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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Energy, Work & Power

Paper 2 — Theory / Structured Questions (topical compilation)

Fahad H. Ahmad

Contact: +92 323 509 4443

M.Eng NUS Singapore · B.Eng NUST · 15+ years of teaching experience in Singapore, UAE & Pakistan · 60,000+ subscribers and 20 million+ video lecture views.

Topic 8: Energy Sources and Transfer of Energy

For Examiner's Use

Question 1

4 Fig. 4.1 shows a hydroelectric power station. Water from the lake is used to produce electricity in the turbine house.

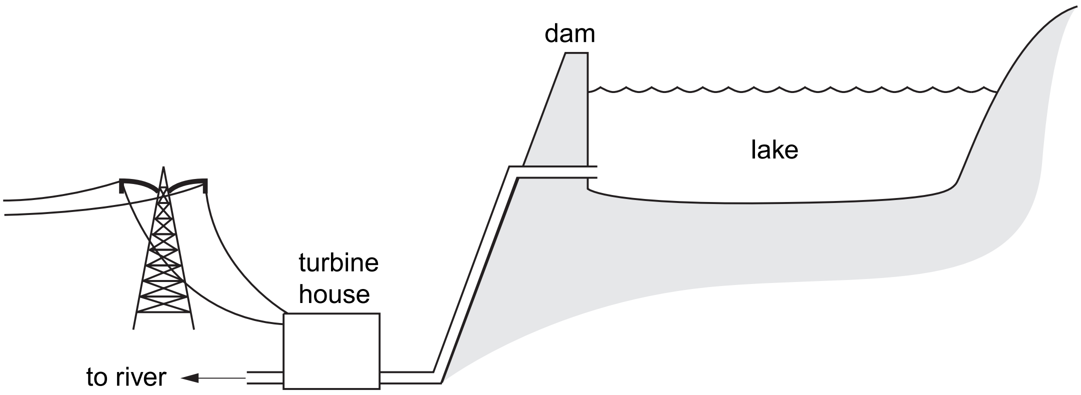

Fig. 4.1

(a) State where the water in Fig. 4.1 has the least potential energy.

.... [1]

(b) In 30 minutes, the water loses 5.0×10^9 J of energy and 4.5×10^9 J of electrical energy is produced in the turbine house.

(i) Calculate the efficiency of the energy conversion.

efficiency = ... [1]

(ii) Calculate, in watts, the electrical power output from the turbine house.

power = ... W [3]

(c) Some power stations burn coal to produce the same electrical power output. State one advantage of the hydroelectric power station.

....

....

.... [1]

(d) State one harmful effect that the hydroelectric power station may have on the environment.

....

.... [1]

For Examiner's Use

Question 2

1 A student carries out an experiment to measure the power he produces. He runs up a flight of stairs, as shown in Fig. 1.1.

Fig. 1.1

The student takes readings to calculate his power.

(a) **(i)** List all of the readings he must take.

....

....

....

.... [3]

(ii) State one precaution he should take to make sure one of his readings is accurate.

....

.... [1]

(b) Write down all of the equations he must use to calculate his power from the readings.

You may use symbols or words in your equations.

....

....

....

....

.... [2]

For Examiner's Use

Question 3

1 Fig. 1.1 is a block diagram of a power station.

The four boxes represent different parts of the power station. The first box is labelled boiler.

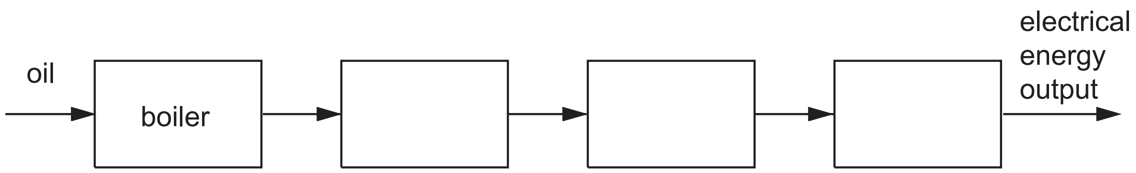

Fig. 1.1

Each of the other three boxes should contain **one** of the labels from the following list.

generator, motor, transformer, turbine, solar panel

(a) On Fig. 1.1, label the boxes using words from the list. [2]

(b) State **one** environmental problem caused by burning oil to produce electricity.

....

.... [1]

(c) Oil is a non-renewable energy source.

(i) State why oil is described as a non-renewable energy source.

....

....

.... [1]

(ii) State **one** renewable energy source.

....

.... [1]

For Examiner's Use

Question 4

1 A piece of paper falls from 4.0 m above the ground.
Fig. 1.1 shows how the height h above the ground varies with the time t.

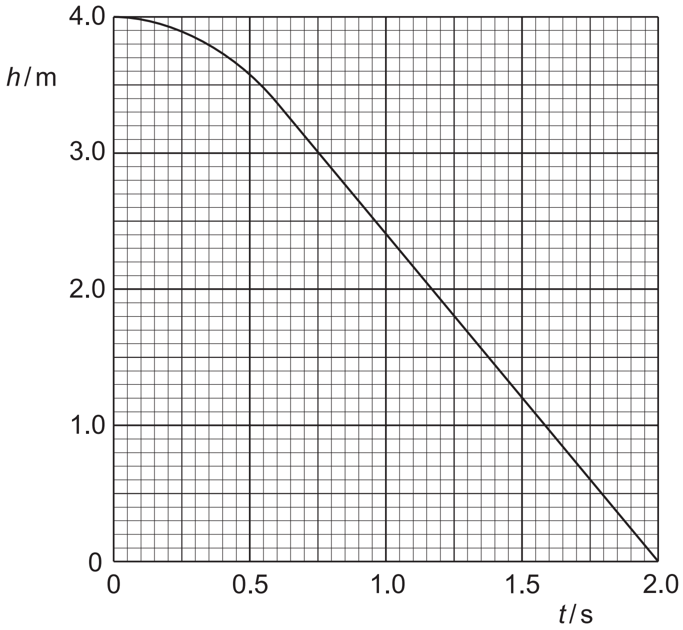

Fig. 1.1

(a) State what happens to the speed of the paper as it falls.

....

....

.... [2]

(b) Calculate the speed of the paper at time t = 1.5 s.

speed = ... [2]

(c) As the paper falls, energy changes from one form to another.
State the main energy change between t = 1.0 s and t = 2.0 s.

....

....

.... [2]

Question 5

3 Fig. 3.1 shows a student rubbing her hands together.

For Examiner's Use

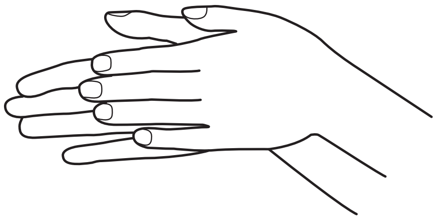

Fig. 3.1

(a) State the main energy conversion that causes the hands to become warm.

....

.... [2]

(b) State why the hands become even warmer if they are pressed harder together when rubbing.

....

.... [1]

(c) The average force used to slide one hand along the other is 1.2 N.

In each movement, one hand moves 0.080 m. The other hand remains stationary.

(i) Calculate the number of movements needed for 2.0 J of work to be done.

number = ... [3]

(ii) Each movement takes 0.20 s. Calculate the average power developed.

power = ... [2]

Question 6

2 Fig. 2.1 shows a motor used to operate a lift (elevator). There is a man in the lift.

For Examiner's Use

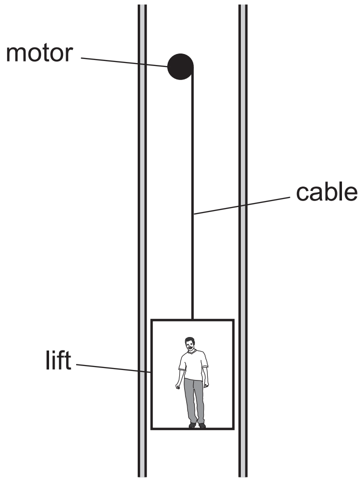

Fig. 2.1 (not to scale)

The input power to the motor is 6200 watts.

(a) Define the *watt*.

....

.... [2]

(b) The lift and the man have a total mass of 580 kg. The lift moves up a distance of 12 m in 15 s.

(i) Calculate the tension in the cable when the lift is moving at constant speed.

tension = ... [1]

(ii) Calculate the increase in potential energy of the lift and man.

potential energy = ... [2]

(iii) Calculate the efficiency of the motor.

efficiency = ... [2]

Question 7

3 Fig. 3.1 shows part of a small hydroelectric system that generates electricity from moving water.

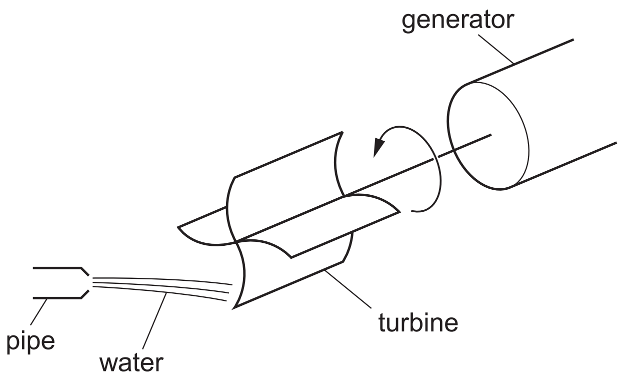

Fig. 3.1

(a) Every minute, water with kinetic energy 14 000 J emerges from the pipe. The water turns a turbine that is connected to the generator.
Half of the kinetic energy of the water is given to the generator.

(i) Calculate the power input to the generator.

power = ... [3]

(ii) Suggest a reason why only some of the kinetic energy of the water is given to the generator.

....

.... [1]

(b) Hydroelectric systems use sources of renewable energy.

(i) State what is meant by *renewable energy*.

....

.... [1]

(ii) State one source of **non**-renewable energy.

.... [1]

Question 8

2 Fig. 2.1 illustrates the journey of a cyclist from point A to point B. Points A and B are at the same height.

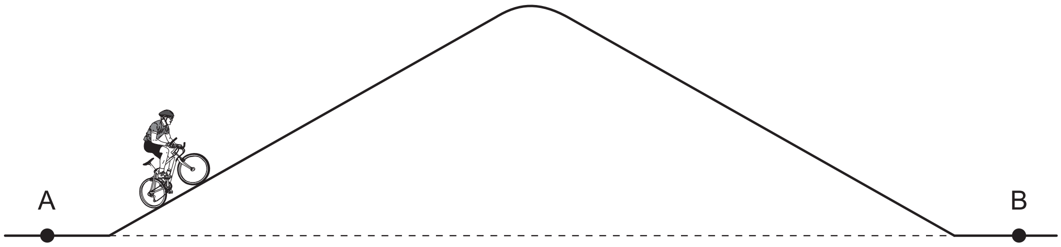

Fig. 2.1

The cyclist starts from rest at A and pedals up and over a hill. Near the bottom of the hill, she starts to brake and comes to rest at B.

(a) Describe the energy changes that take place as she pedals up the hill at constant speed.

....

....

....[3]

(b) Explain how the law of conservation of energy applies to the complete journey from A to B.

....

....

....[1]

(c) At one point in the journey, the gravitational potential energy of the cyclist has increased by 5400 J. The mass of the cyclist is 60 kg. The gravitational field strength is 10 N / kg.

Calculate the height above A of the cyclist at this point.

height above A = ...[2]

Question 9

2 Fig. 2.1 shows a windsurfer, sail and board.

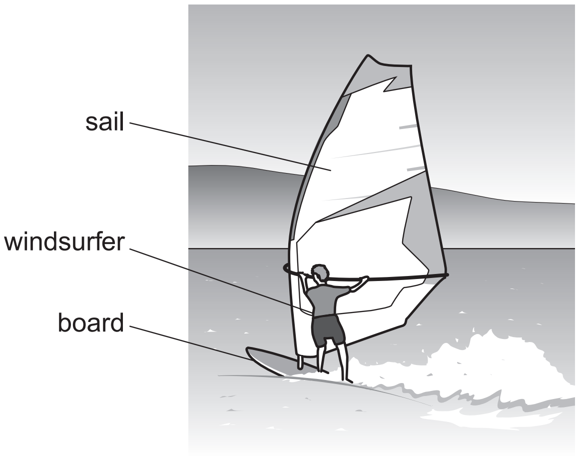

Fig. 2.1

The total mass of the windsurfer, sail and board is 90 kg. They travel at a constant speed of 5.0 m/s.

(a) Calculate the total kinetic energy of the windsurfer, sail and board.

kinetic energy = ...[2]

(b) The wind exerts a forward force on the sail.

(i) Explain, in terms of the forces acting, why the board travels at a constant speed.

....

....

....[2]

(ii) The wind does work on the sail. Explain, in terms of the conservation of energy, why the total kinetic energy does not increase.

....

....

....[1]

Question 10

2 Fig. 2.1 shows a student doing a press-up. A total force *F* acts upwards on his hands. There is also a force upwards on his toes.

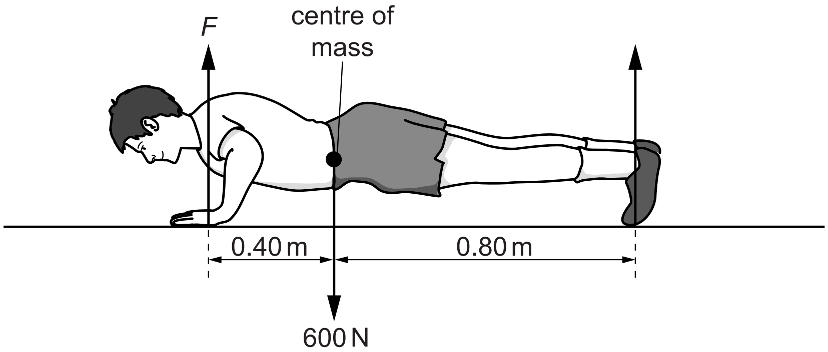

Fig. 2.1 (not to scale)

The weight of the student is 600 N and this force acts downwards from his centre of mass.

(a) **(i)** Explain why the student does work as his body rises from the ground.

....

....[1]

(ii) State the form of energy that the student uses to do this work.

....[1]

(b) At the position shown in Fig. 2.1, the student is stationary.
The weight of the student causes a moment about his toes.

(i) Calculate the moment of the weight of the student about his toes.

moment = ...[1]

(ii) Calculate the value of the force *F*.

F = ...[2]

Question 11

3 Two different kettles are used to heat water, as shown in Fig. 3.1.

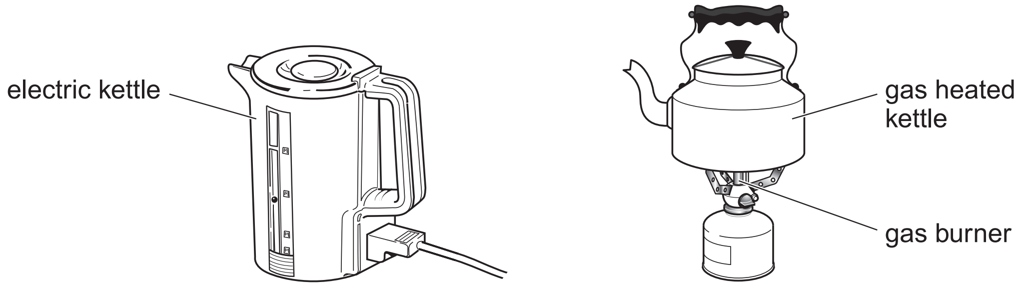

Fig. 3.1

Data for the two kettles is shown in Fig. 3.2.

	energy supplied to the kettle in one minute / J	thermal energy (heat) supplied by the kettle to the water in one minute / J
electric kettle	120 000	95 000
gas heated kettle	130 000	90 000

Fig. 3.2

(a) **(i)** Calculate the efficiency of the electric kettle.

efficiency = ... [2]

(ii) Calculate the useful power of the gas heated kettle.

power = ... [2]

(b) Both kettles contain the same mass of water, at the same initial temperature.

State and explain which kettle brings the water to boiling point first.

....

....

.... [1]

(c) The boiling water produces steam at 100 °C.

State one difference between molecules in the steam and molecules in the boiling water.

....

....

.... [1]

Question 12

2 Fig. 2.1 shows an electric motor lifting a load.

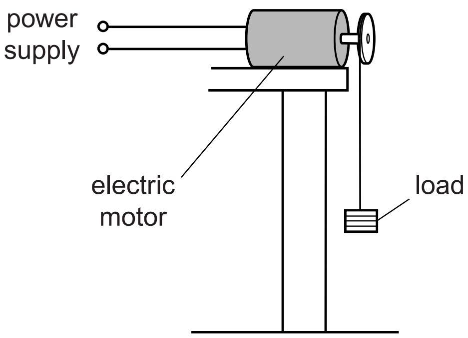

Fig. 2.1

The load, of weight 5.0 N, is raised through a vertical height of 3.5 m at a constant speed.
The efficiency of the electric motor is 0.65 (65%).

(a) Calculate the increase in gravitational potential energy of the load.

gravitational potential energy = ...[2]

(b) **(i)** State the formula that relates efficiency, energy input and useful energy output.

....

....[1]

(ii) Calculate the energy input to the motor.

energy input = ...[2]

(c) Suggest one reason why the efficiency of the motor is less than 1.0 (100%).

....

....[1]

Question 13

2 A swing is made by tying rope loosely to the branch of a tree, as shown in Fig. 2.1.

A child swings backwards and forwards several times, starting at the highest point A.

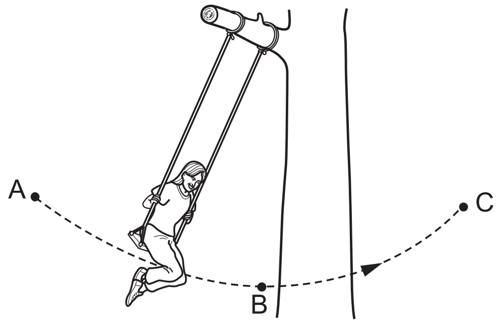

Fig. 2.1

(a) Explain how another child can obtain an accurate measurement of the time for one complete swing.

....

....

....

....

....[2]

(b) When the child moves from A to B, she falls a vertical distance of 0.60 m. She loses 240 J of gravitational potential energy. The gravitational field strength *g* is 10 N / kg.

(i) Calculate the mass of the child.

mass = ...[2]

(ii) Suggest two reasons why her kinetic energy at B is not equal to 240 J.

1. ....

....

2. ....

....

[2]

Question 14

4 A woman does work as she raises a flag by pulling downwards on a rope. This is shown in Fig. 4.1.

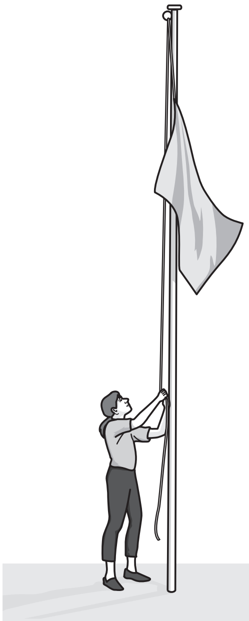

Fig. 4.1

(a) Define what is meant by *work done*.

....

....[2]

(b) The mass of the flag is 0.35 kg and the flag is raised through a height of 6.0 m.

The gravitational field strength g is 10 N / kg.

Calculate the increase in gravitational potential energy of the flag.

gravitational potential energy = ...[2]

(c) Suggest and explain a reason why the work done on the rope is larger than the value calculated in **(b)**.

....

....

....

....[2]

Question 15

2 In an experiment, a student takes measurements and determines the extension of a spring for different loads. The apparatus is shown in Fig. 2.1.

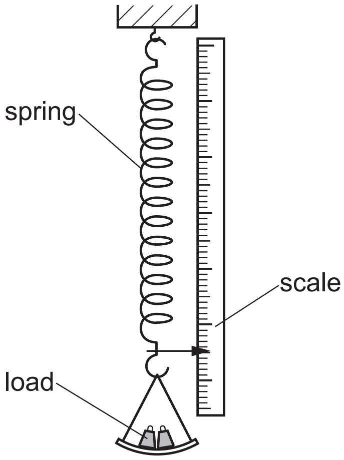

Fig. 2.1

The table in Fig. 2.2 shows the results.

load / N	0	1.0	2.0	3.0	4.0	5.0
length of spring / mm	200	235	270	305	350	420
extension / mm	0	35	70	105		

Fig. 2.2

(a) Only some of the extensions are shown in the table.

Complete the table to show all of the extensions. [1]

(b) Calculate the load that produces an extension of 49 mm.

load = ... [2]

(c) The student pulls a load downwards from position A to position B and holds it fixed at position B, as shown in Fig. 2.3.

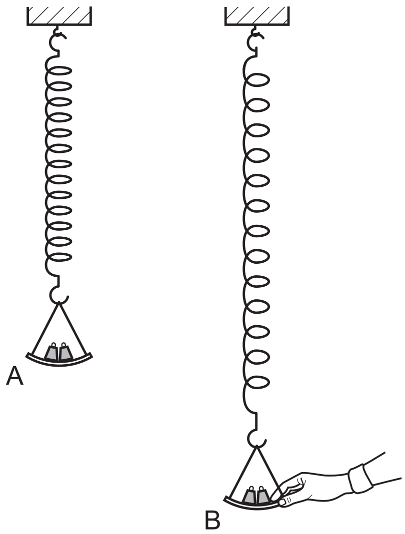

Fig. 2.3

The load is stationary at A and at B. The load has no kinetic energy at either point.

(i) Place ticks (✓) in the boxes to show how the value of each of the forms of energy compares at A and B.

	equal at A and B	larger at A	larger at B
energy stored in spring	☐	☐	☐
gravitational potential energy of load	☐	☐	☐

[1]

(ii) Work is done by the student to pull the load down. The law of conservation of energy states that energy cannot be created and cannot be destroyed.

Explain how this principle applies in this case.

....

....

....

....[2]

Question 16

For Examiner's Use

3 A pole-vaulter runs along a track, reaching a maximum speed of 8.4 m/s. At the end of the track, he places a pole into the ground as shown in Fig. 3.1, and uses the pole to push himself vertically upwards.

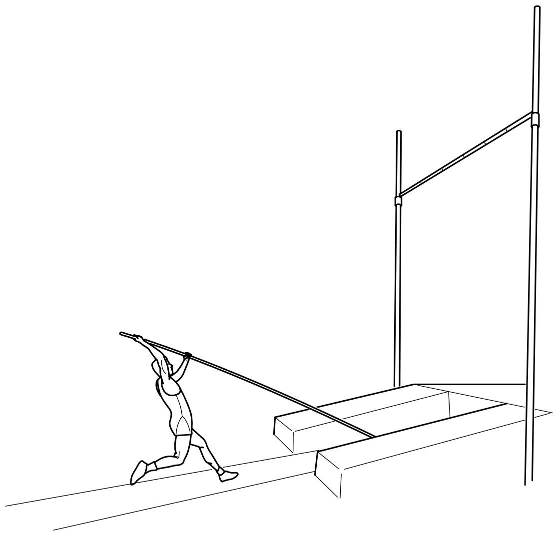

Fig. 3.1

(a) When the pole-vaulter runs along the track, there is a constant forward force on him of 320 N and a backwards resistive force that varies with his speed as shown in Fig. 3.2.

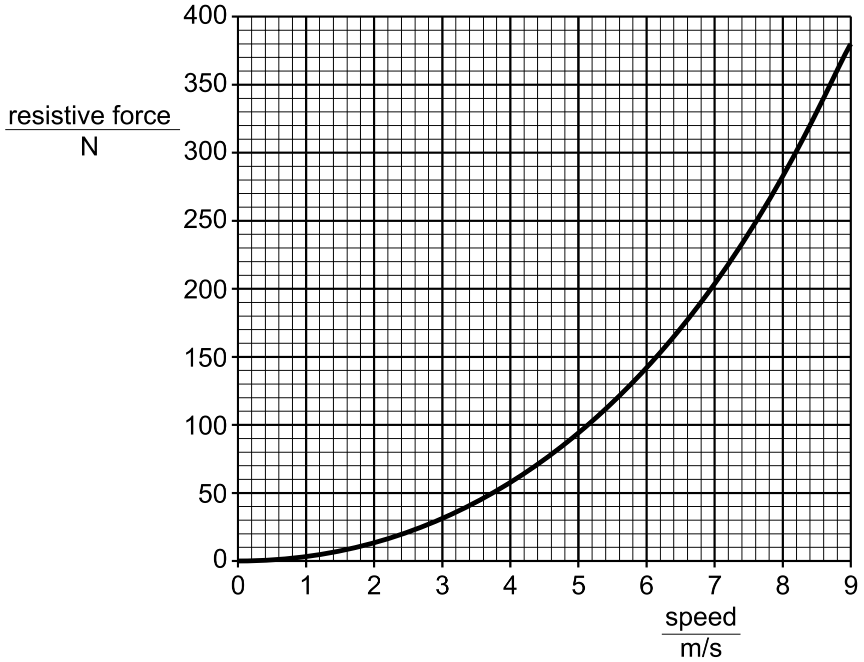

Fig. 3.2

Explain why the maximum speed that he can reach is 8.4 m/s.

....

....[1]

For Examiner's Use

(b) The mass of the pole-vaulter is 60 kg.

(i) Calculate the maximum kinetic energy of the pole-vaulter as he runs along the track. State clearly the formula that you use.

kinetic energy = ...

(ii) The pole is used to convert all this kinetic energy into gravitational potential energy. Calculate the height through which the pole-vaulter rises. Give your answer to an appropriate number of significant figures. The gravitational field strength is 10 N/kg.

height = ...
[6]

For Examiner's Use

Question 17

5 This question is about the sound produced by a mobile phone and the energy changes while it is operating.

(a) The sound produced by a ringing phone consists of two notes, one after the other.

Fig. 5.1 shows the trace on an oscilloscope screen produced by the first of the notes.

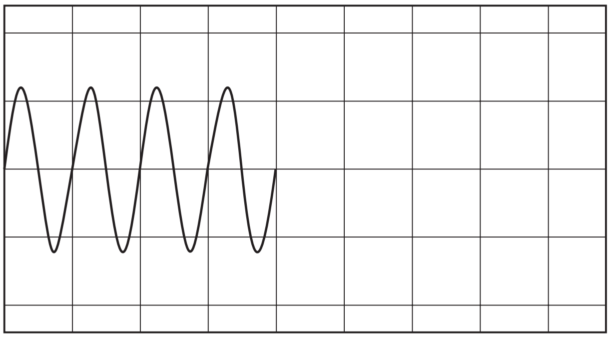

Fig. 5.1

The second note is louder and has a higher pitch.

(i) On Fig. 5.1, continue the trace to show what happens when the second note is sounding. [1]

(ii) Explain the differences between the two traces.

....

....

....

....

.... [2]

(b) The mobile phone contains a rechargeable battery.

Energy is stored inside the battery as it is charged.

Describe the useful energy change that takes place inside the battery as it is charged from the mains.

....

....

.... [2]

For Examiner's Use

Question 18

6 Fig. 6.1 shows a device used to generate electricity. Water entering at the top turns the wheel. A generator connected to the wheel produces electric current.

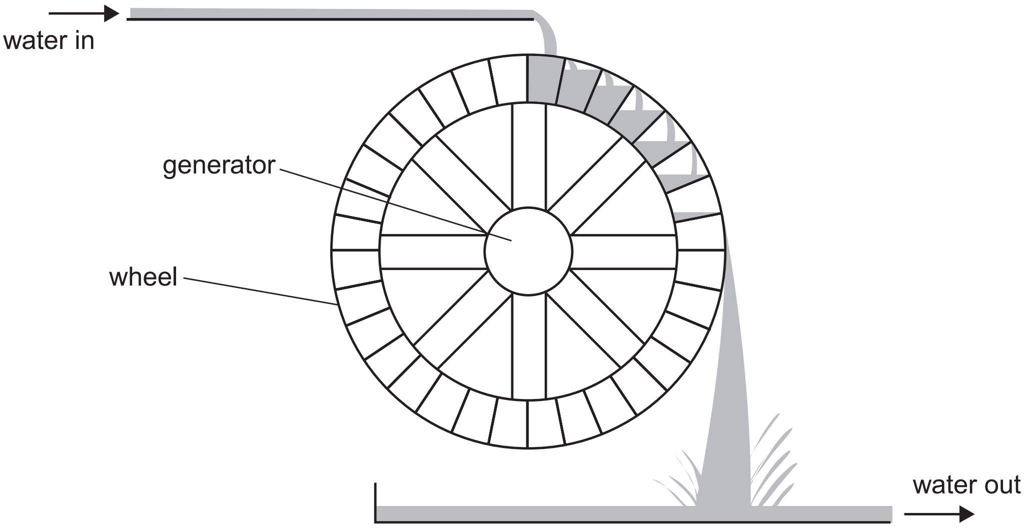

Fig. 6.1

(a) State the two main energy changes that take place in this device as water starts to flow.

1. ....

2. .... [2]

(b) The change in the potential energy of the water every second is 2000 J. The electrical energy output is 1200 J every second.

Calculate the efficiency of the process.

efficiency = ... [2]

(c) State two ways in which the device wastes energy.

1. ....

2. .... [2]

For Examiner's Use

Question 19

3 One type of renewable energy source is shown in Fig. 3.1.

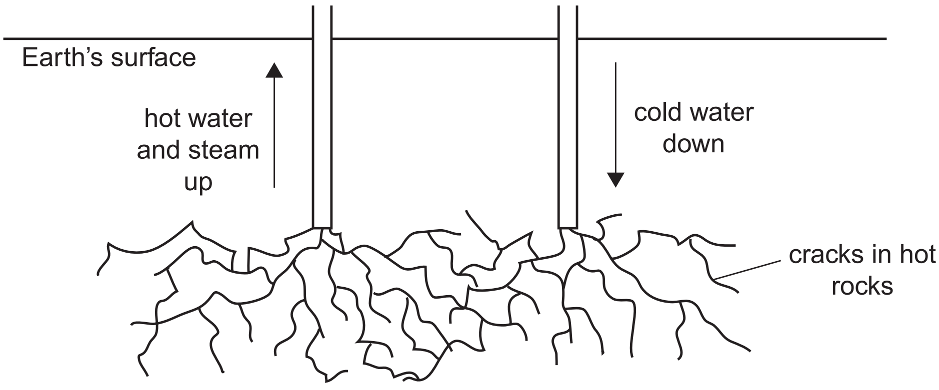

Fig. 3.1

(a) (i) State the name of the renewable energy source shown in Fig. 3.1.

.... [1]

(ii) State what is meant by a *renewable* energy source.

....

....

.... [1]

(b) 1000 kg of cold water at a temperature of 20 °C is pumped down to the hot rocks. 100 kg of water returns as steam and 900 kg as hot water, both at a temperature of 100 °C.

The specific heat capacity of water is 4200 J/(kg °C) and the specific latent heat of vaporisation of water is 2.3×10^6 J/kg.

Calculate

(i) the energy needed to heat 1000 kg of water from 20 °C to 100 °C,

energy = ... [2]

(ii) the energy needed to produce 100 kg of steam from water that is already at 100 °C.

energy = ... [2]

Question 20

3 A river flows over a cliff, producing a waterfall. The water, at a temperature of 7.2 °C, falls 700 m into a pool. The gravitational field strength is 10 N / kg.

For Examiner's Use

(a) Calculate the change in the gravitational potential energy of each kilogram of water due to its fall.

energy change = ... [2]

(b) Assume that all of this energy is converted into thermal energy (heat) in the water in the pool. Calculate the temperature of this water when it is in the pool. The specific heat capacity of water is 4200 J / (kg °C).

temperature = ... [3]

For Examiner's Use

Question 21

2 Fig. 2.1 shows a boat stationary in still water in a narrow tunnel.

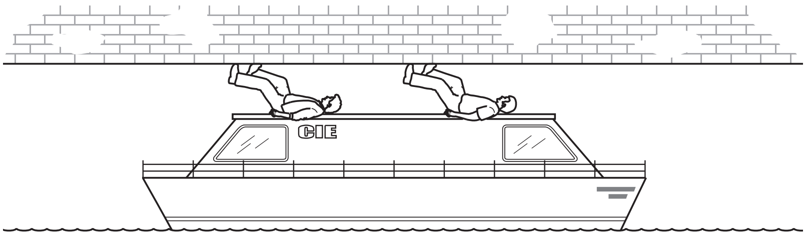

Fig. 2.1

To move the boat, two men lie on the top of it and push against the tunnel roof with their legs. They exert a total forwards force of 1680 N on the boat.

(a) The men push the boat 50.0 m to the end of the tunnel. Calculate the work done on the boat by the men.

work done = ... [2]

(b) Explain why the kinetic energy of the boat at the end of the tunnel is less than the work done on the boat by the men.

....

....

.... [2]

For Examiner's Use

Question 22

3 **(a)** State the *principle of conservation of energy*.

....

....

.... [2]

(b) Fig. 3.1 shows a miner using a head torch powered by a battery pack. The battery pack contains the cells that power the filament lamp in the head torch.

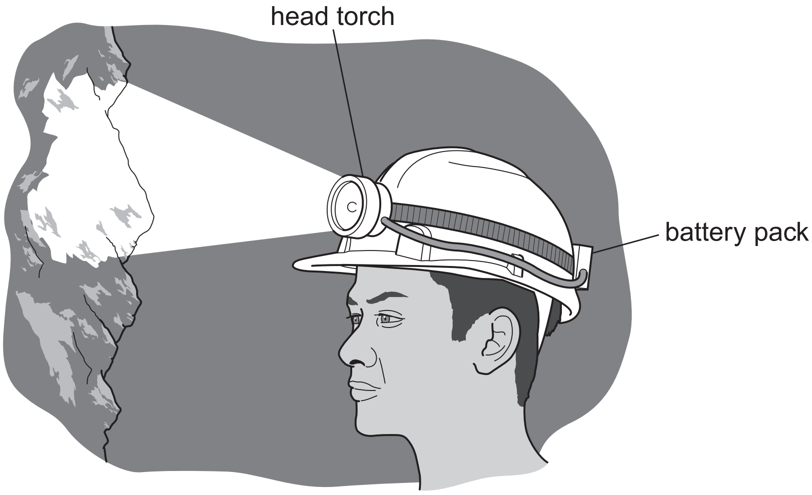

Fig. 3.1

(i) State the main energy change that takes place in the cells.

....

.... [2]

(ii) State two different forms of energy that are produced in the filament lamp.

1. ....

2. ....
[2]

(c) An identical battery pack powers a different head torch that uses light-emitting diodes (LEDs) instead of the filament lamp. The two torches are equally bright but the efficiency of the torch using the LEDs is much higher.

State how the amounts of the different forms of energy produced in the LEDs compare with the amounts produced in the filament lamp.

....

....

.... [2]

Question 23

2 Fig. 2.1 shows an elevator (lift) that is supported by a cable.

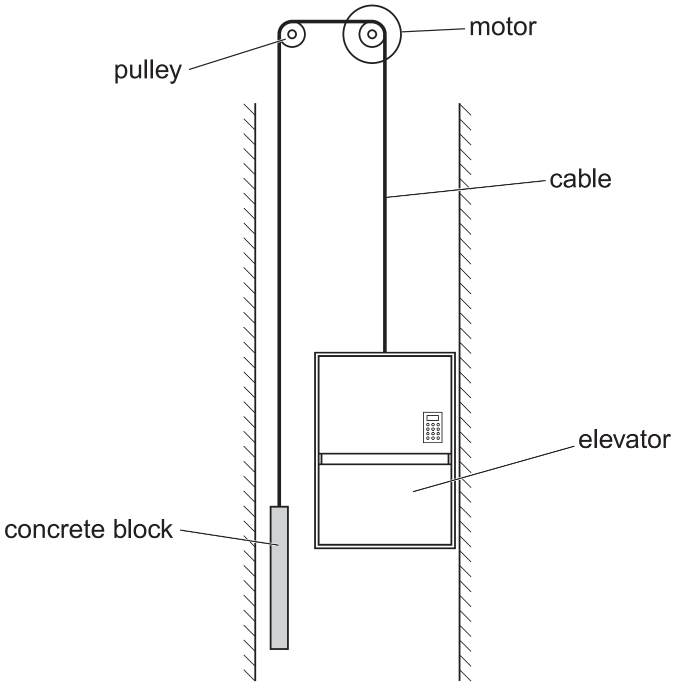

Fig. 2.1 (not to scale)

The cable passes around the axle of an electric motor and over a pulley. The cable is then attached to a concrete block that has the same mass as the empty elevator. As the elevator moves up, the concrete block moves down.

(a) Explain why very little work is done by the electric motor when lifting up the empty elevator.

....

....

....[2]

(b) Several people of total weight 4900 N are travelling upwards at constant speed in the elevator. They rise through a distance of 24 m in 28 s.

Calculate the minimum power output of the electric motor.

power = ...[3]

Question 24

2 Fig. 2.1 shows a skier of mass 85 kg skiing down a very steep slope.

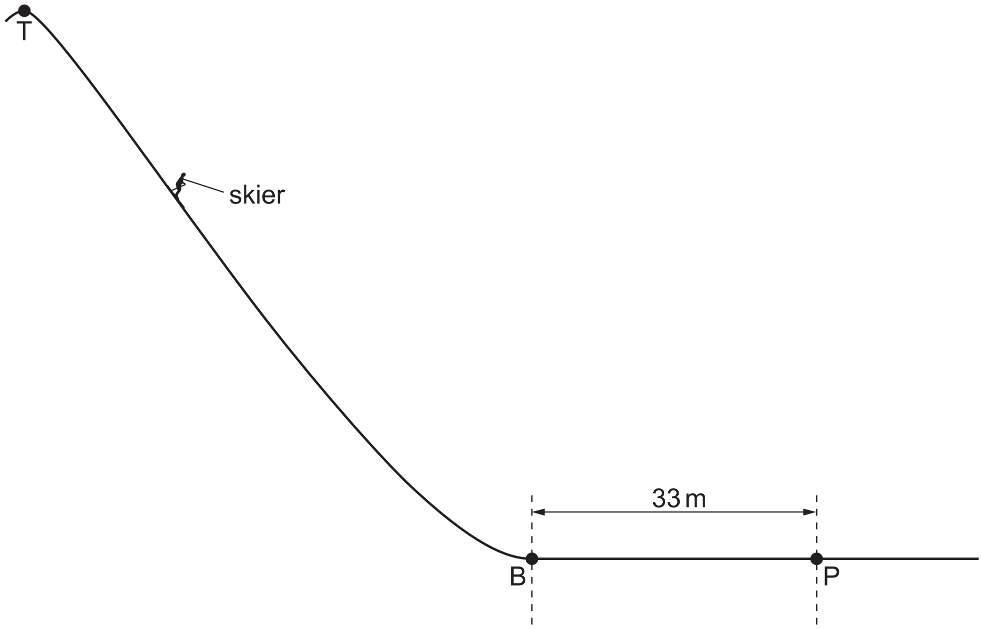

Fig. 2.1 (not to scale)

The skier starts from rest at the top T of the slope. The force of gravity accelerates him down the slope.
When he reaches the bottom B of the slope, his kinetic energy is 5.5×10^4 J.

(a) The gravitational field strength is 10 N / kg. Calculate

(i) the weight of the skier,

weight = ...[1]

(ii) the minimum possible difference in height between T and B.

height difference = ...[2]

(b) At B, the skier digs his skis into the snow and stops at the point P after travelling 33 m horizontally.

Calculate the average horizontal force that acts on the skier between B and P.

force = ...[2]

For Examiner's Use

Question 25

3 Fig. 3.1 shows an electric motor being used on a building site to lift bricks.

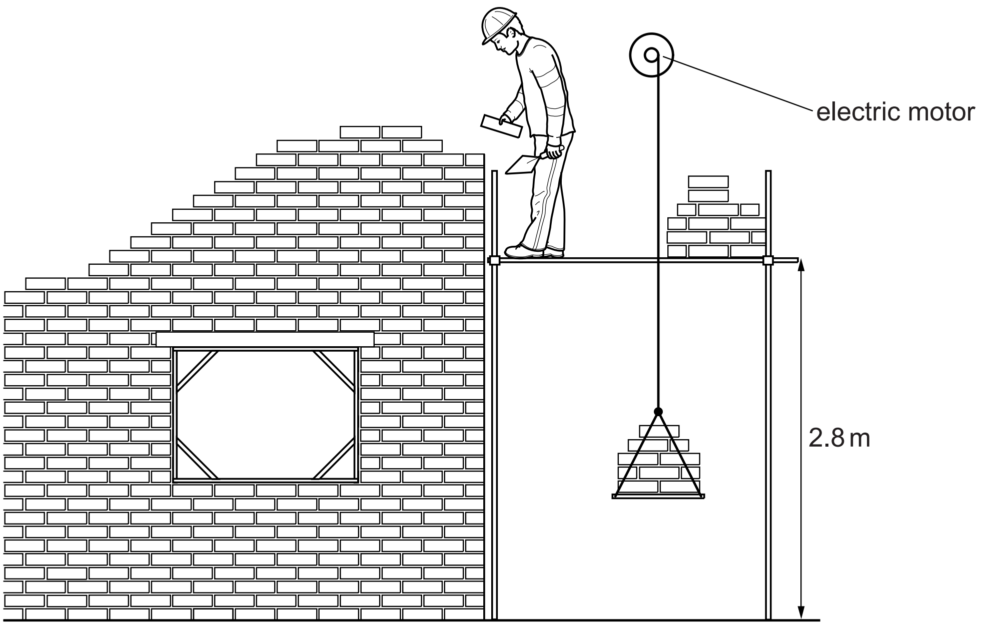

Fig. 3.1

The gravitational field strength is 10 N / kg. The motor lifts bricks of total mass 54 kg through a height of 2.8 m in 3.0 s.

(a) Calculate

(i) the work done in lifting the bricks,

work done = ... [2]

(ii) the useful output power of the motor.

power = ... [2]

(b) Suggest two reasons why the electrical power supplied to the motor is greater than its useful output power.

1. ....

2. ....

[2]

(c) (i) Fig. 3.2 shows a battery and an electric motor. The battery is used to power the motor. Complete Fig. 3.2 to show the circuit diagram of a circuit that is used to determine the power supplied to the electric motor.

For Examiner's Use

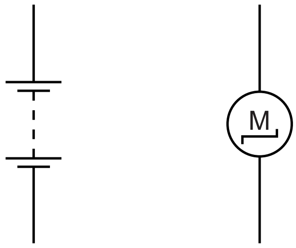

Fig. 3.2 [2]

(ii) State how the power supplied is calculated.

....

.... [1]

Question 26

For Examiner's Use

3 A man of mass 75 kg falls from a platform high above a lake.
Fig. 3.1a shows the man tied to the platform by a long elastic rope (bungee).
Fig. 3.1b shows the man when he has fallen 20 m. After this point the rope begins to stretch.
Fig. 3.1c shows the man at 25 m below the platform where he is first stopped by the rope.

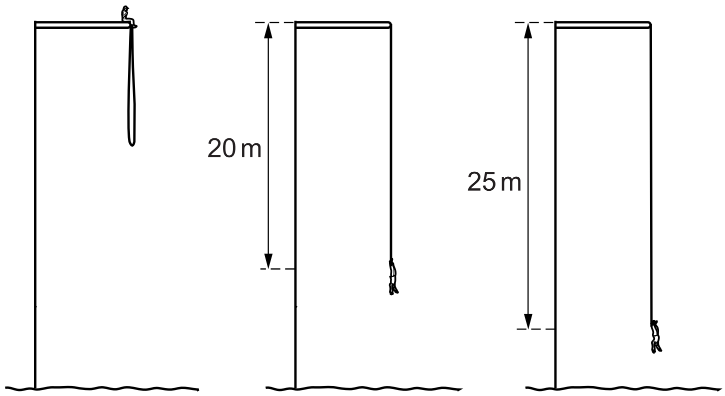

Fig. 3.1a **Fig. 3.1b** **Fig. 3.1c**

(a) As the man falls, his gravitational potential energy changes.

(i) The gravitational field strength is 10 N / kg. Calculate the change in his gravitational potential energy as he falls through 20 m.

change in potential energy = ... [2]

(ii) When he is 20 m below the platform, his kinetic energy is equal to the change in his gravitational potential energy calculated in **(i)**. Calculate his speed at this point.

speed = ... [3]

(b) State the energy changes that take place as he falls from 20 m to 25 m below the platform. Ignore the effect of air resistance.

....

....

.... [3]

Question 27

4 Fig. 4.1 shows a black car going up a hill on a bright, sunny day.

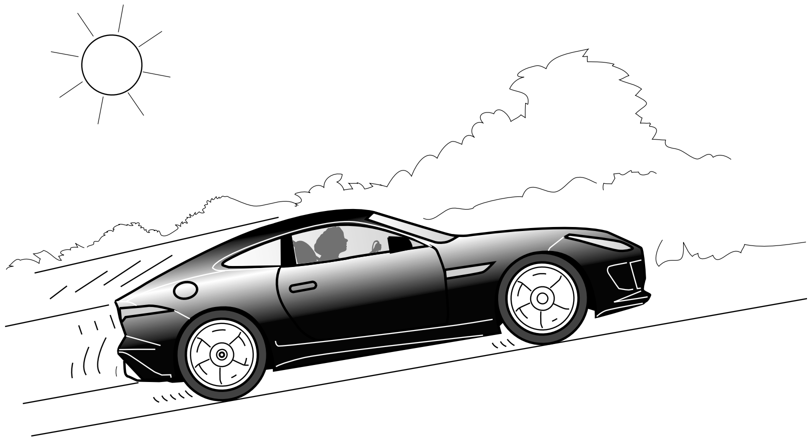

Fig. 4.1

(a) State

(i) one way in which the car is gaining thermal energy,

....

....[1]

(ii) one way in which the car is losing thermal energy.

....[1]

(b) The car accelerates up the hill. In addition to the changes in the thermal energy of the car, there are other energy changes taking place.

Describe the other energy changes occurring as the car moves.

....

....

....

....[3]

Question 28

3 A lorry of mass 4.4×10^4 kg travels along a straight, horizontal road at 20 m/s.

(a) Calculate the kinetic energy of the lorry.

kinetic energy = ... [3]

(b) The lorry driver sees an obstruction ahead and applies the brakes. The lorry slows down and stops. The lorry stops a distance of 40 m from where the driver first applies the brakes.

As it slows down, the kinetic energy of the lorry decreases to zero. The kinetic energy decreases as work is done by the braking force exerted on the lorry.

(i) State the formula that relates the work done to the braking force.

....

....

.... [1]

(ii) Calculate the braking force exerted on the lorry.

force = ... [2]

Question 29

1 Water is transported to a village in a tank pulled by a tractor.

Fig. 1.1 shows the tank being pulled by a tractor.

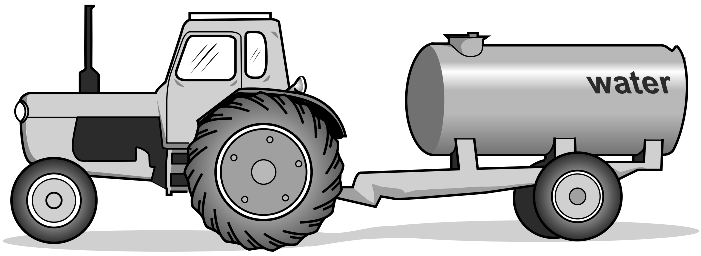

Fig. 1.1

The combined mass of the tractor and the tank is 4100 kg when the tank is empty and 6500 kg when the tank is full of water.

(a) The density of water is 1000 kg / m^3.

Calculate the volume of water in the tank when it is full.

volume = ... [2]

(b) At the start of the journey, the tractor and tank accelerate from rest along a straight, horizontal road. As their speed increases, one form of energy is decreasing.

(i) State the name of the form of energy that is decreasing.

.... [1]

(ii) Explain what happens to this energy.

....

....

....

.... [2]

(c) The village is located on a mountain at a vertical height of 850 m above the water supply. The gravitational field strength *g* is 10 N / kg.

Calculate the gravitational potential energy gained by the water as it is transported from the supply to the village.

energy gained = ... [2]

Question 30

3 A large power station burns oil to heat water in a boiler.

(a) State the name of the form of energy stored in the oil before it is burnt.

....[1]

(b) **(i)** State and explain whether oil is a renewable or a non-renewable energy source.

....

....

....[1]

(ii) Describe one environmental issue caused by burning oil to generate electricity in a power station.

....

....[1]

(c) **(i)** State what is meant by *efficiency*.

....

....[1]

(ii) The efficiency of the power station is 0.38 (38%). Its electrical power output is 1.9×10^9 W.

Calculate

1. the input power to the power station,

input power = ...[2]

2. the energy wasted in 2.0 hours.

energy wasted = ...[2]

Question 30

2 A skateboarder of mass 45 kg is at the top of a ramp.

Fig. 2.1 shows the skateboarder and the ramp.

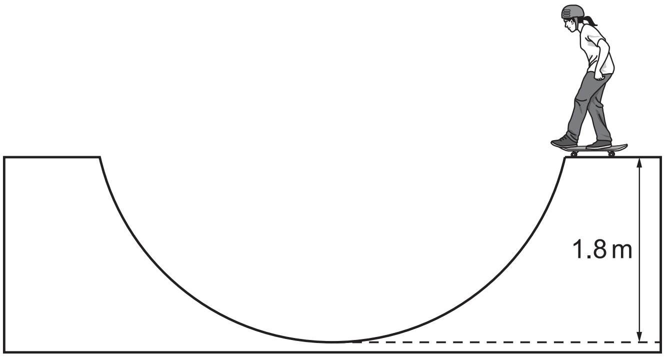

Fig. 2.1 (not to scale)

(a) The skateboarder moves off and she descends vertically through 1.8 m. The gravitational field strength *g* is 10 N / kg.

(i) Calculate the change in gravitational potential energy of the skateboarder.

energy change = ...[2]

(ii) State the name of two forms of energy that increase as she descends.

1. ....

2. ....

[2]

(b) At the lowest point on the ramp, the skateboarder is travelling at a constant speed along a path which is part of a vertical circle.

State

(i) the direction of the resultant force on the skateboarder at this point,

....[1]

(ii) how the weight of the skateboarder compares with the upward force that the ramp exerts on her.

....

....

....[1]

Question 31

4 A 75 W filament lamp in an office is accidentally left switched on for 63 hours when the office is closed.

(a) **(i)** Calculate the electrical energy that is supplied to this lamp in this time.

electrical energy = ...[3]

(ii) The efficiency of the lamp is 0.12 (12%).

Calculate the energy released by the lamp in the form of light.

light energy = ...[1]

(b) The power station that generates the electricity supplied to the office uses oil as its fuel.

(i) State and explain whether oil is a renewable or a non-renewable source of energy.

....

....

....[1]

(ii) Discuss one environmental consequence of using oil as a source of energy.

....

....

....[2]

Question 32

5 A process called *nuclear fusion* takes place in the Sun.

(a) Discuss the process of nuclear fusion taking place in the Sun.

....

....

....

....

....

....

....[3]

(b) On Earth, solar panels and solar cells are powered by energy from the Sun.

Describe how this energy from the Sun travels to Earth.

....

....

....

....[2]

Question 33

4 A rock from space is travelling at high speed towards the Earth.

(a) Complete the equation for the kinetic energy of an object travelling with a speed *v* and state what any other terms in the equation represent.

kinetic energy =

[1]

(b) The mass of the rock is 0.60 kg. When it hits the Earth, its average temperature increases by 25 °C.

(i) The specific heat capacity of the rock is 560 J / (kg °C).

Calculate the increase in the internal energy of the rock.

increase in internal energy = ... [2]

(ii) Use the answer from **(b)(i)** to determine the minimum possible speed of the rock when it hits the Earth.

minimum speed = ... [2]

(iii) Suggest one reason why the speed determined in **(b)(ii)** is less than the actual speed of the rock when it hits the Earth.

....

.... [1]

Question 34

2 **(a)** Some sources of energy, used to produce electricity, may run out in the future.

Underline the **two** sources of energy that are likely to run out first, before the others.

coal oil solar tides wave wind

[1]

(b) Fig. 2.1 is a simplified diagram of a geothermal power station.

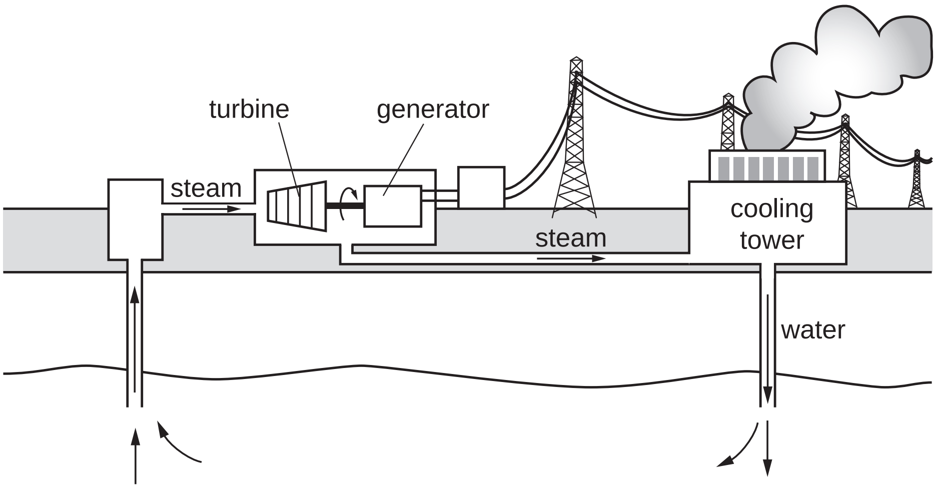

Fig. 2.1

(i) Thermal energy is given to the water as it passes through rocks underground.

Describe the process by which this thermal energy causes the turbine to turn.

....

....

....

.... [2]

(ii) Water from the cooling tower at 30 °C passes into the ground and is heated to 160 °C.

The specific heat capacity of water is 4200 J / (kg °C).

Calculate the thermal energy (heat) needed to heat 90 kg of water from 30 °C to 160 °C.

thermal energy = ... [2]

[Total: 5]

5054/21/M/J/19

Question 35

3 A large spring is stretched by an athlete to increase the strength of his arms.

The athlete extends the spring, as shown in Fig. 3.1, and then releases it gently. He extends and releases the spring several times during a period of 60 s.

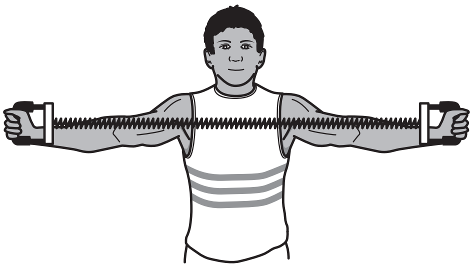

Fig. 3.1

(a) State the form of energy stored in the stretched spring and the form of energy stored in the muscles of the athlete.

form of energy in spring ....

form of energy in muscles ....
[2]

(b) Suggest what happens if he extends the spring beyond the limit of proportionality.

....

.... [1]

(c) During one extension of the spring, its length increases from 70 cm to 93 cm. The average force exerted by the athlete is 400 N.

(i) Calculate the work done by the athlete in one extension.

work done = ... [2]

(ii) Describe how the athlete can use the value obtained in **(i)** to determine his average power during the 60 s.

....

....

....

.... [2]

[Total: 7]

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Question 36

10 Fig. 10.1 shows a motor lifting a mass. Fig. 10.2 shows part of the circuit diagram of the connections to the motor.

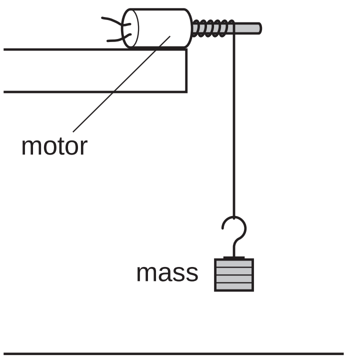

Fig. 10.1

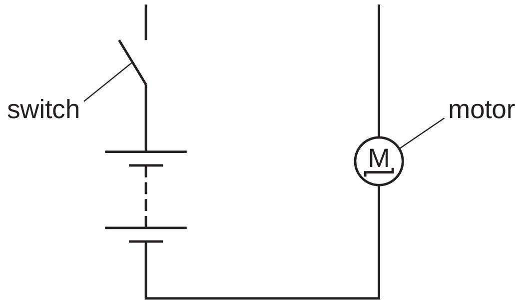

Fig. 10.2

(a) The current in the motor is 1.5 A and the voltage supplied by the battery is 8.0 V.

(i) Complete the circuit diagram in Fig. 10.2 to show an ammeter and a voltmeter in the correct positions to take these measurements while the motor is working. [2]

(ii) The motor takes 4.0 s to lift the mass.

Calculate the electrical energy transferred to the motor in this time.

energy = ... [2]

(iii) The motor lifts the 150 g mass through a height of 80 cm in the 4.0 s.

Calculate the gravitational potential energy gained by the mass.

The gravitational field strength g = 10 N / kg.

gravitational potential energy = ... [3]

(iv) State **two** reasons why the gravitational potential energy gained by the mass is less than the electrical energy supplied to the motor.

1. ....

2. ....
[2]

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(b) Fig. 10.3 shows the structure of the motor.

When the mass reaches the top of its motion, the switch is opened. This disconnects the battery and causes the mass to fall. The coil turns as the mass falls.

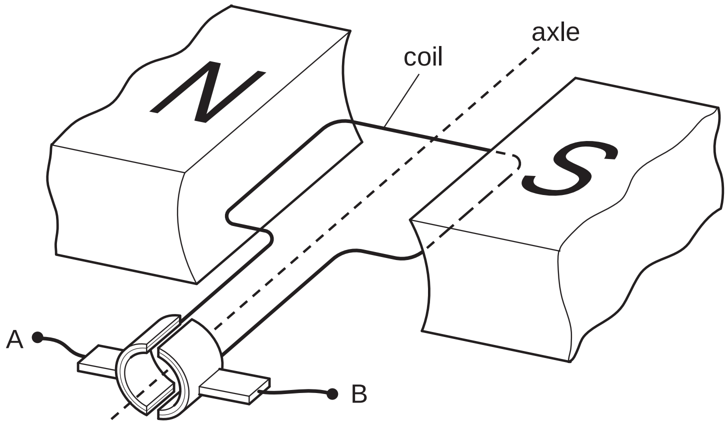

Fig. 10.3

As the coil turns, a small voltage is produced.

(i) Explain why a voltage is produced as the coil turns.

....

....

.... [3]

(ii) As the mass falls, a student connects a wire between the points A and B shown in Fig. 10.3.

He notices that the mass takes a longer time to fall when the wire is connected.

The student suggests that this is an example of Lenz's law.

State Lenz's law and suggest why the mass takes longer to fall.

....

....

....

....

....

.... [3]

[Total: 15]

Question 37

3 Fig. 3.1 shows part of a hydraulic press that is used to compress waste paper into a brick for burning.

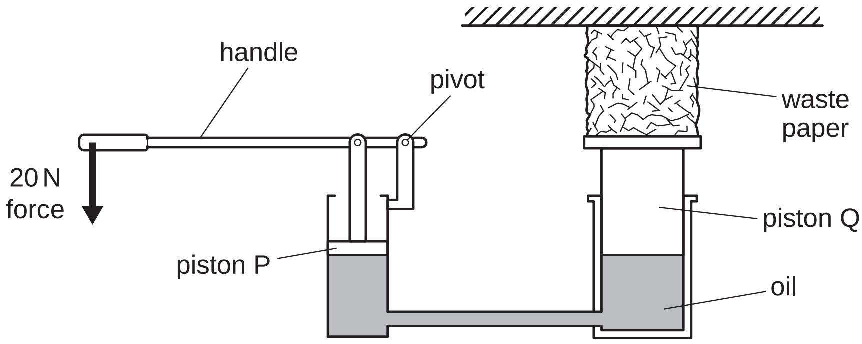

Fig. 3.1

A force of 20 N is exerted downwards on the end of the handle.

(a) The force on the handle creates a moment about the pivot.

(i) Define the *moment of a force*.

....

....

....

.... [2]

(ii) Explain why the force exerted on piston P is greater than the force exerted on the handle.

....

....

.... [1]

(b) Explain how the hydraulic press enables a greater force to be exerted on piston Q than is exerted on piston P.

....

....

....

....

.... [2]

5054/22/M/J/20

(c) In moving the handle downwards, the 20 N force moves through a distance of 0.60 m and piston Q rises by 0.020 m.

The force exerted by piston Q on the paper is 400 N.

Calculate:

(i) the work done in moving the handle downwards

work = ... [2]

(ii) the efficiency of the hydraulic press.

efficiency = ... [2]

[Total: 9]

Question 38

2 A small coin of mass m is initially at rest. It is dropped from a height h above ground level. The coin has a speed v as it hits the ground.

The gravitational field strength g is equal to 10 N/kg.

(a) State an expression for:

- the gravitational potential energy of the coin at a height h above ground level

  gravitational potential energy = ...

- the kinetic energy of the coin when travelling at a speed v.

  kinetic energy = ...
[1]

(b) The coin is dropped from the top of a building of height 380 m.

Determine the speed of the coin as it hits the ground. You may ignore air resistance.

speed = ... [3]

(c) When air resistance is negligible, a heavier coin hits the ground at the same speed as a lighter coin when they are both dropped from the same height.

(i) Explain why.

....

....

.... [1]

(ii) When air resistance acts, coins of different masses do **not** hit the ground at the same speed when they are dropped from the same height.

Explain why.

....

....

.... [2]

[Total: 7]

5054/21/O/N/19

Question 39

2 The total mass of a wheelbarrow and its load is 90 kg. A worker pushes the wheelbarrow and load up a plank of length 2.0 m on to a platform, as shown in Fig. 2.1. The platform is at a height of 0.60 m above the ground.

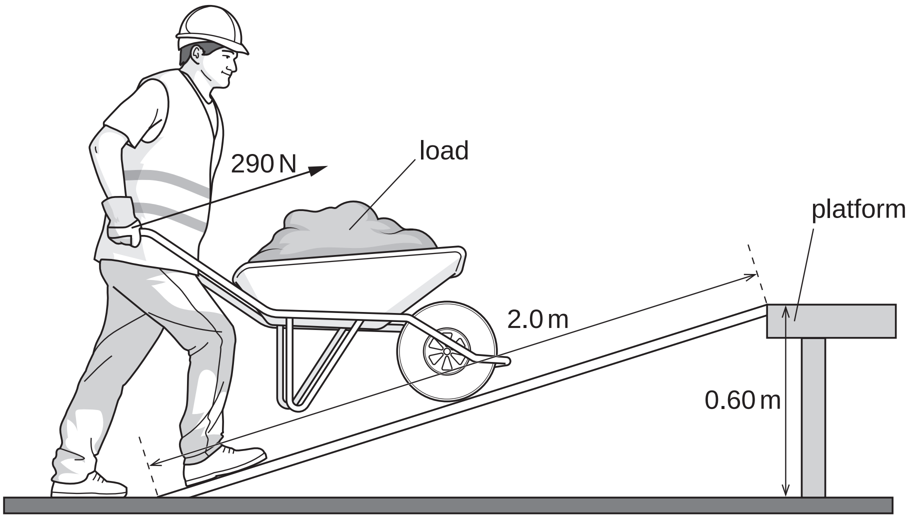

Fig. 2.1

The worker exerts a force of 290 N on the wheelbarrow in the direction in which the wheelbarrow moves.

(a) The gravitational field strength g is equal to 10 N / kg.

(i) Calculate the gravitational potential energy gained by the wheelbarrow and its load.

energy = ... [2]

(ii) The worker pushes the wheelbarrow 2.0 m along the plank.

Calculate the work done on the wheelbarrow by the worker.

work done = ... [2]

(iii) Suggest one reason why the answer to **(a)(ii)** is not equal to the answer to **(a)(i)**.

....

.... [1]

5054/22/O/N/20

(b) The worker finds that walking up the plank pushing the wheelbarrow is even more inefficient than the answers in **(a)** suggest.

(i) State what is meant by *efficiency*.

....

.... [1]

(ii) Suggest **one** reason why this method of lifting the load onto the platform is so inefficient.

....

.... [1]

[Total: 7]