Topic 7 Energy, Work and Power

PAPER 1

MULTIPLE-CHOICE QUESTIONS

For each question, there are four possible answers. Choose the one you consider correct and record your choice (A, B, C or D) in the brackets provided.

1. A car is travelling along a level road.

   The brakes are applied and the car slows down and stops.

   Which form of energy is most of the car's kinetic energy converted to? (2011/P1/Q8)

   A chemical
   B gravitational potential
   C sound
   D thermal ( )

2. A boy and a girl run up the same flight of stairs on two occasions.

   On the first occasion they both take 10 s.

   On the second occasion they both take 12 s.

   The boy weighs 600 N and the girl weighs 400 N.

   Who produces the most power, and when? (2011/P1/Q9 / 2016/P1/Q9)

   A the boy when he takes 10 s
   B the boy when he takes 12 s
   C the girl when she takes 10 s
   D the girl when she takes 12 s ( )

3. Which activity converts elastic potential energy to gravitational potential energy? (2012/P1/Q7)

   A climbing a steep hill
   B hammering a post into the ground
   C lifting a box onto a shelf
   D shooting an arrow up into the air ( )

4. A worker lifts boxes of identical weight from the ground onto a moving belt.

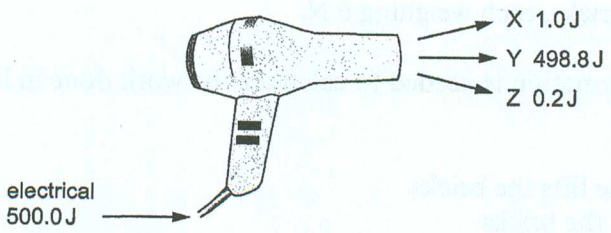
   In the morning, it takes him 2 s to lift each box. Later in the day, it takes him 3 s.

   Which statement is correct? (2012/P1/Q8)

   A Later in the day, less work is done in lifting each box.
   B Later in the day, more work is done in lifting each box.
   C Later in the day, less power is developed in lifting each box.
   D Later in the day, more power is developed in lifting each box. ( )

5. The main purpose of a hair drier is to heat air.

   The diagram shows some of the energy conversions that take place when a hair drier is switched on.



   Which type of energy is Y? (2012/P1/Q9 / 2015/P1/Q19)

   A electrical **B** kinetic
   C sound **D** thermal ( )

6. What is the unit of work? (2013/P1/Q8)

   A joule **B** kilogram
   C newton **D** watt ( )

7. A worker carries bricks up a ladder.

The following quantities are known.
- the height the bricks are lifted up
- the time taken for the builder to lift the bricks
- the volume of the bricks
- the weight of the bricks

Which quantities are needed to calculate the useful power produced by the worker as he carries the bricks up the ladder? (2013/P1/Q9)

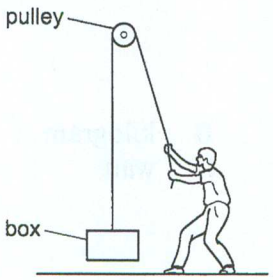
A height, time and volume
B height, time and weight
C height, volume and weight
D time, volume and weight ( )

8. A man lifts 20 bricks, each weighing 6 N.

What other information is needed to calculate the work done in lifting the bricks? (2014/P1/Q8)

A the height he lifts the bricks
B the mass of the bricks
C the time taken to lift the bricks
D the volume of the bricks ( )

9. A pulley is used to lift a box.

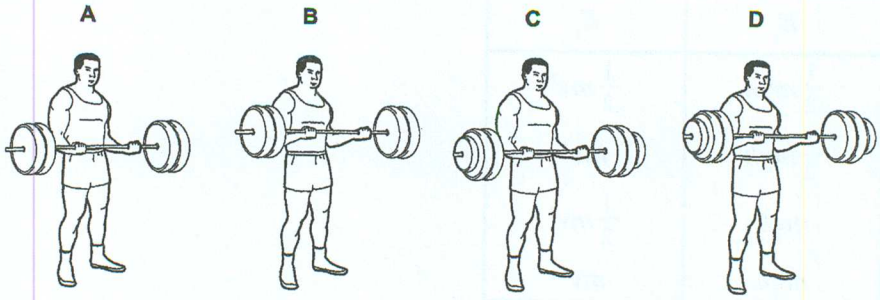


Which change would need **less** power to lift the box? (2014/P1/Q9)

A lifting a heavier box
B lifting the box more slowly
C lifting the box higher
D lifting the box using a motor ( )

10. A weightlifter lifts different weights through different heights.

When does he do the most work? (2015/P1/Q9)



( )

11. Which equation for calculating gravitational potential energy is correct? (2015/P1/Q10)

A $E_p = \frac{mg}{h}$ **B** $E_p = \frac{m}{gh}$

C $E_p = mgh$ **D** $E_p = \frac{gh}{m}$ ( )

12. What is the principle of conservation of energy? (2016/P1/Q8)

A Energy can be lost to the surroundings.
B Energy can be stored.
C Energy cannot be created.
D Energy cannot be created or destroyed. ( )

13. A gymnast jumps onto a trampoline and bounces upwards.

On a second occasion, the gymnast bounces higher.

What remains constant on both occasions? (2017/P1/Q2)

A the gymnast's acceleration in the air
B the gymnast's maximum gravitational potential energy
C the gymnast's maximum kinetic energy
D the gymnast's speed on contact with the trampoline ( )

14. Which row gives the correct formulae for gravitational potential energy E_p and kinetic energy E_k? (2017/P1/Q9)

	E_p	E_k
A	$\frac{1}{2}mgh$	$\frac{1}{2}mv^2$
B	$\frac{1}{2}mgh$	mv^2
C	mgh	$\frac{1}{2}mv^2$
D	mgh	mv^2

( )

15. A person does 150 J of work each time they lift a weight.

In four minutes, the average power used is 75 W.

How many times is the weight lifted in four minutes? (2017/P1/Q10)

A 2 **B** 8
C 120 **D** 480 ( )

16. A cyclist pedals to the top of a hill at constant speed.

Which type of energy decreases as he pedals? (2018/P1/Q9)

A chemical potential energy
B elastic potential energy
C gravitational potential energy
D kinetic energy ( )

17. What needs to be known to calculate the work done by a force acting on an object? (2018/P1/Q10)

	the size of the force	the distance the force moves the object	the time for which the force acts
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✓	✗	✗

key
✓ = needed
✗ = not needed

( )

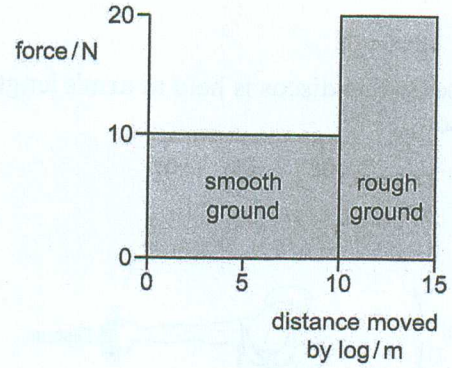
18. A man eats his breakfast and later goes for a run.

Which energy change will take place as the man accelerates? (2019/P1/Q8)

A Chemical potential energy is converted into kinetic energy.
B Chemical potential energy is destroyed.
C Kinetic energy is converted into chemical potential energy.
D Kinetic energy is destroyed.

( )

19. The force used by an engine to drag a log over smooth ground and then over rough ground is represented in the bar chart.



What is the total work done by the engine in dragging the log? (2019/P1/Q9)

A 200 J
B 225 J
C 300 J
D 450 J

( )

PAPER 2

STRUCTURED QUESTIONS

Section A

Answer the following questions.

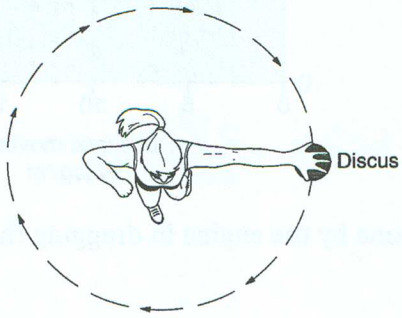
1. A car is parked on a hill. The parking brake fails and the car runs down the hill.

   (a) What force causes the car to run down the hill? [1]

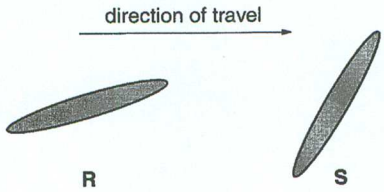
   (b) Describe the energy change as the car starts to run down the hill. [1]

   (2012/P2/A2)

2. An athlete throws a discus. The discus is held at arm's length. She turns in a circle before releasing the discus.

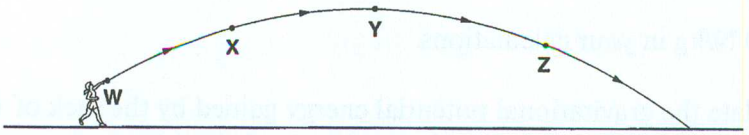


   (a) The diagrams show two ways that the discus can leave the athlete's hand and travel through the air.



   Explain why the athlete makes sure that the discus leaves the hand travelling as shown in **R**. [1]

(b) The diagram shows the path of the discus through the air after being thrown.



Write down the letter which corresponds to the position where the discus has

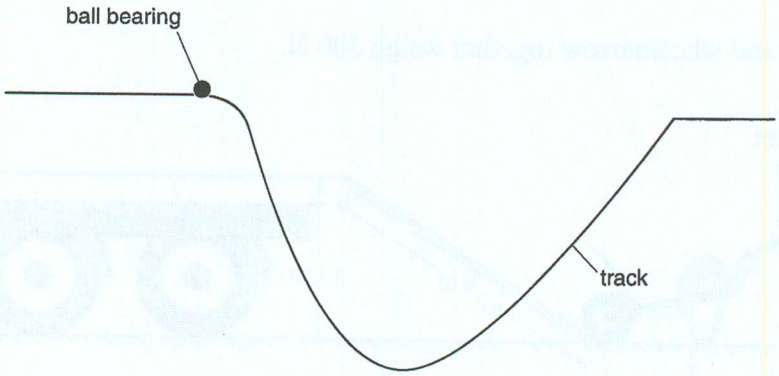
(i) the greatest gravitational potential energy, [1]

(ii) the greatest kinetic energy. [1]

(2013/P2/A3b, c)

3. A small ball bearing is released from the top of the sloping part of a track.

The ball bearing moves along the track.



(a) Mark on the track, with the letter **P**, where the ball bearing has the greatest gravitational potential energy. [1]

(b) Mark on the track, with the letter **K**, where the ball bearing has the greatest kinetic energy. [1]

(c) State the Principle of Conservation of Energy. [1]

(2014/P2/A1)

4. A man uses a pulley system to lift a sack of rice. The sack of rice has a mass of 25 kg and it takes 5 s to lift the sack 6 m above the ground.

   Use g = 10 N/kg in your calculations.

   (a) Calculate the gravitational potential energy gained by the sack of rice when it is lifted 6 m above the ground. [1]

   (b) Calculate the power supplied by the man to lift the sack of rice 6 m above the ground. [2]

   (2019/P2/A2)

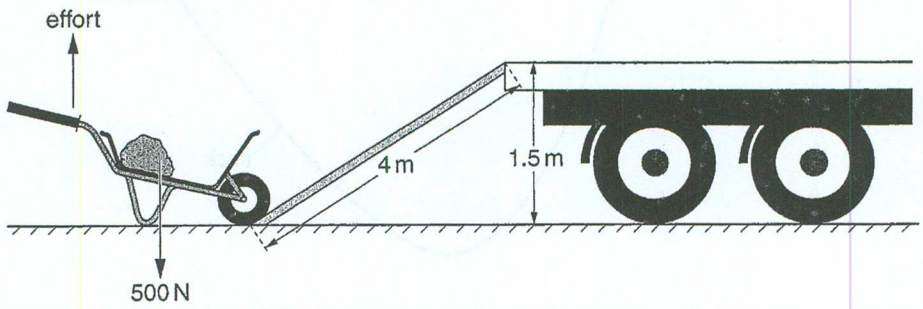
Section B

Answer the following questions.

1. Mr Chan moves a rock onto the back of a lorry, using a wheelbarrow and ramp.

   The diagram shows where he places the rock in the wheelbarrow and where he applies his effort to the handle of the wheelbarrow.

   The rock and wheelbarrow together weigh 500 N.



   (a) On the diagram, label with a **P** the pivot about which the wheelbarrow turns. [1]

   (b) (i) Will Mr Chan's effort need to be greater, less than or equal to 500 N to lift the handle? Give a reason for your answer. [1]

   (ii) State two ways in which Mr Chan could reduce this effort. [2]

(c) Calculate the work done against gravity in moving the rock and wheelbarrow onto the back of the lorry.

Show your working. [2]

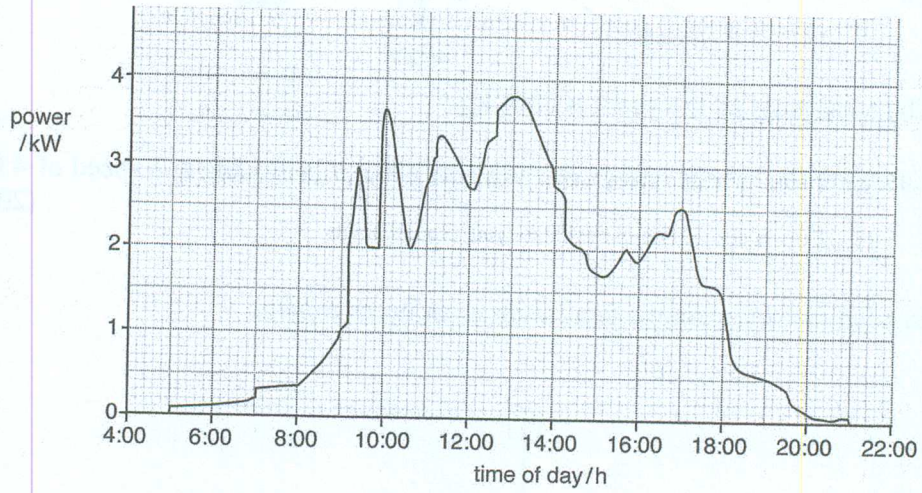
(d) Mr Chan pushes the wheelbarrow and rock up the ramp, with a velocity of 2 m/s.

Calculate the kinetic energy of the wheelbarrow and rock as they are pushed up the ramp. Use $g = 10$ m/s^2.

Show your working. [2]

(2011/P2/B6)

2. (a) The graph shows the power generated by a set of solar panels during a day.



(i) At what time of day was the sunlight brightest? [1]

(ii) At what time of day did the Sun rise? [1]

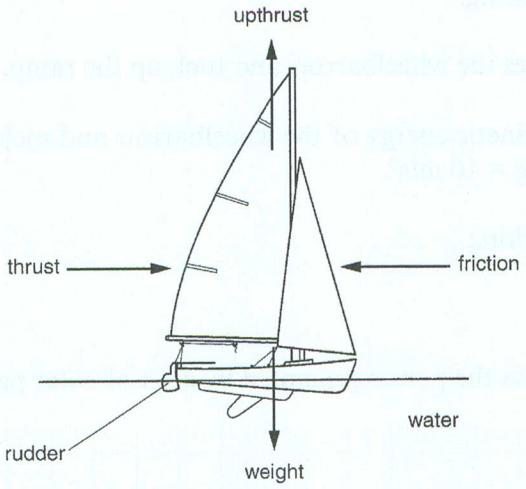
(b) The solar panels produce 24 kW h of electricity on one day.

For how long would 24 kW h of electricity allow two 1500 W air-conditioner units to be used? [3]

(2015/P2/B7b, c)

3. A racing yacht is moving at a constant speed on smooth water.

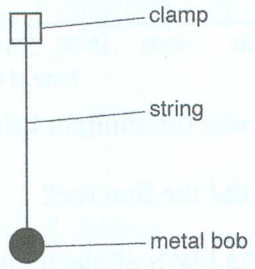
   The diagram shows the direction of the four forces acting on the yacht.



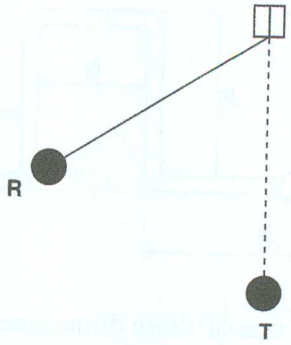
   The total mass of the yacht is 5000 kg.

   Calculate the kinetic energy of the yacht when it is moving at a speed of 4.0 m/s. [2]
   (2016/P2/B5d)

4. In a laboratory, a simple pendulum is set up as shown.



The bob is pulled from position **T** to position **R** as shown below.



The bob is then released and allowed to swing through ten oscillations.

(a) Draw on the second diagram the position of the bob at its maximum height to the **right** of **T** after it has completed ten oscillations. Label this position **S**. [1]

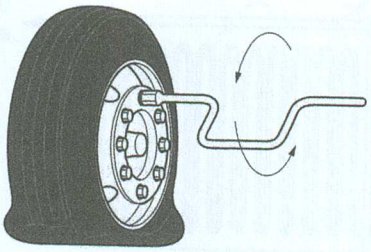
(b) Explain your answer to (a). [1]

(c) Describe the energy changes that occur to the bob as it swings from **R** to **T** and then to **S**. [2]

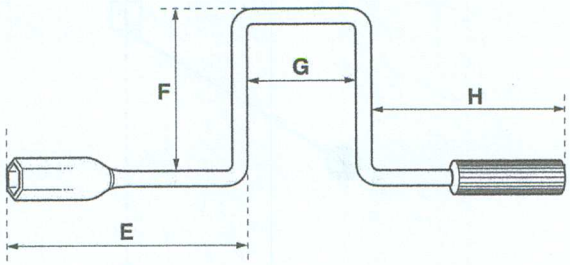
(2017/P2/B5a)

5. A racing car takes 1.25 hours to complete a 350 kilometre race.

A tyre on the transporter carrying the racing car to the track has a puncture. A mechanic uses a wheel brace to undo the nuts on the wheel with the punctured tyre.



(a) The diagram shows the shape and dimensions, **E**, **F**, **G** and **H**, of the wheel brace.



Increasing the length of one of these dimensions would reduce the effort needed by the mechanic to undo the wheel nut.

Write the letter **E**, **F**, **G** or **H**, corresponding to this dimension below. [1]

(b) The mechanic applies a force to the wheel brace of 20 N. This force moves 30 cm when one quarter of a turn is made.

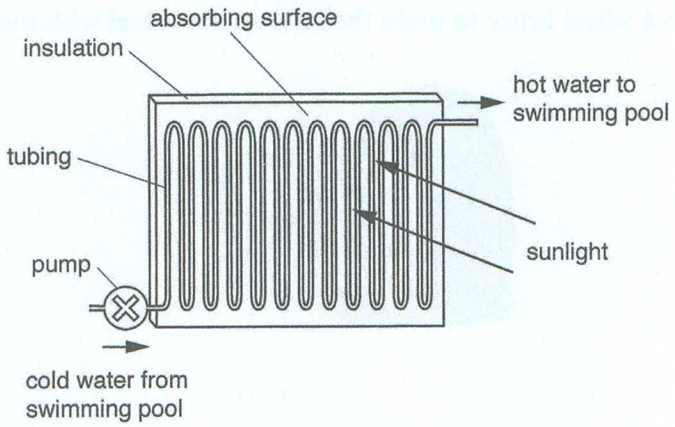
Calculate the work done by the force when the wheel brace makes **one full turn**.

[3]

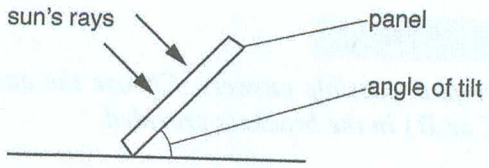
(2017/P2/B7c)

6. Water in a swimming pool is heated by solar powered pool heater panels.

The structure of one of the panels is shown.



It is found that tilting the panels at different angles affects the amount of energy they receive during different months of the year.



The table shows the results of the amount of energy received by a 1 m^2 panel at different angles of tilt between the months of April and September.

Energy in megajoules to a 1 m^2 panel

	angle of tilt									
month	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
April	20.5	22.3	23.8	24.9	24.8	24.1	22.7	20.5	18.4	15.1
May	26.3	27.7	28.4	28.8	27.4	25.2	23.0	19.8	16.6	13.0
June	28.4	28.8	29.2	29.2	27.4	25.2	22.3	19.1	15.1	11.2
July	28.1	28.4	28.8	29.2	27.4	25.6	23.0	20.2	16.2	12.2
August	23.0	24.8	25.6	25.9	26.3	24.8	22.7	20.5	17.3	13.7
September	16.2	18.7	20.5	21.6	22.3	22.7	21.6	20.5	18.7	16.2

(a) State the angle of tilt that would produce the most energy for the month of April.
[1]

(b) Determine, by calculation, whether it would be better to tilt the panels at an angle of 30° or 40° between the months of June to September to obtain the most energy.
[1]

(c) There are 10 panels by the side of the swimming pool and each panel has an area of 3 m^2. Calculate the maximum energy that can be received by all the panels during the month of May.
[1]

(2019/P2/B6e)