$ [1]

(c) $\angle ABF = \angle ECF$ (alt. $\angle$s, $AB // CE$)
$\angle BAF = \angle CEF$ (alt. $\angle$s, $AB // CE$)
$\angle AFB = \angle EFC$ (vert. opp. $\angle$s) [1]
Therefore, the interior angles of $\triangle ABF$ and $\triangle ECF$ are equal. (proven) [1]

Chapter 11 Geometrical Constructions

Class Test 1

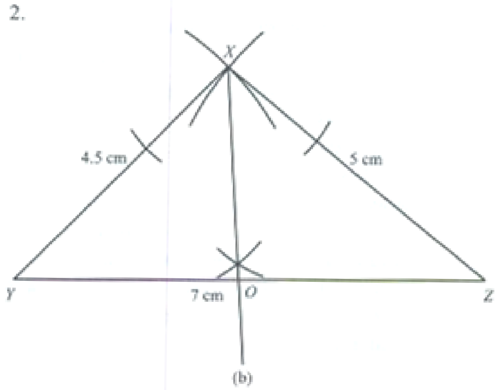
1. (a), (b)



[3]

(c) $XM = 1.8$ cm [1]

2.



[2]

(a) $\angle XYZ = 45°$ [1]
(c) $OX = 3.2$ cm [1]

3. Refer to Appendix 12.
(b) (i) $\angle XPY = 103°$ [1]
(ii) $PX = 5$ cm [1]

4. Refer to Appendix 14.
(b) (i) $\angle MSN = 67°$ [1]
(ii) $SN = 4.5$ cm [1]

5. Refer to Appendix 16.
(b) (i) $QX = 6.1$ cm [1]
(ii) $\angle QXM = 35°$ [1]

6. Refer to Appendix 22.
(a) $\angle ONM = 40°$ [1]
(b) $OQ = 6.1$ cm [1]

7. Refer to Appendix 24.
(a) $PR = 8.6$ cm [1]
(b) $RS = 5.9$ cm [1]

8. Refer to Appendix 29.
(b) (i) $BD = 4.1$ cm [1]
(ii) $\angle DBA = 52°$ [1]

9. Refer to Appendix 30.
(a) $PR = 12.9$ cm [1]
(c) (i) $MN = 6$ cm [1]
(ii) $\angle MNQ = 45°$ [1]

10. Refer to Appendix 37.
(c) (i) $\angle ADX = 68°$ [1]
(ii) $DX = 2.9$ cm [1]

11. Refer to Appendix 34.
(c) (i) $QR = 7.1$ cm [1]
(ii) $QM = 3.1$ cm
Area of $\triangle RQM = \frac{1}{2} \times 3.1 \times 7.1$
$= 11.005 \text{ cm}^2$ [1]

12. Refer to Appendix 25.
(a) $BC = 6.2$ cm [1]
(b) (i) $\angle CEB = 61°$ [1]
(ii) $CE = 6$ cm [1]

Class Test 2

1. Refer to Appendix 11.
   (a) $ABCD$ is a **trapezium**. [1]
   (b) (i) CD = **10.5 cm** [1]
   (ii) $\angle ADC$ = **59°** [1]

2. Refer to Appendix 18.
   (d) (i) PQ = **11.7 cm** [1]
   (ii) $\angle QNM$ = **45°** [1]
   (iii) $\angle MNP$ = **70°** [1]
   (e) $PNQM$ is a **kite**. [1]

3. Refer to Appendix 19.
   (a) XY = **6.3 cm** [1]
   (b) MN = **5.8 cm** [1]

4. Refer to Appendix 21.
   (a) OD = **1.8 cm** [1]
   (b) $AO = 7.3 \div 2$
   $= 3.65$ cm [1]
   Area of $\triangle AOD = \frac{1}{2} \times 3.65 \times 1.8$
   $=$ **3.285 cm²** [1]

5. Refer to Appendix 23.
   EF = **5.6 cm** [1]

6. Refer to Appendix 27.
   (b) (i) AC = **4.5 cm** [1]
   BC = **3.9 cm** [1]
   (ii) $\angle ACB$ = **118°** [1]

7. Refer to Appendix 31.
   (b) (i) $\angle MAF$ = **57°** [1]
   (ii) MF = **5.7 cm** [1]

8. Refer to Appendix 35.
   (a) BC = **8.3 cm** [1]
   (b) (i) $\angle CEB$ = **90°** [1]
   (ii) CE = **4.2 cm** [1]

9. Refer to Appendix 39.
   (a) AC = **13.5 cm** [1]
   (b) (i) DE = **2 cm** [1]
   (ii) DC = 4 cm
   Area of $\triangle CDE = \frac{1}{2} \times 4 \times 2$ [1]
   $=$ **4 cm²** [1]

10. Refer to Appendix 38.
   (a) ON = **6.5 cm** [1]
   (b) $\angle NOM$ = **63°** [1]

Chapter 12 Perimeter and Area of Plane Figures

Class Test 1

1. $PS = QR = (40 - 8 - 8) \div 2$
   $= 24 \div 2$
   $= 12$ cm
   Area of the parallelogram $= SR \times a$
   $= (8 \times a)$ cm²
   $8 \times a = 72$
   a = **9** [1]
   Area of the parallelogram $= QR \times b$
   $= (12 \times b)$ cm²
   $12 \times b = 72$
   b = **6** [1]

2. (a) Radius of the larger semicircle
   $= (14 + 5 + 5) \div 2$
   $= 24 \div 2$
   $= 12$ m
   Radius of the smaller semicircle $= 14 \div 2$
   $= 7$ m
   Arc length of the larger semicircle
   $= \frac{1}{2} \times 2 \times \pi \times 12$
   $= 12\pi$ m [1]
   Arc length of the smaller semicircle
   $= \frac{1}{2} \times 2 \times \pi \times 7$
   $= 7\pi$ m [1]
   Total inner and outer perimeter of the track
   $= (2 \times 12\pi) + (2 \times 7\pi) + (4 \times 32)$
   $= 24\pi + 14\pi + 128$
   $=$ **247 m** (3 s.f.) [1]

   (b) Area of the rectangular field $= 75 \times 35$
   $= 2625$ m²
   Area of the larger semicircle $= \frac{1}{2} \times \pi \times 12^2$
   $= 72\pi$ m²
   Area of the smaller semicircle $= \frac{1}{2} \times \pi \times 7^2$
   $= 24.5\pi$ m² [1]
   Area of the medium rectangle
   $= 32 \times (14 + 5 + 5)$
   $= 32 \times 24$
   $= 768$ m²
   Area of the small rectangle $= 32 \times 14$
   $= 448$ m² [1]
   Area of the region covered with grass
   $= 2625 - (2 \times 72\pi) - 768 + (2 \times 24.5\pi) + 448$
   $= 2625 - 144\pi - 768 + 49\pi + 448$
   $=$ **2010 m²** (3 s.f.) [1]

3. $WP = PV = VT = 9 \div 3$
$= 3$ cm
$RT = 2 \times 3$
$= 6$ cm
$ZR = 11 - 6$
$= 5$ cm
$OZ = 9 \div 2$
$= 4.5$ cm
Area of $\triangle YZR = \frac{1}{2} \times 5 \times 4.5$
$= 11.25$ cm^2
Area of trapezium $RXWT$
$= \frac{1}{2} \times (11 + 6) \times 9$
$= \frac{1}{2} \times 17 \times 9$
$= 76.5$ cm^2 [1]
Area of $\triangle VST = \frac{1}{2} \times 3 \times 3$
$= 4.5$ cm^2
Area of quadrant $PQRT = \frac{1}{4} \times \pi \times 6^2$
$= 9\pi$ cm^2 [1]
Area of the shaded region
$= 11.25 + 76.5 - 9\pi + 4.5$
$=$ **64.0 cm^2** (3 s.f.) [1]

4. (a) $CD = \frac{3}{4} \times 12$
$= 9$ cm
Area of $\triangle BCD = \frac{1}{2} \times 9 \times h$
$= 4.5h$ cm^2
Area of rhombus $ABDE = 12 \times h$
$= 12h$ cm^2
Area of figure $ABCDE = 4.5h + 12h$
$= 16.5h$ cm^2
$16.5h = 194.7$ [1]
$h =$ **11.8** [1]

(b) Area of $\triangle BDE = \frac{1}{2} \times 12 \times 11.8$
$= 70.8$ cm^2
If BE is the base of $\triangle BDE$, FD is the height.
$\frac{1}{2} \times 15 \times x = 70.8$ [1]
$x =$ **9.44** [1]

(c) Area of the shaded region $= 194.7 - 70.8$
$=$ **123.9 cm^2** [1]

5. (a) If BC is the base of $\triangle ABC$,
Height of $\triangle ABC = BD$
$\frac{1}{2} \times 6 \times BD = 21$
$BD = 7$ cm [1]
$BE = 7 \div 2$
$= 3.5$ cm
Area of $\triangle BEC = \frac{1}{2} \times 6 \times 3.5$
$=$ **10.5 cm^2** [1]

(b) If BC is the base of $\triangle BCD$,
Height of $\triangle BCD = BD$
Area of $\triangle BCD =$ area of $\triangle ABC$
$= 21$ cm^2
Area of $\triangle ECD =$ area of $\triangle ABE$
$= 21 - 10.5$
$= 10.5$ cm^2
Area of the shaded region $= 2 \times 10.5$
$=$ **21 cm^2** [1]

6. (a) Area of square $ABCD = 8 \times 8$
$= 64$ cm^2
Area of $\triangle ADE = \frac{1}{2} \times x \times 8$
$= 4x$ cm^2
$64 + 4x = 84$ [1]
$4x = 20$
$x =$ **5** [1]

(b) $EC = 8 + 5$
$= 13$ cm [1]
$EF = 8$ cm
$CF = 13 - 8$
$=$ **5 cm** [1]

(c) $DF = 8 - 5$
$= 3$ cm
Area of trapezium $ABFD$
$= \frac{1}{2} \times (3 + 8) \times 8$
$= \frac{1}{2} \times 11 \times 8$
$=$ **44 cm^2** [1]

7. $AX = XY = YZ = 15 \div 3$
$= 5$ cm
$BH = \frac{1}{3} \times 12$
$= 4$ cm
$FB = 2 \times 5$
$= 10$ cm
Area of $\triangle ACB = \frac{1}{2} \times 12 \times 15$
$= 90$ cm^2 [$\frac{1}{2}$]
Area of $\triangle EFB = \frac{1}{2} \times 4 \times 10$
$= 20$ cm^2
Area of $\triangle BHG = \frac{1}{2} \times 4 \times 5$
$= 10$ cm^2 [$\frac{1}{2}$]
Area of the entire figure
$= 90 + 20 + 10$
$=$ **120 cm^2** [1]

8. Radius of semicircle $ABC = 24 \div 2$
$= 12$ cm
Area of semicircle $ABC = \frac{1}{2} \times \frac{22}{7} \times 12^2$
$= 226\frac{2}{7}$ cm^2 [$\frac{1}{2}$]
Area of $\triangle ACD = \frac{1}{2} \times 24 \times 9$
$= 108$ cm^2 [$\frac{1}{2}$]
Area of $\triangle ABC = \frac{1}{2} \times 24 \times 8$
$= 96$ cm^2
Area of the shaded region
$= 226\frac{2}{7} + 108 - 96$
$=$ **$238\frac{2}{7}$ cm^2** [1]

9. (a) Area of parallelogram $ABCD = AB \times 8$
$AB \times 8 = 68$
$AB = 8.5$ cm
$BF = 8.5 - 3$
$=$ **5.5 cm** [1]

(b) If BF is the base of $\triangle FBC$,
Area of $\triangle FBC = \frac{1}{2} \times 5.5 \times 8$
$= 22$ cm^2
If FC is the base of $\triangle FBC$,
Area of $\triangle FBC = \frac{1}{2} \times FC \times 4$
$= 2FC$ cm^2
$2FC = 22$
$FC =$ **11 cm** [1]

10. $PR = RT = 21 \div 2$
$= 10.5$ cm
$BV = VZ = ZX = 21 \div 3$
$= 7$ cm
$OQ = \frac{1}{2} \times 16$
$= 8$ cm
$AC = \frac{1}{4} \times 16$
$= 4$ cm
Area of $\triangle PQR =$ area of $\triangle RST$
$= \frac{1}{2} \times 10.5 \times 8$
$= 42$ cm^2 [1]
Area of $\triangle ABV =$ area of $\triangle VWZ$
$=$ area of $\triangle XYZ$
$= \frac{1}{2} \times 7 \times 4$
$= 14$ cm^2 [1]
Area of rectangle $PTXB = 21 \times 16$
$= 336$ cm^2
Area of the shaded region
$= 336 - (2 \times 42) - (3 \times 14)$
$= 336 - 84 - 42$
$=$ **210 cm^2** [1]

11. (a) Arc length of each semicircle
$= \frac{1}{2} \times 2 \times \frac{22}{7} \times 28$
$= 88$ m
Perimeter of the field $= (2 \times 88) + (2 \times 70)$
$= 176 + 140$
$= 316$ m [1]
Number of cones required $= 316 \div 4$
$=$ **79** [1]

(b) Area of each semicircle $= \frac{1}{2} \times \frac{22}{7} \times 28^2$
$= 1232$ m^2
Area of the rectangle $= 70 \times (2 \times 28)$
$= 70 \times 56$
$= 3920$ m^2
Area of the field $= (2 \times 1232) + 3920$
$= 6384$ m^2 [1]
Area of the small rectangle $= 42 \times 5$
$= 210$ m^2
Radius of the circle $= 21 \div 2$
$= 10.5$ m
Area of the circle $= \frac{22}{7} \times 10.5^2$
$= 346.5$ m^2
Area of the shaded region
$= 6384 - 210 - 346.5$
$= 5827.5$ m^2 [1]
Cost of laying down grass on the shaded region
$= \frac{5827.5}{7.5} \times \$45$
$=$ **\$34 965** [1]

12. Area of parallelogram $ABCD = 8 \times BH$
$8 \times BH = 55.2$
$BH = 6.9$ cm [1]
$GH = \frac{1}{3} \times 6.9$
$= 2.3$ cm
$EC = \frac{1}{2} \times 8$
$= 4$ cm
Area of $\triangle EFC = \frac{1}{2} \times 4 \times 2.3$
$= \mathbf{4.6\ cm^2}$ [1]

13. $ST = TO = 28 \div 2$
$= 14$ cm
Radius of the smaller circle $= 14 \div 2$
$= 7$ cm
Radius of each smaller semicircle $= 28 \div 2$
$= 14$ cm
Area of each smaller semicircle $= \frac{1}{2} \times \frac{22}{7} \times 14^2$
$= 308$ cm^2 [1]
Area of the smaller circle $= \frac{22}{7} \times 7^2$
$= 154$ cm^2 [1]
$PQ = 2 \times 28$
$= 56$ cm
Area of the triangle $= \frac{1}{2} \times 56 \times 28$
$= 784$ cm^2
Area of circle $PSQR = \frac{22}{7} \times 28^2$
$= 2464$ cm^2
Area of the shaded region
$= 2464 - 154 - (2 \times 308) - 784$
$= 2464 - 154 - 616 - 784$
$= \mathbf{910\ cm^2}$ [1]

14. (a) $DE = FX$
$= 6 \div 2$
$= 3$ cm
$JA = DB$
$= 3 \times 3$
$= 9$ cm
$BC = AB$
$= 2 \times 6$
$= 12$ cm
Arc length of semicircle FGE
$= \frac{1}{2} \times 2 \times \frac{22}{7} \times 3$
$= 9\frac{3}{7}$ cm [1]
Perimeter of the entire figure
$= 9 + 6 + (2 \times 3) + 9\frac{3}{7} + 15 + (2 \times 12)$
$= 9 + 6 + 6 + 9\frac{3}{7} + 15 + 24$
$= \mathbf{69\frac{3}{7}\ cm}$ [1]

(b) Area of rectangle $JAKH = 9 \times 6$
$= 54$ cm^2
$GK = 9 - 3$
$= 6$ cm
Area of square $GKBE = 6 \times 6$
$= 36$ cm^2
Area of semicircle $FGE = \frac{1}{2} \times \frac{22}{7} \times 3^2$
$= 14\frac{1}{7}$ cm^2
Area of $\triangle BCD = \frac{1}{2} \times 12 \times 9$
$= 54$ cm^2 [1]
Area of the entire figure
$= 54 + 36 + 14\frac{1}{7} + 54$
$= \mathbf{158\frac{1}{7}\ cm^2}$ [1]

15. (a) Let the length of PQ be x cm.
$SR = 6 + x + 4.5$
$= (10.5 + x)$ cm
Area of trapezium $PQRS$
$= \frac{1}{2} \times [x + (10.5 + x)] \times 7.5$
$= 3.75 \times (10.5 + 2x)$
$3.75 \times (10.5 + 2x) = 110.625$ [1]
$10.5 + 2x = 29.5$
$2x = 19$
$x = 9.5$ [1]
$RS = 6 + 9.5 + 4.5$
$= \mathbf{20\ cm}$ [1]

(b) $WT = \frac{2}{3} \times 7.5$
$= 5$ cm
Area of parallelogram $RSTV$
$= 20 \times 5$
$= \mathbf{100\ cm^2}$ [1]

Class Test 2

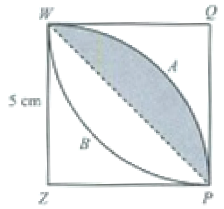
1. (a) $CH = \frac{1}{3} \times 15$
$= 5$ cm
Area of parallelogram $EFCH = 5 \times 7.2$
$= 36$ cm^2 [1]
$GH = 8 \div 2$
$= 4$ cm
$EH = 4 + 8$
$= 12$ cm
Area of parallelogram $EFCH = 12 \times CG$
$12 \times CG = 36$
$CG = \mathbf{3\ cm}$ [1]

(b) $AB = CH$
$= 5$ cm
Area of trapezium $ABCD = \frac{1}{2} \times (5 + 15) \times 7.2$
$= 72$ cm^2
Area of $\triangle GCH = \frac{1}{2} \times 3 \times 4$
$= 6$ cm^2
Area of the shaded region $= 72 + 36 - 6 - 6$
$=$ **96 cm^2** [1]

(c) Perimeter of the entire figure
$= 8.5 + 5 + 5 + 8 + 5 + 12 + 15$
$=$ **58.5 cm** [1]

2. (a) $YZ = 2 \times 5$
$= 10$ cm
Arc $WAP = \frac{1}{4} \times 2 \times \pi \times 5$
$= 2.5\pi$ cm [1]
Since the arcs WAP, WBP, PCX and PDX are equal,
Perimeter of the shaded region $= 4 \times 2.5\pi$
$=$ **31.4 cm** [1]

(b) Draw line WP to divide $WAPB$ into 2 equal segments.



Area of $\triangle WZP = \frac{1}{2} \times 5 \times 5$
$= 12.5$ cm^2
Area of quadrant $WAPZ = \frac{1}{4} \times \pi \times 5^2$
$= 6.25\pi$ cm^2 [1]
Area of segment $WAP = (6.25\pi - 12.5)$ cm^2
Since the shaded region is made up of 4 equal segments,
Area of the shaded region $= 4 \times (6.25\pi - 12.5)$
$=$ **28.5 cm^2** (3 s.f.)
[1]

3. (a) Radius of the semicircle $= 7 \div 2$
$= 3.5$ m
Area of the semicircle $= \frac{1}{2} \times \pi \times 3.5^2$
$= 6.125\pi$ m^2
Area of each quadrant $= \frac{1}{4} \times \pi \times 1.5^2$
$= 0.5625\pi$ m^2
Total area of the rectangular paths
$= [2 \times (9 \times 1.5)] + (5 \times 1.5)$
$= 27 + 7.5$
$= 34.5$ m^2
Area of the rectangular field $= 20 \times 11$
$= 220$ m^2 [1]
Total area of the concrete areas
$= 6.125\pi + (2 \times 0.5625\pi) + 34.5$
$= 6.125\pi + 1.125\pi + 34.5$
$= (7.25\pi + 34.5)$ m^2 [1]
Area of the shaded region
$= 220 - (7.25\pi + 34.5)$
$=$ **163 m^2** (3 s.f.) [1]

(b) Total cost of paving the unshaded regions with concrete
$= \frac{7.25\pi + 34.5}{1.25} \times \$30$
$=$ **\$1374.64** (nearest cent) [1]

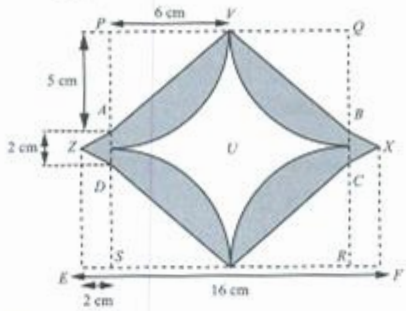
(c) Arc length of each quadrant
$= \frac{1}{4} \times 2 \times \pi \times 1.5$
$= 0.75\pi$ m
Perimeter of the path
$= (2 \times 1.5) + (4 \times 9) + (2 \times 5) + (2 \times 0.75\pi)$
$= 3 + 36 + 10 + 1.5\pi$
$=$ **53.7 m** (3 s.f.) [1]

4. (a) Let the radius of the circle be r cm.
Area of the circle $= \frac{22}{7} \times r^2$
$\frac{22}{7} \times r^2 = 804\frac{4}{7}$
$r^2 = 256$
$r = 16$
The radius of the circle is **16 cm**. [1]

(b) Circumference of the circle $= 2 \times \frac{22}{7} \times 16$
$=$ **$100\frac{4}{7}$ cm** [1]

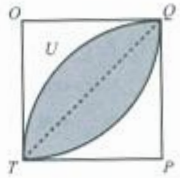
(c) $QS = 2 \times 16$
$= 32$ cm
$PT = TR = 14 \div 2$
$= 7$ cm
Area of $\triangle PQS$ = area of $\triangle QRS$
$= \frac{1}{2} \times 32 \times 7$
$= 112$ cm^2 [1]
Area of the shaded region
$= 804\frac{4}{7} - 112 - 112$
$= \mathbf{580\frac{4}{7}}$ **cm^2** [1]

5. $PS = 2 \times 6$
$= 12$ cm
$ES = (16 - 12) \div 2$
$= 4 \div 2$
$= 2$ cm
$AD = ES$
$= 2$ cm
$AP = (12 - 2) \div 2$
$= 10 \div 2$
$= 5$ cm



Area of square $PQRS = 12 \times 12$
$= 144$ cm^2
Area of each quadrant $= \frac{1}{4} \times \frac{22}{7} \times 6^2$
$= 28\frac{2}{7}$ cm^2
Area $U = 144 - \left(4 \times 28\frac{2}{7}\right)$
$= 144 - 113\frac{1}{7}$
$= 30\frac{6}{7}$ cm^2 [1]
Area of $\triangle APV = \frac{1}{2} \times 5 \times 6$
$= 15$ cm^2
Area of $\triangle ZAD = \frac{1}{2} \times 2 \times 2$
$= 2$ cm^2 [1]
Area of the shaded area
$= \left[144 - (4 \times 15) - 30\frac{6}{7}\right] + (2 \times 2)$
$= 53\frac{1}{7} + 4$
$= \mathbf{57\frac{1}{7}}$ **cm^2** [1]

6. (a) Area of quadrant $QTP = \frac{1}{4} \times \frac{22}{7} \times 7^2$
$= 38.5$ cm^2
Area of $\triangle QTP = \frac{1}{2} \times 7 \times 7$
$= 24.5$ cm^2



Area of segment $QUT = 38.5 - 24.5$
$= 14$ cm^2 [1]
Area of $\triangle QPR$ = area of $\triangle SPT$
= area of $\triangle QTP$
$= 24.5$ cm^2
Area of quadrant PRS = area of quadrant QTP
$= 38.5$ cm^2 [1]
Area of the shaded region
$= (2 \times 14) + (2 \times 24.5) + 38.5$
$= 28 + 49 + 38.5$
$= \mathbf{115.5}$ **cm^2** [1]

(b) Arc length of quadrant QTP
= arc length of quadrant OQT
= arc length of quadrant PRS
$= \frac{1}{4} \times 2 \times \frac{22}{7} \times 7$
$= 11$ cm [1]
Perimeter of the shaded region
$= TS + QR + QP + PT + (3 \times 11)$
$= TS + QR + 7 + 7 + 33$
$= TS + QR + 47$
$TS + QR + 47 = 66.8$ [1]
$TS + QR = 19.8$
Since $TS = QR$, $QR = 19.8 \div 2$
$= \mathbf{9.9}$ **cm** [1]

7. (a) If AF, FE and EC are the bases of $\triangle ABF$, $\triangle BEF$ and $\triangle BEC$ respectively, then BF is the common perpendicular height of the triangles. Since $AF = FE = EC$, the areas of $\triangle ABF$, $\triangle BEF$ and $\triangle BEC$ are equal. (proven) [1]

(b) Area of $\triangle ABF = 72 \div 6$
$= 12$ cm^2
$\frac{1}{2} \times 4 \times x = 12$ [1]
$x = \mathbf{6}$ [1]

(c) Area of $\triangle CED$ = 12 cm^2

$\frac{1}{2} \times CD \times 1.5 = 12$

CD = **16 cm** [1]

8. (a) $OS = 2 \times 3$

$= 6$ cm

Area of quadrant $STO = \frac{1}{4} \times \pi \times 6^2$

$= 9\pi$ cm^2

Area of quadrant $RQO = \frac{1}{4} \times \pi \times 3^2$

$= 2.25\pi$ cm^2 [1]

Area of the shaded region

$= (2 \times 9\pi) - (2 \times 2.25\pi)$

$= 18\pi - 4.5\pi$

$=$ **42.4 cm^2** (3 s.f.) [1]

(b) Arc length of quadrant STO

$= \frac{1}{4} \times 2 \times \pi \times 6$

$= 3\pi$ cm

Arc length of quadrant RQO

$= \frac{1}{4} \times 2 \times \pi \times 3$

$= 1.5\pi$ cm [1]

Perimeter of the shaded region

$= (2 \times 3\pi) + (2 \times 1.5\pi) + (2 \times 3)$

$= 6\pi + 3\pi + 6$

$=$ **34.3 cm** [1]

9. $PZ = ZS = 10 \div 2$

$= 5$ m

$AC = \frac{1}{2} \times 10$

$= 5$ m

$AO = 5 \div 2$

$= 2.5$ m

$BD = \frac{1}{2} \times 17$

$= 8.5$ m [1]

Area of $\triangle TXZ = \frac{1}{2} \times 17 \times 5$

$= 42.5$ m^2

Area of $\triangle BAD = \frac{1}{2} \times 8.5 \times 2.5$

$= 10.625$ m^2 [1]

Area of $\triangle QXE = \frac{1}{2} \times 2 \times 4.5$

$= 4.5$ m^2 [1]

Area of the shaded region

$= 2 \times (42.5 + 4.5 - 10.625)$

$= 2 \times 36.375$

$= 72.75$ m^2 [1]

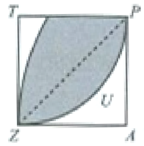
Amount it costs to paint the shaded region

$= \frac{72.75}{1.25} \times \$28$

$=$ **\$1629.60** [1]

10. (a) $QR = RS = 8 \div 2$

$= 4$ cm



Area of quadrant $TPZ = \frac{1}{4} \times \frac{22}{7} \times 4^2$

$= 12\frac{4}{7}$ cm^2

Area of square $TPAZ = 4 \times 4$

$= 16$ cm^2

Area $U = 16 - 12\frac{4}{7}$

$= 3\frac{3}{7}$ cm^2 [1]

Area of semicircle $XYZ = \frac{1}{2} \times \frac{22}{7} \times 8^2$

$= 100\frac{4}{7}$ cm^2

Area of semicircle $PRX = \frac{1}{2} \times \frac{22}{7} \times 4^2$

$= 25\frac{1}{7}$ cm^2 [1]

Area of the shaded region

$= 100\frac{4}{7} - 25\frac{1}{7} - \left(2 \times 3\frac{3}{7}\right) - (2 \times 16)$

$= 100\frac{4}{7} - 25\frac{1}{7} - 6\frac{6}{7} - 32$

$=$ **$36\frac{4}{7}$ cm^2** [1]

(b) Arc length of semicircle XYZ

$= \frac{1}{2} \times 2 \times \frac{22}{7} \times 8$

$= 25\frac{1}{7}$ cm [1]

Arc length of semicircle PRX

$= \frac{1}{2} \times 2 \times \frac{22}{7} \times 4$

$= 12\frac{4}{7}$ cm

Arc length of quadrant TPZ

$= \frac{1}{4} \times 2 \times \frac{22}{7} \times 4$

$= 6\frac{2}{7}$ cm [1]

Perimeter of the shaded region

$= 25\frac{1}{7} + 12\frac{4}{7} + \left(2 \times 6\frac{2}{7}\right)$

$= 25\frac{1}{7} + 12\frac{4}{7} + 12\frac{4}{7}$

$=$ **$50\frac{2}{7}$ cm** [1]

Chapter 13 Volume and Surface Area of Solids

Class Test 1

1. Volume of the rectangular block = $25 \times 9 \times 5$
$= 1125 \text{ cm}^3$
Volume of each cube = $1125 \div 72$
$= 15.625 \text{ cm}^3$ [1]
Length of each side of the cubes
$= \sqrt[3]{15.625}$
$=$ **2.5 cm** [1]

2. (a) Volume of the cube = 9^3
$= 729 \text{ cm}^3$
Area of the cross-section of the triangular prism
$= \frac{1}{2} \times 6 \times 4$
$= 12 \text{ cm}^2$
Volume of the triangular prism = $12 \times h$
$= 12h \text{ cm}^3$
$12h = 729$
$h =$ **60.75** [1]

(b) Total surface area of the cube = 6×9^2
$= 486 \text{ cm}^2$
Perimeter of the cross-section of the triangular prism = $5 + 5 + 6$
$= 16 \text{ cm}$
Total surface area of the triangular prism
$= (2 \times 12) + (16 \times 60.75)$
$= 24 + 972$
$= 996 \text{ cm}^2$ [1]
Difference between the total surface area of the cube and the prism
$= 996 - 486$
$=$ **510 cm²** [1]

3. (a) Area of quadrant $ABC = \frac{1}{4} \times \frac{22}{7} \times 7^2$
$= 38.5 \text{ cm}^2$ [1]
Area of $\triangle ABC = \frac{1}{2} \times 7 \times 7$
$= 24.5 \text{ cm}^2$
Area of the cross-section
$= 2 \times (38.5 - 24.5) + (11^2 - 7^2)$
$= 2 \times 14 + 72$
$= 100 \text{ cm}^2$ [1]
Volume of the solid = 100×28
$=$ **2800 cm²** [1]

(b) Arc $AB = \frac{1}{4} \times 2 \times \frac{22}{7} \times 7$
$= 11 \text{ cm}$
Perimeter of the cross-section
$= (4 \times 11) + (4 \times 7) + (2 \times 11)$
$= 44 + 28 + 22$
$= 94 \text{ cm}$ [1]
Total surface area of the solid
$= (2 \times 100) + (94 \times 28)$
$= 200 + 2632$
$=$ **2832 cm²** [1]

4. (a) Capacity of the tank = $18 \times 6 \times 3$
$= 324 \text{ m}^3$
$=$ **324 000 *l*** [1]

(b) $3240\ l = 3.24 \text{ m}^3$
Change in the height of the water level
$= \frac{3.24}{18 \times 6}$
$=$ **0.03 m/h** [1]

5. (a) $AB = BC = CD = 12 \text{ cm}$
Radius of the semicircle = $12 \div 2$
$= 6 \text{ cm}$
Area of semicircle $BGC = \frac{1}{2} \times \frac{22}{7} \times 6^2$
$= 56\frac{4}{7}$ [1]
Area of the cross-section
$= \left[2 \times \left(\frac{1}{4} \times \frac{22}{7} \times 12^2\right)\right] + 12^2 - 56\frac{4}{7}$
$= 226\frac{2}{7} + 144 - 56\frac{4}{7}$
$= 313\frac{5}{7} \text{ cm}^2$ [1]
Volume of the solid = $313\frac{5}{7} \times 18$
$=$ **$5646\frac{6}{7}$ cm³** [1]

(b) Perimeter of the cross-section
$= (3 \times 12) + \left(\frac{1}{2} \times 2 \times \frac{22}{7} \times 6\right) + \left[2 \times \left(\frac{1}{4} \times 2 \times \frac{22}{7} \times 12\right)\right]$
$= 36 + 18\frac{6}{7} + 37\frac{5}{7}$
$= 92\frac{4}{7} \text{ cm}$ [1]
Total surface area of the solid
$= \left(2 \times 313\frac{5}{7}\right) + \left(92\frac{4}{7} \times 18\right)$
$= 627\frac{3}{7} + 1666\frac{2}{7}$
$=$ **$2293\frac{5}{7}$ cm²** [1]

6. (a) Capacity of the water tank = $52 \times 24 \times h$
$= 1248h$ cm^3
$9.36\ l = 9360$ cm^3
$\frac{3}{5} \times 1248h = 9360$ [1]
$1248h = 15\ 600$
$h = \mathbf{12.5}$ [1]

(b) Change in volume of water = $52 \times 24 \times 3$
$= 3744$ cm^3
$= 3744$ m*l*
Time taken for the water level to be reduced by 3 cm = $3744 \div 96$
$=$ **39 min** [1]

7. (a) Volume of the cube = 11^3
$= 1331$ cm^3
Radius of each cylindrical rod = $2 \div 2$
$= 1$ cm
Volume of each rod = $\frac{22}{7} \times 1^2 \times 5.5$
$= 17\frac{2}{7}$ cm^3 [1]
Number of metal rods that can be formed
$= 1331 \div 17\frac{2}{7}$
$=$ **77** [1]

(b) Total surface area of the rods painted gold
$= 77 \times \left(2 \times \frac{22}{7} \times 1 \times 5.5\right)$
$= 77 \times 34\frac{4}{7}$
$=$ **2662 cm²** [1]

8. (a) Length of the smaller cuboid = $66 - 3 - 3$
$= 60$ cm
Breadth of the smaller cuboid = $45 - 3 - 3$
$= 39$ cm
Height of the smaller cuboid = $38 - 3$
$= 35$ cm
Volume of the larger cuboid = $66 \times 45 \times 38$
$= 112\ 860$ cm^3
Volume of the smaller cuboid = $60 \times 39 \times 35$
$= 81\ 900$ cm^3 [1]
Volume of the material used to make the tub
$= 112\ 860 - 81\ 900$
$=$ **30 960 cm³** [1]

(b) Total area of the inner surfaces
$= [2 \times (60 \times 35)] + [2 \times (39 \times 35)] + (60 \times 39)$
$= 4200 + 2730 + 2340$
$= 9270$ cm^2

Total area of the outer surfaces
$= [2 \times (45 \times 38)] + [2 \times (66 \times 38)] + (66 \times 45) + [(66 \times 45) - (60 \times 39)]$
$= 3420 + 5016 + 2970 + 630$
$= 12\ 036$ cm^2 [1]
Total surface area of the tub
$= 9270 + 12\ 036$
$=$ **21 306 cm²** [1]

(c) Inner base area of the tub = 60×39
$= 2340$ cm^2
$15.21\ l = 15\ 210$ cm^3
Height of the water level in the tub
$= 15\ 210 \div 2340$
$=$ **6.5 cm** [1]

9. (a) Area of the cross-section
$= \left(\frac{1}{4} \times \frac{22}{7} \times 4.2^2\right) + (8 \times 4.2) + \left(\frac{1}{2} \times 5.6 \times 4.2\right)$
$= 13.86 + 33.6 + 11.76$
$= 59.22$ cm^2 [1]
Volume of the solid = 59.22×12
$=$ **710.64 cm³** [1]

(b) Perimeter of the cross-section
$= \left(\frac{1}{4} \times 2 \times \frac{22}{7} \times 4.2\right) + (2 \times 8) + 5.6 + 7 + 4.2$
$= 6.6 + 16 + 5.6 + 7 + 4.2$
$= 39.4$ cm [1]
Total surface area of the solid
$= (2 \times 59.22) + (39.4 \times 12)$
$=$ **591.24 cm²** [1]

10. (a) Radius of the cylinder $= OP$
$= 16.8 \div 2$
$= 8.4$ cm

$ST = 2 \times 8.4$
$= 16.8$ cm

$\frac{7}{8}RV = ST$

$RV = 16.8 \div \frac{7}{8}$
$= 19.2$ cm

Area of the cross-section
$= \left[\frac{1}{2} \times (19.2 + 26) \times 16.8\right] + \left(\frac{1}{2} \times \frac{22}{7} \times 8.4^2\right)$
$= 379.68 + 110.88$
$= 490.56$ cm^2 [1]

Volume of the solid $= 490.56 \times 16$
$= \mathbf{7848.96}$ **cm^3** [1]

(b) Mass of the solid $= \$520.80 \div \$25$
$= 20.832$ kg
$= 20\,832$ g

Density $= \frac{\text{Mass}}{\text{Volume}}$

Density of the solid $= \frac{20\,832}{7848.96}$
$= \mathbf{2.65}$ **g/cm^3** (3 s.f.) [1]

11. (a) Area of cross-section $= 5 \times \left(\frac{1}{2} \times 2x \times 1.4x\right)$
$= 5 \times 1.4x^2$
$= 7x^2$ cm^2

Volume of the prism $= 7x^2 \times 22$
$= 154x^2$ cm^3

Volume of 1 metal cube $= x \times x \times x$
$= x^3$ cm^3

Total volume of 44 metal cubes
$= 44 \times x^3$
$= 44x^3$ cm^3

$154x^2 = 44x^3$ [1]

$44x^3 - 154x^2 = 0$

$x^2(44x - 154) = 0$

$x = 0$ (rejected) or $44x - 154 = 0$
$x = \mathbf{3.5}$ [1]

(b) Perimeter of the cross-section $= 5 \times 2x$
$= 10x$
$= 10 \times 3.5$
$= 35$ cm [1]

Total surface area of the prism
$= [2 \times (7 \times 3.5^2)] + (35 \times 22)$
$= 171.5 + 770$
$= \mathbf{941.5}$ **cm^2** [1]

12. (a) Radius of the semicircle $= 12 \div 2$
$= 6$ cm

$VS = 2 \times 6$
$= 12$ cm

Area of the cross-section
$= \left(\frac{1}{2} \times \frac{22}{7} \times 6^2\right) + (12 \times 12) - \left(\frac{1}{2} \times 12 \times 6\right)$
$= 56\frac{4}{7} + 144 - 36$
$= 164\frac{4}{7}$ cm^2 [1]

Volume of the solid
$= 164\frac{4}{7} \times 18$
$= \mathbf{2962\frac{2}{7}}$ **cm^3** [1]

(b) Density $= \frac{\text{Mass}}{\text{Volume}}$

Mass of the solid $= 2.8 \times 2962\frac{2}{7}$
$= 8294.4$ g
$= \mathbf{8.29}$ **kg** (2 d.p.) [1]

13. (a) Radius of each circular disc $= 11 \div 2$
$= 5.5$ cm

Volume of the 2 circular discs
$= 2 \times (\pi \times 5.5^2 \times 1.5)$
$= 90.75\pi$ cm^3

Radius of the cylinder $= 4 \div 2$
$= 2$ cm

Volume of the cylinder $= \pi \times 2^2 \times 17$
$= 68\pi$ cm^3 [1]

Volume of the solid $= 90.75\pi + 68\pi$
$= \mathbf{498.7}$ **cm^3** (4 s.f.) [1]

(b) Area of the circular face of each circular disc
$= \pi \times 5.5^2$
$= 30.25\pi$ cm^2

Area of the circular face of the cylinder
$= \pi \times 2^2$
$= 4\pi$ cm^2 [1]

Curved surface area of the each circular disc
$= 2 \times \pi \times 5.5 \times 1.5$
$= 16.5\pi$ cm^2

Curved surface area of the cylinder
$= 2 \times \pi \times 2 \times 17$
$= 68\pi$ cm^2 [1]

Total surface area of the solid
$= (4 \times 30.25\pi) + (2 \times 16.5\pi) + 68\pi - (2 \times 4\pi)$
$= 121\pi + 33\pi + 68\pi - 8\pi$
$= \mathbf{672.3}$ **cm^2** (4 s.f.) [1]

14. Volume of the rectangular block
$= 17.5 \times 9 \times 15$
$= 2362.5$ cm^3
Volume of each prism $= \left(\frac{1}{2} \times 2 \times 8\right) \times x$
$= 8 \times x$
$= 8x$ cm^3
$175 \times 8x = 2362.5$ [1]
$1400x = 2362.5$
$x = \mathbf{1.6875}$ [1]

15. (a) Radius of the bottom disc $= 18 \div 2$
$= 9$ cm
Radius of the middle disc $= \frac{2}{3} \times 9$
$= 6$ cm
Radius of the top disc $= \frac{2}{3} \times 6$
$= 4$ cm [1]
Volume of the solid
$= \left(\frac{22}{7} \times 9^2 \times 2\right) + \left(\frac{22}{7} \times 6^2 \times 2\right) + \left(\frac{22}{7} \times 4^2 \times 2\right)$
$= 509\frac{1}{7} + 226\frac{2}{7} + 100\frac{4}{7}$
$= \mathbf{836}$ **cm^3** [1]

(b) Total area of the top surfaces of the top, middle and bottom discs
= Area of the bottom surface of the bottom disc
$= \frac{22}{7} \times 9^2$
$= 254\frac{4}{7}$ cm^2
Total area of the curved surfaces of the top, middle and bottom discs
$= \left(2 \times \frac{22}{7} \times 9 \times 2\right) + \left(2 \times \frac{22}{7} \times 6 \times 2\right) + \left(2 \times \frac{22}{7} \times 4 \times 2\right)$
$= 113\frac{1}{7} + 75\frac{3}{7} + 50\frac{2}{7}$
$= 238\frac{6}{7}$ cm^2 [1]
Total surface area of the solid
$= \left(2 \times 254\frac{4}{7}\right) + 238\frac{6}{7}$
$= 509\frac{1}{7} + 238\frac{6}{7}$
$= \mathbf{748}$ **cm^2** [1]

Class Test 2

1. (a) Area of $\triangle OAB = \frac{1}{2} \times AB \times OX$
$= \frac{1}{2} \times 6 \times 4$
$= 12$ cm^2
Area of the hexagonal cross-section
$= 6 \times 12$
$= 72$ cm^2
Volume of the hexagonal prism $= 72 \times 23$
$= 1656$ cm^3
Height of the cylindrical shape $= 23 - 8$
$= 15$ cm
Volume of the cylindrical shape
$= \frac{22}{7} \times 2.5^2 \times 15$
$= 294\frac{9}{14}$ cm^3 [1]
Volume of the solid $= 1656 - 294\frac{9}{14}$
$= \mathbf{1361\frac{5}{14}}$ **cm^3** [1]

(b) Area of each lateral side $= 23 \times 6$
$= 138$ cm^2
Total surface area of the solid that is painted
$= 6 \times 138 + 72$
$= \mathbf{900}$ **cm^2** [1]

2. (a) Radius of the cylindrical solid $= 15 \div 2$
$= 7.5$ cm
Volume of the cylindrical solid
$= \frac{22}{7} \times 7.5^2 \times 35$
$= 6187.5$ cm^3
Total volume of the cuboid and the prism
$= (5 \times 1.5 \times 35) + (\frac{1}{2} \times 3 \times 5 \times 35)$
$= 262.5 + 262.5$
$= 525$ cm^3 [1]
Volume of the solid $= 6187.5 - 525$
$= \mathbf{5662.5}$ **cm^3** [1]

(b) Radius of the smaller circle $= 12 \div 2$
$= 6$ cm
Total area of the rectangular and triangular cross-section $= (5 \times 1.5) + (\frac{1}{2} \times 3 \times 5)$
$= 7.5 + 7.5$
$= 15$ cm^2 [1]
Area of the top of the solid painted
$= (\frac{22}{7} \times 6^2) - 15$
$= 113\frac{1}{7} - 15$
$= 98\frac{1}{7}$ cm^2 [1]

Surface area of the solid that is painted

$= 2 \times 98\frac{1}{7}$

$= \mathbf{196\frac{2}{7}\ cm^2}$ [1]

3. (a) Volume of the triangular prism

$= \frac{1}{2} \times 8 \times 6 \times 12$

$= 288\ cm^3$

Volume of the cuboid $= 20 \times 8 \times 2$

$= 320\ cm^3$

Volume of the trapezoidal prism

$= \frac{1}{2} \times (5.5 + 8) \times 5 \times 20$

$= 675\ cm^3$ [1]

Volume of the solid $= 288 + 320 + 675$

$= \mathbf{1283\ cm^3}$ [1]

(b) Density $= \frac{\text{Mass}}{\text{Volume}}$

Mass of the solid = Density × Volume

$= 4.2 \times 1283$

$= 5388.6$ g

$= 5.3886$ kg [1]

Cost of building the solid

$= 5.3886 \times \$23$

= **$123.94** (nearest cent) [1]

4. (a) Radius of the cylinder $= 5.6 \div 2$

$= 2.8$ cm

Height of the cuboid $= \frac{3}{4} \times 30$

$= 22.5$ cm [$\frac{1}{2}$]

Height of the cylinder $= \frac{1}{2} \times 30$

$= 15$ cm [$\frac{1}{2}$]

Total volume of the cuboid and the cylinder

$= (5.6 \times 5.6 \times 22.5) + \left(\frac{22}{7} \times 2.8^2 \times 15\right)$

$= 705.6 + 369.6$

$= 1075.2\ cm^3$ [1]

Volume of the solid

$= (22 \times 13.5 \times 30) - 1075.2$

$= 8910 - 1075.2$

$= \mathbf{7834.8\ cm^3}$ [1]

(b) Surface area of the top of the solid

$= (22 \times 13.5) - \left(\frac{22}{7} \times 2.8^2\right) - 5.6^2$

$= 297 - 24.64 - 31.36$

$= 241\ cm^2$ [1]

Inner surface area of the bored cylinder

$= \left[2 \times \left(\frac{22}{7} \times 2.8 \times 15\right)\right] + \left(\frac{22}{7} \times 2.8^2\right)$

$= 264 + 24.64$

$= 288.64\ cm^2$

Inner surface area of the bored cuboid

$= [4 \times (22.5 \times 5.6)] + 5.6^2$

$= 504 + 31.36$

$= 535.36\ cm^2$ [1]

Total surface area of the solid

$= [2 \times (30 \times 22)] + [2 \times (30 \times 13.5)] + (22 \times 13.5) + 241 + 288.64 + 535.36$

$= 1320 + 810 + 297 + 241 + 288.64 + 535.36$

$= \mathbf{3492\ cm^2}$ [1]

5. (a) Area of the cross-section

$= 14 \times \left(\frac{1}{2} \times 6 \times 4\right)$

$= 14 \times 12$

$= 168\ cm^2$ [1]

Volume of the solid $= 168 \times 25$

$= \mathbf{4200\ cm^3}$ [1]

(b) Perimeter of the cross-section

$= (2 \times 6) + (4 \times 10) + (2 \times 10)$

$= 12 + 40 + 20$

$= 72$ cm [1]

Total surface area of the solid

$= (72 \times 25) + (2 \times 168)$

$= 1800 + 336$

$= \mathbf{2136\ cm^2}$ [1]

6. Radius of the outer circle $= 8 \div 2$

$= 4$ cm

Radius of the inner circle $= 3 \div 2$

$= 1.5$ cm

Volume of the cylinder

$= \left(\frac{22}{7} \times 4^2 \times 24\right) - \left(\frac{22}{7} \times 1.5^2 \times 24\right)$

$= 1206\frac{6}{7} - 169\frac{5}{7}$

$= 1037\frac{1}{7}\ cm^3$ [1]

Area of the cross-section of a prism

$= \frac{1}{2} \times (a + 2a) \times 1$

$= 1.5a\ cm^2$

Volume of 1 prism $= 1.5a \times 5$

$= 7.5a\ cm^3$

$7.5a = 1037\frac{1}{7} \div 11$ [1]

$7.5a = 94\frac{2}{7}$

$a = \mathbf{12\frac{4}{7}}$ [1]

7. (a) Area of the base of the tank
$= \frac{1}{2} \times 15 \times 17$
$= 127.5$ cm^2
Volume of water in the tank
$= 127.5 \times 28$
$= 3570$ cm^3
$=$ **3.57 *l*** [1]

(b) Volume of each cube $= 1.5^3$
$= 3.375$ cm^3
Change in volume of water
$= 340 \times 3.375$
$= 1147.5$ cm^3 [1]
Change in the height of the water level
$= 1147.5 \div 127.5$
$=$ **9 cm** [1]

8. (a) Total volume of the 2 semicircular prisms
$= 2 \times \left[\left(\frac{1}{2} \times \frac{22}{7} \times 4.2^2\right) \times 2.4\right]$
$= 2 \times 66.528$
$= 133.056$ m^3 [1]
Breadth of the outer cuboid $= 2 \times 4.2$
$= 8.4$ m
Breadth of the inner cuboid $= 8.4 - 0.15 - 0.15$
$= 8.1$ m
Volume of the outer cuboid $= 22 \times 8.4 \times 2.4$
$= 443.52$ m^3
Volume of the inner cuboid $= 22 \times 8.1 \times 2.2$
$= 392.04$ m^3 [1]
Volume of the material needed to make the tank
$= 133.056 + 443.52 - 392.04$
$=$ **184.5 m^3** (1 d.p.) [1]

(b) Capacity of the tank
= volume of the inner cuboid
$= 392.04$ m^3
$=$ **392 040 *l*** [1]

(c) Time taken to drain the tank completely
$= 392\ 040 \div 396$
$=$ **990 min** [1]

9. Radius of semicircle $XZY = 20 \div 2$
$= 10$ cm
Radius of the cylinder $= 4 \div 2$
$= 2$ cm
Volume of the semicircular cylinder
$= \frac{1}{2} \times \frac{22}{7} \times 10^2 \times 9$
$= 1414\frac{2}{7}$ cm^3
Volume of the triangular prism
$= \left(\frac{1}{2} \times 9 \times 7\right) \times 20$
$= 31.5 \times 20$
$= 630$ cm^3 [1]
Total volume of the cuboid and the cylinder
$= (10 \times 9 \times 2) + \left(\frac{22}{7} \times 2^2 \times 9\right)$
$= 180 + 113\frac{1}{7}$
$= 293\frac{1}{7}$ cm^3 [1]
Volume of the solid
$= 1414\frac{2}{7} + 630 - 293\frac{1}{7}$
$=$ **$1751\frac{1}{7}$ cm^3** [1]

10. (a) $5.67\ l = 5670$ cm^3
Base area of the rectangular tank
$= 36 \times 21$
$= 756$ cm^2
Height of the water level in the tank
$= 5670 \div 756$
$=$ **7.5 cm** [1]

(b) Change in volume of water
= Total volume of 126 cubes
$= 126 \times 3^3$
$= 3402$ cm^3
Change in the height of the water level
$= 3402 \div 756$
$=$ **4.5 cm** [1]

(c) Height of the water level after adding the cubes
$= 7.5 + 4.5$
$= 12$ cm
$\frac{3}{7}$ of the height of the tank ⟶ 12 cm
$\frac{7}{7}$ of the height of the tank ⟶ $\frac{12}{3} \times 7$
$= 28$ cm [1]
Additional volume of water needed to fill the tank completely
$= 756 \times (28 - 12)$
$= 756 \times 16$
$= 12\ 096$ cm^3 [1]
Time taken to fill the tank completely
$= 12\ 096 \div 336$
$=$ **36 min** [1]

Chapter 14 Data Analysis

Class Test 1

1. (a) Total number of people surveyed
$= 4 + 7 + 13 + 6$
$= 30$
Required percentage $= \frac{6}{30} \times 100\%$
$= \mathbf{20\%}$ [1]

(b) Angle of the sector representing number of people who like chips $= \frac{13}{30} \times 360°$
$= \mathbf{156°}$ [1]

2. (a) Sum of the angles of the sectors representing the number of people who enjoy reading and listening to music
$= 360° - 112° - 62° - 46°$ ($\angle$s at a pt.)
$= 140°$
$x° = \frac{140°}{2}$
$x = \mathbf{70}$ [1]

(b) Number of people who chose sleeping
$= \frac{62°}{360°} \times 180$
$= \mathbf{31}$ [1]

(c) Angle of the most popular hobby $= 112°$
Angle of the least popular hobby $= 46°$
Difference between the angles $= 112° - 46°$
$= 66°$
Difference between the number of people who chose the most popular hobby and the least popular hobby $= \frac{66°}{360°} \times 180$
$= \mathbf{33}$ [1]

3. (a) Total number of students
$= 21 + 47 + 64 + 30 + 18$
$= 180$

Marks (x)	Number of students	Angle of sector
$x > 80$	21	$\frac{21}{180} \times 360° = 42°$
$70 < x \leq 80$	47	$\frac{47}{180} \times 360° = 94°$
$60 < x \leq 70$	64	$\frac{64}{180} \times 360° = 128°$
$50 < x \leq 60$	30	$\frac{30}{180} \times 360° = 60°$
$x \leq 50$	18	$\frac{18}{180} \times 360° = 36°$

[2]

[2]

(b) Required percentage $= \frac{30 + 18}{180} \times 100\%$
$= \frac{48}{180} \times 100\%$
$= \mathbf{26.7\%}$ (1 d.p.) [1]

4. (a) Total number of users
$= 70 + 40 + 115 + 95 + 30$
$= 350$
Number of users who borrowed 2 or 3 books
$= 115 + 95$
$= 210$
Required fraction $= \frac{210}{350}$
$= \mathbf{\frac{3}{5}}$ [1]

(b) Total number of books borrowed
$= (70 \times 0) + (40 \times 1) + (115 \times 2) + (95 \times 3) + (30 \times 4)$
$= 675$
Number of users at the library the next day
$= 116\% \times 350$
$= 406$
Total number of books borrowed the next day
$= 406 \times 2$
$= 812$
Difference between the number of books borrowed over the two days $= 812 - 675$
$= \mathbf{137}$ [1]

5. (a) $a = 5 \times \frac{46}{2}$
$= \mathbf{115}$ [1]

(b) (i) $46° + 115° + b° = 360°$ ($\angle$s at a pt.)
$b = \mathbf{199}$ [1]

(ii) $115° \longrightarrow 575$ spectators
$360° \longrightarrow 360 \times \frac{575}{115}$
$= 1800$ spectators
Total number of spectators at the match
$= \mathbf{1800}$ [1]

(c) Angle of the sectors representing women and children = 115° + 46°
= 161°
Required percentage = $\frac{161}{199}$ × 100%
= **80.9%** (1 d.p.) [1]

6. (a) Total expenditure from July to November
= 5 × $375
= $1875
Amount of money he spent in November
= $1875 – $275 – $400 – $250 – $200
= **$750** [1]

(b) 12.5% of his salary ⟶ $275
100% of his salary ⟶ 100 × $\frac{275}{12.5}$
= $2200
Required percentage = $\frac{\$200}{\$2200}$ × 100%
= **9.1%** (1 d.p.) [1]

7. (a) Angle of the sectors representing food, school fees and savings
= 360° – 28° – 104° (∠s at a pt.)
= 228°
Ratio of her expenditure spent on food and school fees to her savings = 2 : 1
Angle of the sector representing savings
= $\frac{1}{3}$ × 228°
= 76°

$(6a + 4)° = 76°$
$6a = 72$
$a =$ **12** [1]

(b) Angle of the sector representing food
= (5 × 12)°
= 60°
60° ⟶ $300
360° ⟶ 360 × $\frac{\$300}{60}$
= $1800
Total amount of money she receives every month = **$1800** [1]

(c) (i) 104° ⟶ 104 × $\frac{\$300}{60}$
= $520
Amount of money she spends on accommodation = **$520** [1]

(ii) 76° ⟶ 76 × $\frac{\$300}{60}$
= $380
Required percentage = $\frac{\$380}{\$1800}$ × 100%
= **21.1%** (1 d.p.) [1]

8. (a) (i) The most popular fruit is **mango**. [1]

(ii) The least popular fruit is **grape**. [1]

(b) Total number of teachers who were surveyed
= 30 × 16
= 480
Number of teachers who chose durian
= $6\frac{3}{4}$ × 16
= 108
Required percentage = $\frac{108}{480}$ × 100%
= **22.5%** [1]

(c) Number of teachers who actually like mangoes
= 8 × 16 – 24
= 104
Number of teachers who actually like apples
= $5\frac{1}{2}$ × 16 + 24
= 112
Required ratio = 112 : 104
= **14 : 13** [1]

9. (a) Total number of adults
= 31 + 23 + 17 + 37 + 12
= 120

Country	Number of adults	Angle of sector
Japan	31	$\frac{31}{120}$ × 360° = 93°
England	23	$\frac{23}{120}$ × 360° = 69°
America	17	$\frac{17}{120}$ × 360° = 51°
Australia	37	$\frac{37}{120}$ × 360° = 111°
Brazil	12	$\frac{12}{120}$ × 360° = 36°

[2]

[1]

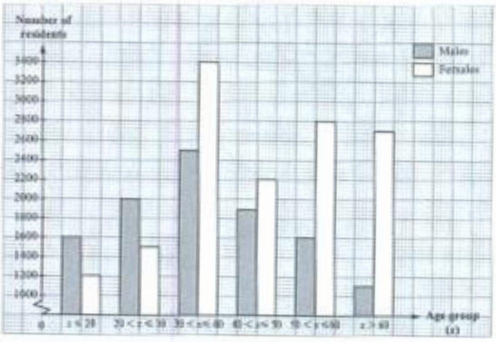
(b) Number of adults who would like to visit England or America = 23 + 17
= 40

Required fraction = $\frac{40}{120}$
= $\frac{1}{3}$ [1]

(c) Fraction of people who would like to visit Japan
= $\frac{31}{120}$

Number of people in a survey of 1800 people who would like to visit Japan
= $\frac{31}{120}$ × 1800
= **465** [1]

10. (a)



[2]

(b) (i) There are more male residents than female residents in the age group **20 years old and below**, as well as in the age group **of 20 years old to 30 years old**. [1]

(ii) Total number of male residents
= 1600 + 2000 + 2500 + 1900 + 1600 + 1100
= 10 700

Total number of female residents
= 1200 + 1500 + 3400 + 2200 + 2800 + 2700
= 13 800

Difference between the number of male residents and female residents living in the town = 13 800 – 10 700
= **3100** [1]

(c) Number of residents aged 50 years old and above = 1600 + 1100 + 2800 + 2700
= 8200

Total number of residents = 10 700 + 13 800
= 24 500

Required percentage = $\frac{8200}{24\,500}$ × 100%
= **33.5%** (1 d.p.) [1]

11. (a) *(Accept any possible answers.)*
The company could have bought excessive stationery in March which could be used in the later months, thus causing a decline in expenditure between March and April. [1]

(b) (i) Total expenditure over the 5 months
= \$650 + \$250 + \$400 + \$400 + \$300
= \$2000

Average expenditure per month
= $\frac{\$2000}{5}$
= **\$400** [1]

(ii) The company spent less than average in **April** and **July**. [1]

12. (a) Total number of books in the library
= 105 + 70 + 35 + 50 + 25
= **285** [1]

(b) (i) New number of Mandarin books
= 70 + 2
= 72

New number of Tamil books = 35 + 5
= 40

Required fraction = $\frac{40}{72}$
= $\frac{5}{9}$ [1]

(ii) New number of English books
= 105 + 8
= 113

New total number of books in the library
= 285 + 8 + 2 + 5
= 300 [1]

Angle of the sector representing the new number of English books in the library
= $\frac{113}{300}$ × 360°
= **135.6°** [1]

13. (a) Total number of cups of juice sold
$= 22\frac{1}{2} \times 12$
$= 270$
Average number of cups of juice sold per day
$= \frac{270}{5}$
$= \mathbf{54}$ [1]

(b) Number of cups of juice sold on Friday
$= 6\frac{1}{4} \times 12$
$= 75$
Number of cups of juice sold on Thursday
$= 2\frac{1}{2} \times 12$
$= 30$
Difference in revenue between the two days
$= (75 - 30) \times \$0.70$
$=$ **\$31.50** [1]

(c) Number of cups of juice sold on the first 3 days
$= 13\frac{3}{4} \times 12$
$= 165$
Required percentage $= \frac{165}{270} \times 100\%$
$=$ **61.1%** (1 d.p.) [1]

14. (a) Total number of dengue cases in 2013
$= 50 + 60 + 100 + 90$
$= 300$
Total number of dengue cases in 2014
$= 70 + 60 + 90 + 110$
$= 330$
Difference between the number of dengue cases in both years $= 330 - 300$
$= 30$ [1]
Percentage increase in the number of dengue cases in 2014 as compared to 2013
$= \frac{30}{300} \times 100\%$
$=$ **10%** [1]

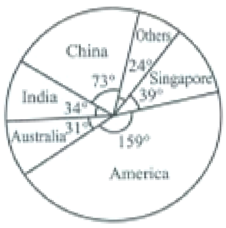
(b) (i) **March** had the lowest number of dengue cases in 2013.
Required fraction $= \frac{50}{300}$
$= \mathbf{\frac{1}{6}}$ [1]

(ii) **June** had the highest number of dengue cases in 2014.
Required fraction $= \frac{110}{330}$
$= \mathbf{\frac{1}{3}}$ [1]

15. (a) Total number of students
$= 117 + 477 + 93 + 102 + 219 + 72$
$= 1200$

Nationality	Number of students	Angle of sector
Singapore	117	$\frac{117}{1080} \times 360° = 39°$
America	477	$\frac{477}{1080} \times 360° = 159°$
Australia	93	$\frac{93}{1080} \times 360° = 31°$
India	102	$\frac{102}{1080} \times 360° = 34°$
China	219	$\frac{219}{1080} \times 360° = 73°$
Others	72	$\frac{72}{1080} \times 360° = 24°$

[2]



[1]

(b) Required percentage $= \frac{117}{1080} \times 100\%$
$=$ **10.8%** (3 s.f.) [1]

(c) Total number of students from India or China
$= 102 + 219$
$= 321$
Required ratio $= 321 : 1080$
$=$ **107 : 360** [1]

Class Test 2

1. (a) Total sales over the 6 months
$= \$3500 + \$2000 + \$5000 + \$5500 + \$8500 + \$7000$
$= \$31\,500$
Average sales per month $= \frac{\$31\,500}{6}$
$=$ **\$5250** [1]

(b) Total sales in April, May and June
$= \$5500 + \$8500 + \$7000$
$= \$21\,000$
Required fraction $= \frac{\$21\,000}{\$31\,500}$
$= \mathbf{\frac{2}{3}}$ [1]

(c) *(Accept any possible answers.)*
The increase in sales between April and May could be due to a special promotion on the product. [1]

2. (a) Number of apples stall A sold $= 4 \times 240$
$= 960$
Number of apples stall B sold
$= 3 \times 240 + \frac{1}{4} \times 240$
$= 780$
Number of apples stall C sold
$= 5 \times 240 + \frac{1}{2} \times 240$
$= 1320$
Number of apples stall D sold
$= 2 \times 240 + \frac{1}{2} \times 240$
$= 600$
Total number of apples sold by stalls A, B, C and $D = 960 + 780 + 1320 + 600$
$= 3660$
Average number of apples sold by stalls A, B, C and $D = \frac{3660}{4}$
$= $ **915** [1]

(b) Amount of revenue stall B collected
$= \frac{780}{5} \times \$2.30$
$= \$358.80$
Amount of revenue stall C collected
$= \frac{1320}{3} \times \$1.50$
$= \$660$
Difference between the revenue collected by the two stalls $= \$660 - \$358.80$
$= $ **$301.20** [1]

(c) (i) Total number of apples sold by all 5 stalls
$= 5 \times 960$
$= 4800$
Number of apples stall E sold in June
$= 4800 - 3660$
$= $ **1140** [1]

(ii) Number of ○ representing the number of apples stall E sold $= \frac{1140}{240}$
$= 4\frac{3}{4}$

Stall	Number of apples sold in June
E	○○○○◕

[1]

3. (a) Total number of boys
$= 550 + 800 + 400 + 350 + 500$
$= 2600$
Total number of girls
$= 300 + 600 + 750 + 800 + 450$
$= 2900$
Difference between the total number of boys and girls $= 2900 - 2600$
$= $ **300** [1]

(b) (i) Average number of girls each week
$= \frac{2900}{5}$
$= $ **580** [1]

(ii) Week **1** and Week **5** [1]

(c) Number of boys who visited from weeks 3 to 5
$= 400 + 350 + 500$
$= 1250$
Number of girls who visited from weeks 3 to 5
$= 750 + 800 + 450$
$= 2000$
Required ratio $= 1250 : 2000$
$= $ **5 : 8** [1]

(d) Amount of money the aquarium earned from the sale of all the child tickets over the 5 weeks
$= (2600 + 2900) \times \$6.50$
$= $ **$35 750** [1]

4. (a) Number of students who like basketball $= 6 \times 8$
$= 48$
Number of students who like swimming
$= 3 \times \frac{48}{2}$
$= 72$
Number of □ representing the number of students who like swimming $= 72 \div 8$
$= 9$ [1]

Sport	Number of students
Swimming	□□□□□□□□□

(b) Number of students who like football
$= 6\frac{3}{4} \times 8$
$= 54$
Number of students who like basketball or football $= 48 + 54$
$= 102$
Total number of students $= 30 \times 8$
$= 240$
Required percentage $= \frac{102}{240} \times 100\%$
$=$ **42.5%** [1]

(c) Angle of the greatest sector $= \frac{9}{30} \times 360°$
$=$ **108°** [1]

Angle of the smallest sector $= \frac{4}{30} \times 360°$
$=$ **48°** [1]

5. (a)

[2]

(b) *(Accept any possible answers.)*
The trend of the data shows that the attendance is generally decreasing. This could be due to a decline in public's interest towards classical music or less awareness for the concert. [1]

(c) Total number of concert attendees
$= 12\ 500 + 11\ 000 + 8000 + 9500 + 6500$
$= 47\ 500$
Average number of concert attendees over the 5 years $= 47\ 500 \div 5$
$=$ **9500** [1]

(d) Difference between the number of concert attendees in 2012 and 2014 $= 12\ 500 - 8000$
$= 4500$
Cost of each ticket $= \$171\ 000 \div 4500$
$= \$38$
Amount of revenue generated by the ticket sales in 2016 $= 6500 \times \$38$
$=$ **\$247 000** [1]

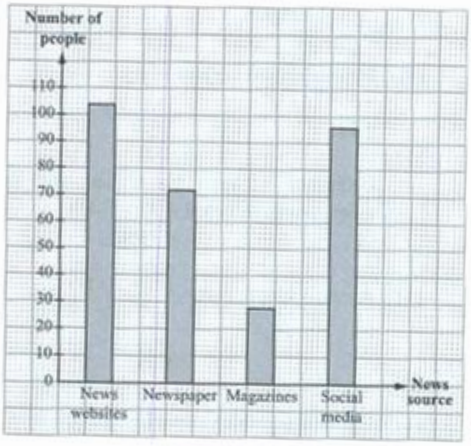
6. (a) *(Accept any possible answers.)*
There might be an increase in fishing activities in the lake during that period of time. [1]

(b) Fish population in August $= 5000$
Fish population in March $= 9000$
Required percentage $= \frac{5000}{9000} \times 100\%$
$=$ **55.6%** (1 d.p.) [1]

(c) Highest fish population $= 9500$
Lowest fish population $= 3500$
Difference between the highest and lowest fish population $= 9500 - 3500$
$=$ **6000** [1]

7. (a) Number of people who refer to news websites
$= 5\frac{1}{5} \times 20$
$= 104$
Number of people who refer to social media
$= 4\frac{4}{5} \times 20$
$= 96$
Total number of people who refer to the top two sources $= 104 + 96$
$= 200$
Total number of people who participated in the survey $= 15 \times 20$
$= 300$
Required percentage $= \frac{200}{300} \times 100$
$=$ **66.7%** (1 d.p.) [1]

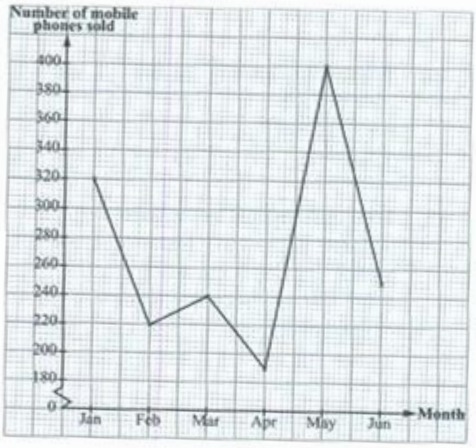
(b) (i) Number of people who refer to newspapers
$= 3\frac{3}{5} \times 20$
$= 72$
Number of people who refer to magazines
$= 1\frac{2}{5} \times 20$
$= 28$



[2]

(ii) The bar graph gives a more accurate comparison of the data as we can easily read off the numerical values from the vertical axis in a bar graph as compared to having to calculate the numerical values using the icons in a pictogram. [1]

8. (a)



[2]

(b) Total number of mobile phones sold
$= 320 + 220 + 240 + 190 + 400 + 250$
$= 1620$
Average number of mobile phones sold per month $= \frac{1620}{6}$
$= \mathbf{270}$ [1]

(c) *(Accept any possible answers.)*
It could be due to a promotion where free gifts are given for every mobile phone bought. [1]

(d) Amount of revenue collected in May
$= 400 \times \$288$
$= \$115\ 200$
Amount of revenue collected in April
$= 190 \times \$288$
$= \$54\ 720$
Difference in sales revenue
$= \$115\ 200 - \$54\ 720$
$= \mathbf{\$60\ 480}$ [1]

9. (a) (i) Angle of the sectors representing the amount of time spent doing homework, sleeping, eating and watching television
$= 25° + 115° + 20° + 10°$
$= 170°$
Angle of the sectors representing the amount of time in CCA, other activities and school
$= 360° - 170°$
$= 190°$ [1]
Angle of the sector representing the amount of time she spends in school
$= \frac{190°}{2}$
$= \mathbf{95°}$ [1]

(ii) Angle of the sectors representing the amount of time she spends in CCA and other activities
$= (3a + 1)° + (4a + 3)°$
$= (7a + 4)°$

$7a + 4 = 95$
$7a = 91$
$a = \mathbf{13}$ [1]

(b) (i) Amount of time she spends sleeping
$= \frac{115°}{360°} \times 24$
$= 7\frac{2}{3}$ h
$= \mathbf{7\ h\ 40\ min}$ [1]

(ii) Amount of time she spends doing her homework $= \frac{25°}{360°} \times 24$

$= 1\frac{2}{3}$ h

$=$ **1 h 40 min** [1]

(c) 1 h 10 min $= 1\frac{1}{6}$ h

Angle of the sector representing the amount of time she spends jogging $= \frac{1\frac{1}{6}}{24} \times 360°$

$=$ **17.5°** [1]

10. (a) Total number of pets owned

$= (550 \times 0) + (375 \times 1) + (450 \times 2) + (175 \times 3) + (50 \times 4)$

$= 2000$ [1]

Total number of people surveyed

$= 550 + 375 + 450 + 175 + 50$

$= 1600$

Average number of pets each person own

$= \frac{2000}{1600}$

$=$ **1.25** [1]

(b) Number of people who own 1 or 2 pets

$= 375 + 450$

$= 825$

Required percentage $= \frac{825}{1600} \times 100\%$

$=$ **51.6%** (1 d.p.) [1]

(c) 10 units ⟶ 150 people

1 unit ⟶ 150 ÷ 10

$= 15$ people

Number of additional people who do not own any pets $= 3 \times 15$

$= 45$

Number of additional people who own 1 pet

$= 5 \times 15$

$= 75$

Number of additional people who own 3 pets

$= 2 \times 15$

$= 30$

Total number of people who own 0 or 3 pets

$= 550 + 175 + 45 + 30$

$= 800$ [1]

Total number of people who own 1 or 2 pets

$= 375 + 450 + 75$

$= 900$

Required ratio $= 800 : 900$

$=$ **8 : 9** [1]

Revision Paper 1

1. (a) (i) HCF of 25 480 and 14 196

$= 2^2 \times 7 \times 13$

$=$ **364** [1]

(ii) LCM of 25 480 and 14 196

$= 2^3 \times 3 \times 5 \times 7^2 \times 13^2$

$=$ **993 720** [1]

(b) Smallest possible value of n

$= 3 \times 7$

$=$ **21** [1]

2. (a) Difference between the highest and lowest temperatures recorded $= 31 - (-15)$

$=$ **46°C** [1]

(b) Average temperature $= \frac{(-15) + 16 + 25 + 31 + 22 + (-7)}{6}$

$= \frac{72}{6}$

$=$ **12°C** [1]

3. (a) Smallest possible value of $t - s = 2 - 0$

$=$ **2** [1]

(b) Greatest possible value of $s^2 + t^2$

$= (-7.8)^2 + 13^2$

$= 60.84 + 169$

$=$ **229.84** [1]

(c) Smallest possible value of $st = -7.8 \times 13$

$=$ **−101.4** [1]

(d) Greatest possible value of $s + t = 0 + 13$

$=$ **13** [1]

4. (a) Total marks scored by the girls

$= x \times 3(y + 2)$

$= x \times (3y + 6)$

$= \mathbf{3xy + 6x}$ [1]

(b) Total marks scored by the boys

$= [6x(y + 2) - y - 2] - (3xy + 6x)$

$= (6xy + 12x - y - 2) - 3xy - 6x$

$= 6xy + 12x - y - 2 - 3xy - 6x$

$= \mathbf{3xy + 6x - y - 2}$ [1]

(c) Number of boys in the class = 32 – 12
= 20
Total marks scored by the boys
= $3xy + 6x - y - 2$
= 3(12)(14) + 6(12) – 14 – 2
= 504 + 72 – 14 – 2
= 560 [1]
Average marks scored by the boys = 560 ÷ 20
= **28** [1]

5. (a) $4 - \frac{1-2a}{5} + \frac{3(a+3)}{2} = -2$

$\frac{3(a+3)}{2} - \frac{1-2a}{5} = -2 - 4$
$= -6$

$5[3(a+3)] - 2(1-2a) = -60$ [$\frac{1}{2}$]
$15a + 45 - 2 + 4a = -60$
$19a + 43 = -60$
$19a = -60 - 43$
$= -103$
$a = \frac{-103}{19}$
$= -5\frac{8}{19}$ [$\frac{1}{2}$]

(b) $\frac{1+2x}{x} - 4 = \frac{3-x}{2x}$
$2(1+2x) - 4(2x) = 3 - x$ [$\frac{1}{2}$]
$2 + 4x - 8x = 3 - x$
$2 - 4x = 3 - x$
$-x + 4x = 2 - 3$
$3x = -1$
$x = \frac{-1}{3}$
$= -\frac{1}{3}$ [$\frac{1}{2}$]

6. (a) Points on line AB: (0, 0) and (–5, 3)
Gradient of line $AB = \frac{3-0}{-5-0}$
$= -\frac{3}{5}$
Equation of line AB: $y = -\frac{3}{5}x$ [1]

(b) When $x = a$ and $y = -1\frac{1}{5}$,
$-1\frac{1}{5} = -\frac{3}{5}a$
$a = 2$ [1]

(c) Points on line PQ: $\left(2, -1\frac{1}{5}\right)$ and (0, –3)
Gradient of line $PQ = \frac{-3-\left(-1\frac{1}{5}\right)}{0-2}$
$= \frac{-1\frac{4}{5}}{-2}$
$= \frac{9}{10}$
Equation of line PQ: $y = \frac{9}{10}x - 3$ [1]

7. (a) $T_4 = 2^2 - 5 = -1$
$T_5 = \left(\frac{5}{2}\right)^2 - 5 = 1\frac{1}{4}$ [1]

(b) General term, $T_n = \left(\frac{n}{2}\right)^2 - 5$ [1]

(c) When $n = k$, $T_k = \left(\frac{k}{2}\right)^2 - 5$
$\left(\frac{k}{2}\right)^2 - 5 = 267\frac{1}{4}$
$\frac{k^2}{4} = 272\frac{1}{4}$
$k^2 = 1089$
$k = 33$ [1]

8. (a) Amount of commission earned in June
= \$1780 – \$700
= \$1080
5% of total sales ⟶ \$1080
100% of total sales ⟶ $100 \times \frac{\$1080}{5}$
= \$21 600
His total sales in June = **\$21 600** [1]

(b) Amount of commission earned in August
= 5% × \$31 160
= \$1558
Total salary in August before bonus
= \$700 + \$1558
= \$2258
Total salary in August after bonus
= (100% + 10%) × \$2258
= 110% × \$2258
= **\$2483.80** [1]

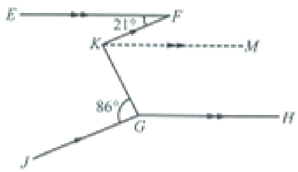
9. (a) Time Raj left point B = 09 08 + 00 36 + 00 18
= 10 02
Time Raj took to travel from point B to point C
= 10 14 – 10 02
= 00 12
= $\frac{1}{5}$ h
Cycling speed between point B and point C
= $2.1 \div \frac{1}{5}$
= **10.5 km/h** [1]

(b) (i) Distance between point A and point B
= $13 \times \frac{36}{60}$
= **7.8 km** [1]

(ii) Total time taken = 10 14 – 09 08
= 01 06 h
= $1\frac{1}{10}$ h
Total distance travelled = 7.8 + 2.1
= 9.9 km
Average speed for the entire journey
= $9.9 \div 1\frac{1}{10}$
= **9 km/h** [1]

10. (a) $\angle FKG = \angle KGJ$ (alt. ∠s, KF // JG)
= 86°
Reflex $\angle FKG$ = 360° – 86° (∠s at a pt.)
= **274°** [1]

(b) Draw a line at K parallel to EF and GH.



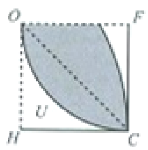
$\angle FKM = \angle EFK$ (alt. ∠s, EF // KM)
= 21°
$\angle MKG$ = 86° – 21°
= 65°
$\angle KGH$ = 180° – 65° (int. ∠s, KM // GH)
= **115°** [1]

(c) $\angle JGH$ = 360° – 86° – 115° (∠s at a pt.)
= **159°** [1]

11. Refer to Appendix 15.
(b) (i) EF = **4.3 cm** [1]
(ii) $\angle CFE$ = **35°** [1]
(c) EC = 3 cm
Area of $\triangle FEC = \frac{1}{2} \times 3 \times 4.3$
= **6.45 cm²** [1]

12. (a) Arc length of quadrant ACD
= $\frac{1}{4} \times 2 \times \frac{22}{7} \times 12$
= $18\frac{6}{7}$ cm
Radius of quadrant AOE = 12 ÷ 2
= 6 cm
Arc length of quadrant AOE
= $\frac{1}{4} \times 2 \times \frac{22}{7} \times 6$
= $9\frac{3}{7}$ cm [1]
Perimeter of the shaded region
= $18\frac{6}{7} + \left(2 \times 9\frac{3}{7}\right)$
= $18\frac{6}{7} + 18\frac{6}{7}$
= **$37\frac{5}{7}$ cm** [1]

(b)



Area of square $OFCH$ = 6 × 6
= 36 cm²
Area of quadrant $OFC = \frac{1}{4} \times \frac{22}{7} \times 6^2$
= $28\frac{2}{7}$ cm²
Area $U = 36 - 28\frac{2}{7}$
= $7\frac{5}{7}$ cm² [1]
Area of quadrant $ACD = \frac{1}{4} \times \frac{22}{7} \times 12^2$
= $113\frac{1}{7}$ cm²
Area of the shaded region
= $113\frac{1}{7} - 28\frac{2}{7} - 36 - 7\frac{5}{7}$
= **$41\frac{1}{7}$ cm²** [1]

(c) (i) Number of tiles along the length of the wall = 3 m ÷ 12 cm
= 300 cm ÷ 12 cm
= 25
Number of tiles along the breadth of the wall = 1.8 m ÷ 12 cm
= 180 ÷ 12
= 15
Total number of tiles required = 25 × 15
= **375** [1]

(ii) Total area of the shaded region on the wall
$= 375 \times 41\frac{1}{7}$
$= \mathbf{15\ 428\frac{4}{7}\ cm^2}$ [1]

13. (a) Area of the square pattern
$= 4 \times \left(\frac{1}{2} \times 5 \times 5\right)$
$= 4 \times 12.5$
$= 50\ cm^2$
Area of the cross-section painted
$= \left(\frac{22}{7} \times 5^2\right) - 50$
$= 78\frac{4}{7} - 50$
$= 28\frac{4}{7}\ cm^2$
Curved surface area of the cylinder
$= 2 \times \frac{22}{7} \times 5 \times 15$
$= 471\frac{3}{7}\ cm^2$ [1]
Surface area of the cylinder that is painted
$= \left(2 \times 28\frac{4}{7}\right) + 471\frac{3}{7}$
$= 57\frac{1}{7} + 471\frac{3}{7}$
$= \mathbf{528\frac{4}{7}\ cm^2}$ [1]

(b) Total surface area needed to be painted
$= 21 \times 528\frac{4}{7}$
$= 11\ 100\ cm^2$
Volume of paint needed to paint 21 such cylinders $= \frac{11\ 100}{2} \times 5$
$= 27\ 750\ ml$
$= 27.75\ l$
Cost of painting the cylinders
$= \frac{27.75}{0.5} \times \$7$
= **$388.50** [1]

14. (a) (i) Total number of fans sold in total by brand A = 800 + 550 + 350 + 700 + 600 + 450
= 3450
Average number of fans sold per week by brand A = 3450 ÷ 6
= **575** [1]

(ii) Total number of fans sold in total by brand B = 650 + 600 + 750 + 750 + 600 + 550
= 3900
Average number of fans sold per week by brand B = 3900 ÷ 6
= **650** [1]

(b) (i) Total revenue collected by brand A
= 3450 × $120
= $414 000
Total revenue collected by brand B
= 3900 × $108
= $421 200
Difference in the total revenue collected over the 6 weeks = $421 200 – $414 000
= **$7200** [1]

(ii) Revenue collected by brand A in the first 2 weeks = (800 + 550) × $120
= $162 000
Revenue collected by brand B in the first 2 weeks = (650 + 600) × $108
= $135 000
Total revenue collected by both brands in the first 2 weeks = $162 000 + $135 000
= $297 000
Total combined revenue collected
= $414 000 + $421 200
= $835 200
Required percentage
$= \frac{\$297\ 000}{\$835\ 200} \times 100\%$
= **35.6%** (1 d.p.) [1]

(c) (i) Combined sales in week 1 = 800 + 650
= 1450
Combined sales in week 2 = 550 + 600
= 1150
Combined sales in week 3 = 350 + 750
= 1100
Combined sales in week 4 = 700 + 750
= 1450
Combined sales in week 5 = 600 + 600
= 1200
Combined sales in week 6 = 450 + 550
= 1000

The lowest combined sales for brand A and brand B was in **week 6**. [1]

(ii) Revenue collected by brand A in week 6
= 450 × $120
= $54 000
Revenue collected by brand B in week 6
= 550 × $108
= $59 400
Difference in revenue between brand A and brand B in week 6
= $59 400 – $54 000
= **$5400** [1]

Secondary 1 • Worked Solutions

Revision Paper 2

1. $\frac{99}{999} = 99 \div 999$
$= 0.099\ 099\ 0\ldots$
$\frac{999}{9999} = 999 \div 9999$
$= 0.099\ 909\ 99\ldots$ [1]
Therefore, $\frac{999}{9999}$ is greater. [1]

2. (a) $A_1 = $ **5 units²**
$A_2 = $ **8 units²**
$A_3 = $ **11 units²** [1]
$P_1 = $ **12 units**
$P_2 = $ **16 units**
$P_3 = $ **20 units** [1]

(i) $5 = 3(1) + 2$
$8 = 3(2) + 2$
$11 = 3(3) + 2$
$A_n = \mathbf{3n + 2}$ [1]

(ii) $12 = 4(1) + 8$
$16 = 4(2) + 8$
$20 = 4(3) + 8$
$P_n = \mathbf{4n + 8}$ [1]

(b) $A_n = 3n + 2$
$3n = A_n - 2$
$n = \frac{A_n - 2}{3}$ [1]
Substitute $n = \frac{A_n - 2}{3}$ into P_n,
$P_n = 4\left(\frac{A_n - 2}{3}\right) + 8$
$= \frac{4A_n - 8 + 24}{3}$
$= \mathbf{\frac{4A_n + 16}{3}}$ [1]

(c) $A_n + P_n = 3n + 2 + 4n + 8$
$= 7n + 10$
$7n + 10 = 206$
$7n = 206 - 10$
$n = 196 \div 7$
$= 28$ [1]
Perimeter of the blank space $= 4(28) + 8$
$=$ **120 units** [1]

3. (a) Cost of each pen $= \$\frac{P}{6}$
Cost of each notebook $= \$\frac{P}{4}$
Let x be the number of pens and notebooks he can buy using $\$P$ respectively.
$x \times \frac{P}{6} + x \times \frac{P}{4} = P$
$\frac{5}{12}Px = P$
$\frac{5}{12}x = 1$
$x = \frac{12}{5}$ [1]
Since x is not an integer, it is **not possible** for Michael to spend all his money on an equal number of each stationery. [1]

(b) $x = \frac{12}{5}$
$= 2.4$
$= 3$ (round up)
Total cost of 1 pen and 1 notebook
$= \$\frac{P}{6} + \$\frac{P}{4}$
$= \$\frac{5P}{12}$ [1]
Total cost of 3 pens and 3 notebooks
$= 3 \times \$\frac{5P}{12}$
$= \$\frac{5P}{4}$
Minimum amount of money that must be added
$= \$\frac{5P}{4} - \$P$
$= \mathbf{\$\frac{P}{4}}$ [1]

4. (a) $y = 65t + 20$

t	0	1	2	3	4
y	20	85	150	215	280

[1]

$y = -45t + 460$

t	5	6	7	8
y	235	190	145	100

[1]
Refer to Appendix 40. [3]

(b) (i) It is moving away from the printing company. [1]
(ii) It is moving towards the printing company. [1]

(c) From the graph,
Total distance moved
$= 280 - 20 + 280 - 100$
$=$ **440 m** [1]

(d) From the graph, when $y = 180$,
$t_1 = \mathbf{2.4}$ [1]
$t_2 = \mathbf{6.2}$ [1]

5. (a) Height of water level = 21 – 1
= 20 cm
Volume of water in the container = 18 × 5 × 20
= **1800 cm^3**
[1]

(b) Base area of the container that is in contact with the water = 18 × 5
= 90 cm^2
Perimeter of the base of the container that is in contact with the water
= 2 × (18 + 5)
= 46 cm
Surface area of the container that is in contact with the water = 90 + (46 × 20)
= **1010 cm^2** [1]

(c) Total volume of the container
= (18 + 2) × (5 + 2) × 21
= 2940 cm^3
Volume of the container = 2940 – 1800
= 1140 cm^3 [1]
Mass of the empty container = 8 × 1140
= **9120 g** [1]

6. Let the first five consecutive multiples of x be a_1, a_2, a_3, a_4 and a_5 respectively, where $a_1 = xn$, $a_2 = x(n + 1)$, $a_3 = x(n + 2)$, $a_4 = x(n + 3)$ and $a_5 = x(n + 4)$.

$\frac{a_1}{a_3} = \frac{4}{5}$

$\frac{xn}{x(n+2)} = \frac{4}{5}$

$\frac{n}{n+2} = \frac{4}{5}$

$5n = 4(n + 2)$
$n = 8$ [1]
$a_5 - a_1 = 72$
$x(n + 4) - xn = 72$
Substitute $n = 8$ into the equation:
$x(8 + 4) - 8x = 72$
$4x = 72$
$x = 18$ [1]
Since the integer x is an even number, the sum of its multiples will be an even number.
Therefore, **the player will win a prize.** [1]

7. (a) Length of CD = Length of AB
= 32 cm
Length of AD = Length of BC
= 55% × 32
= $\frac{55}{100} \times 32$
= **17.6 cm** [1]

(b) Perimeter of rectangle $ABCD$
= 2 × (32 + 17.6)
= **99.2 cm** [1]

8. (a) Sum of interior angles of a hexagon
= (6 – 2) × 180°
= 720°
$242° + 136° + (x - 54)° + 3x° = 720°$ [1]
$4x = 396$
$x = 396 \div 4$
= **99** [1]

(b) Smallest interior angle = $(x - 54)°$ [1]
= 99° – 54°
= 45°
Largest exterior angle = 180° – 45° (adj. ∠s on a st. line)
= **135°**
[1]

9. (a) $65° + 125° + (3x + 10)° + x°$
= 360° (∠s at a pt.) [1]
$200° + 4x° = 360°$
$4x = 160$
$x = \mathbf{40}$ [1]

(b) (i) Angle of sector representing the number of apples at first
= $(3x + 10)°$
= 3(40°) + 10°
= 130°
Difference between the angle of sector representing the number of apples and the number of lemons
= 130° – 125°
= 5° [1]
$\frac{5}{360}$ of the fruits ⟶ 8 – 6
= 2 fruits
$\frac{360}{360}$ of the fruits ⟶ $\frac{2}{5} \times 360$
= 144 fruits
Number of fruits initially = **144** [1]

(ii) Number of pears at first $= \frac{65}{360} \times 144$
$= 26$

Number of oranges at first $= \frac{40}{360} \times 144$
$= 16$

Number of fruits in the end
$= 144 - 6 - 8 - y - y$
$= 130 - 2y$ [1]

$\frac{26-y}{130-2y} \times 360° - \frac{16-y}{130-2y} \times 360°$
$= 35\frac{5}{17}°$ [1]

$\frac{26-y-(16-y)}{130-2y} \times 360 = \frac{600}{17}$

$\frac{26-y-16+y}{130-2y} = \frac{600}{17} \div 360$

$\frac{10}{130-2y} = \frac{5}{51}$

$510 = 5(130-2y)$
$10y = 5(130) - 510$
$= 140$
$y = \mathbf{14}$ [1]

(iii) Number of fruits left $= 130 - 2y$
$= 130 - 2(14)$
$= \mathbf{102}$ [1]

10. (a) (i) Length of arc $AFC = \frac{1}{4} \times 2 \times \pi \times 15$
$= 7.5\pi$ cm

Perimeter of the shaded region
$= 7.5\pi + 7.5\pi$
$= \mathbf{15\pi}$ **cm** [1]

(ii) Area of quadrant $DAFC = \frac{1}{4} \times \pi \times 15^2$
$= 56.25\pi$ cm^2

Area of $\triangle DAC = \frac{1}{2} \times 15 \times 15$
$= 112.5$ cm^2

Area of the shaded region
$= 2 \times (56.25\pi - 112.5)$
$= 112.5\pi - 225$
$= \mathbf{112.5(\pi - 2)}$ **cm^2** [1]

(iii) Area of the unshaded region
$= 15^2 - 112.5(\pi - 2)$
$= 225 - 112.5\pi + 225$
$= 450 - 112.5\pi$
$= 112.5(4 - \pi)$ cm^2

Required ratio
$= 112.5(\pi - 2) : 112.5(4 - \pi)$
$= \mathbf{\pi - 2 : 4 - \pi}$ [1]

(b) 1 cm : 0.5 m
1 cm^2 : 0.25 m^2

Actual area of the leaf $= 112.5(\pi - 2) \times 0.25$
$= 28.125(\pi - 2)$ m^2

Actual area of the 2 identical circles
$= 2 \times \pi \times 2.5^2 \times 0.25$
$= 3.125\pi$ m^2 [1]

Cost of producing the old version of the window (excluding the window frame)
$= 28.125(\pi - 2) \times \$8$
$= \$256.86$ (nearest cent)

Amount of money increased from producing the new version of the window
$= 3.125\pi \times \$8$
$= \$78.54$ (nearest cent)

Percentage increase in the cost
$= \frac{\$78.54}{\$256.86} \times 100\%$
$= \mathbf{30.6\%}$ (3 s.f.) [1]

Problems in Real-World Contexts

1. (a)

2	30	24
2	15	12
3	15	6
	5	2

Shortest length of 1 square tile
$= 2 \times 2 \times 3 \times 5 \times 2$
$= 120$ cm

Minimum area of 1 square tile formed
$= 120 \times 120$
$= \mathbf{14\ 400}$ **cm^2**

(b) Area of each rectangular tile $= 30 \times 24$
$= 720$ cm^2

Number of tiles used to form 1 square tile
$= \frac{14\ 400}{720}$
$= 20$

Total cost of all the tiles used to form 1 square tile $= 20 \times \$8.50$
$= \mathbf{\$170}$

(c) $144 \text{ m}^2 = 144 \times 100 \times 100$
$= 1\,440\,000 \text{ cm}^2$
Total cost to lay a floor of area 144 m^2
$= \frac{1\,440\,000}{14\,400} \times \$170$
$= \mathbf{\$17\,000}$
Area of each 30-cm square tile $= 30 \times 30$
$= 900 \text{ cm}^2$
Cost of laying a floor of area 144 m^2
$= \frac{1\,440\,000}{900} \times \$9.50$
$= \$15\,200$
Difference in cost $= \$17\,000 - \$15\,200$
$= \$1800$
It is cheaper to use **square tiles** to lay the floor as it is cheaper by **$1800**.

2. Let x be the number of shirts he bought.
Number of pairs of jeans he bought $= 90 - x$
Total cost after discount
$= x \times \$8 + (90 - x) \times \$12 - \$8$
$= \$8x + \$(1080 - 12x) - \$8$
$= \$(1072 - 4x)$
$= \$4(268 - x)$
Total amount of money the cashier collected
$= \$1000 - \$55$
$= \$945$
The total cost of all the items after discount was $\$4(268 - x)$, however the amount of money the cashier collected, $945, is not divisible by 4. Hence, the cashier made a mistake in the change. (shown)

3. (a) $y_1 = 3.5x$
$y_2 = x + 55$

x	0	20	40	60	80
y_1	0	70	140	210	280
y_2	55	75	95	115	135

Refer to Appendix 41.

(b) (i) (22, 77)

(ii) The $77 collected from selling 22 packets of sweets is the breakeven point. It means that there is no profit as $77 is just enough to cover the total cost of preparing 22 packets of sweets.

4. (a) $a = \mathbf{20}$, $b = \mathbf{21}$

(b) $c = \boldsymbol{n}$, $d = \boldsymbol{n + 1}$

(c) Number of bacteria at the end of m days
$= \boldsymbol{\frac{1}{m(m+1)}}$
When $m = 50$,
Number of bacteria $= \frac{1}{50 \times 51}$
$= \mathbf{0.000\,392}$ (3 s.f.)

5. Let x be the sales figure.
Sales in the first half of the year
$= (100\% + 40\%) \times x$
$= 140\% \times x$
$= 1.4x$
Sales in the second half of the year
$= (100\% - 40\%) \times 1.4x$
$= 60\% \times 1.4x$
$= 0.84x$
Net decrease $= x - 0.84x$
$= 0.16x$
Net percentage decrease $= 0.16 \times 100\%$
$= 16\%$
Therefore, the store manager should remain **status quo** for his stores since there is a net decrease in sales.

6. Original area of the triangle $= \frac{1}{2}(AB)(AC)$
New base of the triangle $= (100\% - 15\%) \times AB$
$= 85\% \times AB$
$= 0.85AB$
New height of the triangle $= (100\% + x\%) \times AC$
$= \left(1 + \frac{x}{100}\right)AC$
New area of the triangle $= \frac{1}{2}(0.85AB)\left[\left(1 + \frac{x}{100}\right)AC\right]$

$$\frac{\frac{1}{2}(0.85)\left(1 + \frac{x}{100}\right)(AB)(AC) - \frac{1}{2}(AB)(AC)}{\frac{1}{2}(AB)(AC)} = \frac{115}{100}$$

$$\frac{\frac{1}{2}(AB)(AC)\left[0.85\left(1 + \frac{x}{100}\right) - 1\right]}{\frac{1}{2}(AB)(AC)} = \frac{23}{20}$$

$$0.85\left(1 + \frac{x}{100}\right) - 1 = \frac{23}{20}$$

$$1 + \frac{x}{100} = \frac{43}{17}$$

$$x = \mathbf{153} \text{ (3 s.f.)}$$

7. $\angle CDE = 34°$ (alt. $\angle$s, $CD \parallel EF$)
$\angle HDE = 34° \div 2$
$= 17°$
$\angle BDC = 180° - 128°$ (int. $\angle$s, $AB \parallel CD$)
$= 52°$
$\angle BDE = 52° + 34°$
$= 86°$
$\angle GDE = 86° \div 2$
$= 43°$
$\angle GDH = \angle GDE - \angle HDE$
$= 43° - 17°$
$= \mathbf{26°}$

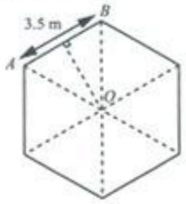
8. $\angle YXZ = \angle WZV$ (corr. $\angle$s, $XY \parallel ZW$)
$\angle XYZ = \angle YZW$ (alt. $\angle$s, $XY \parallel ZW$)
$\angle YXZ + \angle XYZ + \angle YZX = \angle WZV + \angle YZW + \angle YZX$
$= 180°$ (adj. $\angle$s on a st. line)
Since the sum of all the angles in $\triangle XYZ$ is 180°, the batch of elastic balls will **pass** the quality check.

9. $\angle BPR = (180 - x)°$ (adj. $\angle$s on a st. line)
$\angle RPQ = \angle BPQ$ (PQ bisects $\angle BPR$)
$= \left(\frac{180 - x}{2}\right)°$
$\angle BQR = 180° - (x - 15)°$ (adj. $\angle$s on a st. line)
$= (195 - x)°$
$\angle RQP = \angle BQP$ (QP bisects $\angle BQR$)
$= \left(\frac{195 - x}{2}\right)°$
$\angle PRQ = 180° - \left(\frac{180 - x}{2}\right)° - \left(\frac{195 - x}{2}\right)°$ ($\angle$ sum of $\triangle$)
$= 180° - 90° + \frac{x°}{2} - 97.5° + \frac{x°}{2}$
$= (x - 7.5)°$
$\therefore \angle ABC = (x - 7.5)°$

$(x - 7.5)° + (3x + 8)° + (x + 18)° = 180°$ ($\angle$ sum of $\triangle$)
$5x + 18.5 = 180$
$x = 32.3$

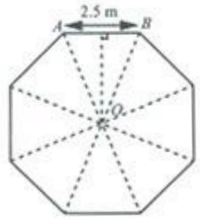
$\angle ABC = (32.3 - 7.5)°$
$= 24.8°$ ($< 25°$)
The proposed ice-cream cones **will be able** to fit into the holder.

10. Figure 1



Vertical height of $\triangle AOB = 4.8 \div 2$
$= 2.4$ m
Area of $\triangle AOB = \frac{1}{2} \times 3.5 \times 2.4$
$= 4.2$ m^2
Area of the hexagonal signboard $= 6 \times 4.2$
$= 25.2$ m^2
Cost of manufacturing $= 25.2 \times \$8.50$
$= \$214.20$

Figure 2

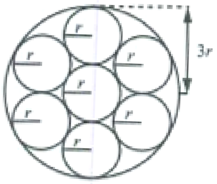


Vertical height of $\triangle AOB = 5.2 \div 2$
$= 2.6$ m
Area of $\triangle AOB = \frac{1}{2} \times 2.5 \times 2.6$
$= 3.25$ m^2
Area of the octagonal signboard $= 8 \times 3.25$
$= 26$ m^2
Cost of manufacturing $= 26 \times \$8.50$
$= \$221$

Difference in cost $= \$221 - \$214.20$
$= \$6.80$
It is cheaper to manufacture the **hexagonal road sign** by **\$6.80** each.

11. (a) Let r be the radius of each piece of chocolate and $3r$ be the radius of the circular tin.
Base area of the circular tin $= \pi \times 3r \times 3r$
$= 9\pi r^2$
Area of the cross-section of each piece of chocolate $= \pi \times r \times r$
$= \pi r^2$
Required ratio $= 9\pi r^2 : \pi r^2$
$= \mathbf{9 : 1}$

(b)



Number of pieces of chocolate that can fit into the circular tin = **7**

(c) Total base area of 7 pieces of chocolate $= 7\pi r^2$
Area of the circular tin not covered by the chocolates $= 9\pi r^2 - 7\pi r^2$
$= 2\pi r^2$
Required percentage $= \frac{2\pi r^2}{9\pi r^2} \times 100\%$
$= \frac{2}{9} \times 100\%$
$= \mathbf{22\frac{2}{9}\ \%}$

12. (a) Let x cm be the thickness of each piece of kitchen towel.
$56 \times 25 \times 22.8 \times x$
$= \pi\left(\frac{15}{2}\right)^2 \times 25 - \pi\left(\frac{4.8}{2}\right)^2 \times 25$
$31\ 920x = 1406.25\pi - 144\pi$
$x = 0.124\ 232$
Thickness of each piece of kitchen towel
$= 0.124\ 232 \times 10$
$= \mathbf{1.24\ mm}$ (3 s.f.)

(b) Let n be the number of kitchen towels that can be detached.
$n \times 25 \times 22.8 \times 0.124\ 232$
$= \pi\left(\frac{15}{2}\right)^2 \times 25 - \pi\left(\frac{3.5}{2}\right)^2 \times 25$
$70.812\ 24n = 4177.336\ 482$
$n = 58.99$
$= 58$ (round down)
Percentage increase $= \frac{58 - 56}{56} \times 100\%$
$= \frac{2}{56} \times 100\%$
$= \mathbf{3.57\%}$ (3 s.f.)