PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



EXAM QUESTION PACK

SECTION 4: ENERGY RESOURCES AND ENERGY TRANSFERS (PACK 1)

SCORE	PERCENTAGE
/325	%

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Q1.

(a) Diagram 1 shows a metal ball held at rest above the floor.

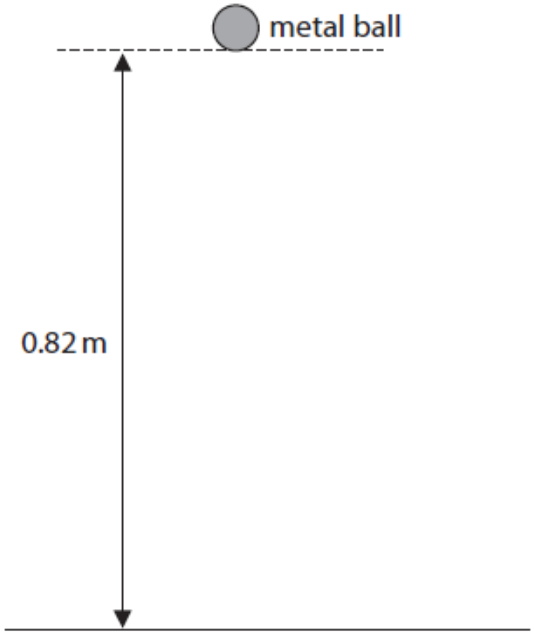


Diagram 1

The metal ball has a mass of 0.52 kg and is held at a height of 0.82 m above the floor.

(i) State the formula linking gravitational potential energy (GPE), mass, *g* and height.

(1)

(ii) Calculate the decrease in the metal ball's GPE store when the ball falls to the floor from this height.

(2)

decrease in GPE store = ... J

(iii) State the amount of energy in the metal ball's kinetic store just before it hits the floor.

Ignore the effects of air resistance.

(1)

energy in kinetic store = ... J

(iv) Calculate the speed of the metal ball just before it hits the floor.

(4)

speed = ... m/s

(b) The metal ball is dropped from rest again from the same height above the floor, as shown in diagram 2.

The metal ball now falls through a cylinder containing oil rather than the air.

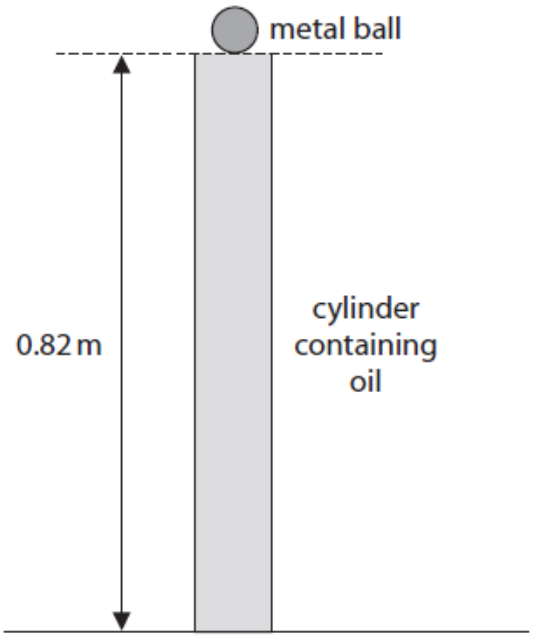


Diagram 2

The speed of the ball just before it hits the floor when moving in oil is less than the speed of the ball just before it hits the floor when moving in air.

Explain, using ideas about energy, the difference in speeds.

(3)

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(Total for question = 11 marks)

Q2.

This question is about a parachutist.

(a) A parachutist leaves a helicopter that is hovering above the ground.

The parachutist is initially at rest and falls vertically downwards.

Calculate the speed of the parachutist after they have fallen through a distance of 1300 m.

Ignore the effect of air resistance.

(4)

speed = ... m/s

(b) When the parachutist is much nearer to the ground, they open their parachute.

The parachutist slows down.

(i) Explain the change in speed of the parachutist.

Use ideas about forces in your answer.

(3)

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(ii) It is observed that from when the parachute opens to just before the parachutist touches the ground, the GPE store and the KE store of the parachutist both decrease, yet energy is still conserved.

Justify these observations.

(3)

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(Total for question = 10 marks)

Q3.

This question is about an electric fan.

(a) A battery supplies a voltage of 12 V and a current of 0.25 A to the fan.

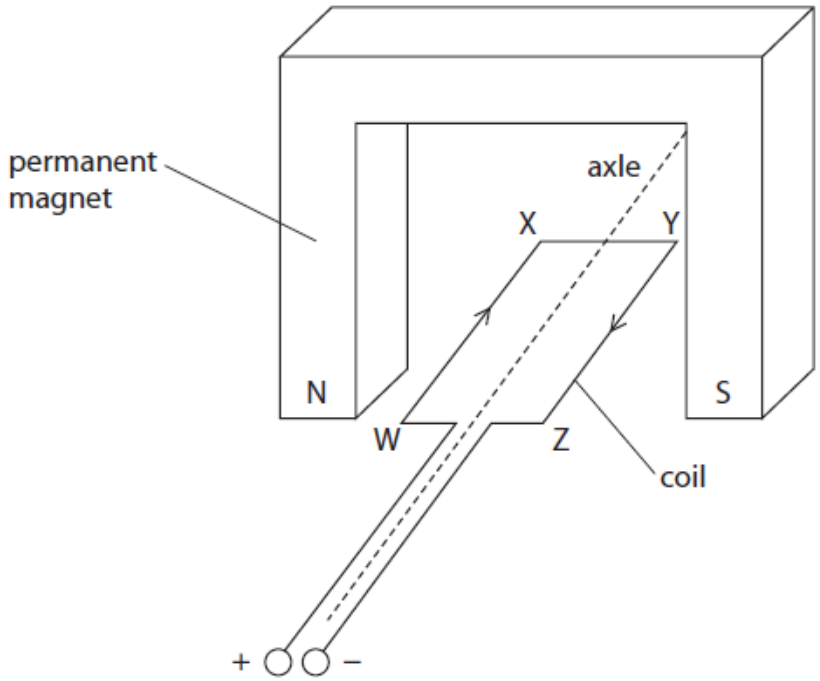
The fan is switched on for 12 seconds and the fan gains 25 J in its kinetic energy store.

Calculate the efficiency of this energy transfer.

(4)

efficiency = ... %

(b) The diagram shows part of the electric motor inside the fan.



(i) Explain why the coil starts to rotate when there is a current in the coil.

(4)

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(ii) Which side of the coil moves vertically upwards?

(1)

☒ **A** WX

☒ **B** XY

☒ **C** YZ

☒ **D** ZW

(Total for question = 9 marks)

Q4.

A light bulb used in homes converts electrical energy into light energy.

The input power of the light bulb is 52 W.

The efficiency of the light bulb is 5.0%.

Calculate the amount of light energy output by the lamp in 9.0 hours of use.

light energy output = ... J

(Total for question = 4 marks)

Q5.

The photographs show two different breeds of cat.



© Kucher Serhii/Shutterstock

Cat X



© Eric Isselee/Shutterstock

Cat Y

Cat X has no fur and light-coloured skin.

Cat Y has thick, black fur.

Both cats have the same body temperature and transfer energy to their surroundings when they are outside on a cold day.

Compare how cat X and cat Y transfer energy to their surroundings.

Refer to conduction, convection and radiation in your answer.

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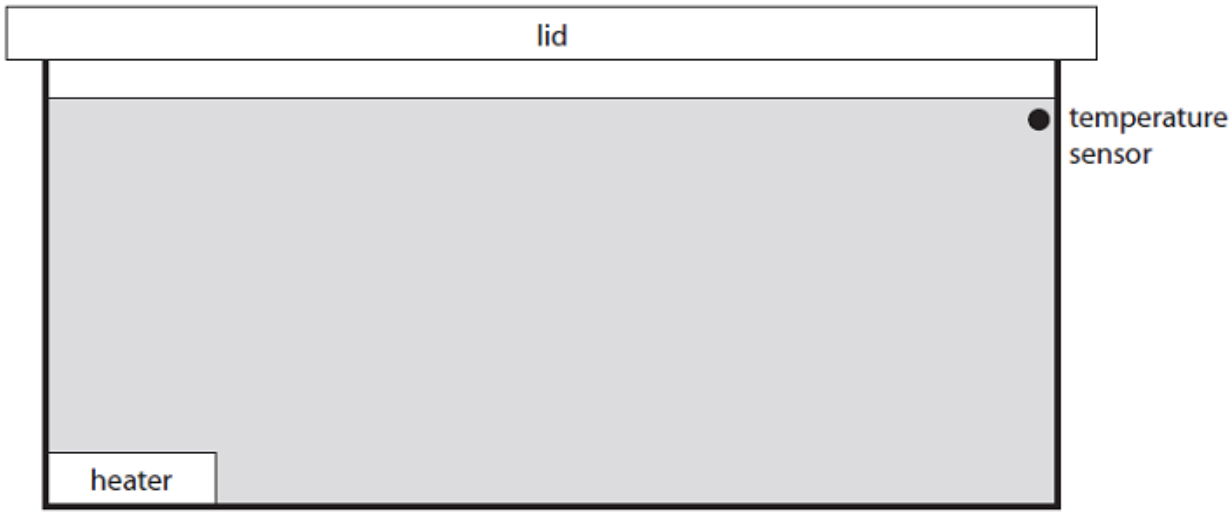
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(Total for question = 6 marks)

Q6.

The diagram shows a container of water.

The container has a heater in the bottom corner, a temperature sensor and a lid.



(a) Explain how a convection current is formed in the container.

You may add to the diagram or draw your own diagram to support your answer.

(4)

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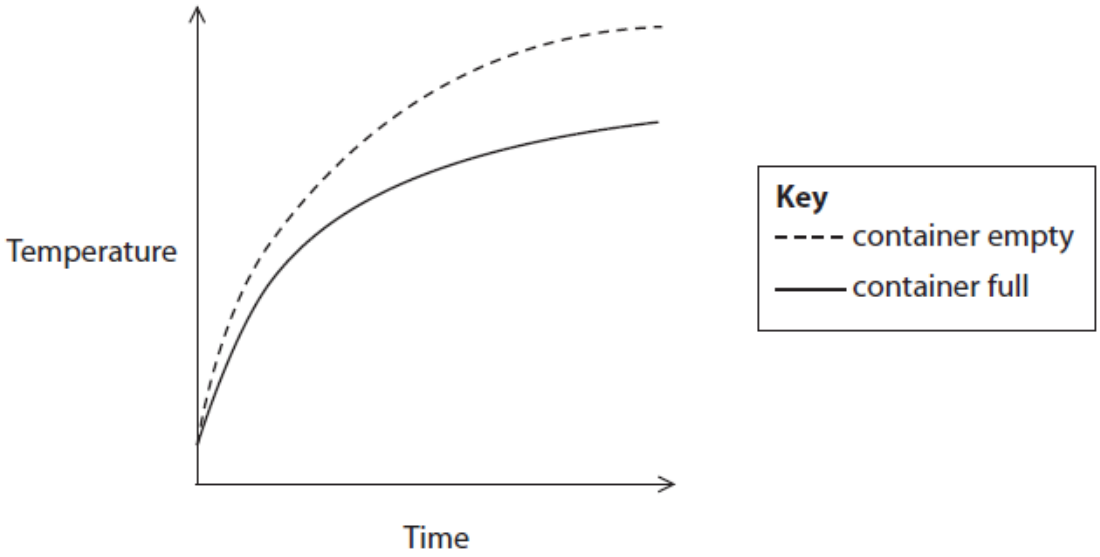
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(b) The graph shows how the temperature sensor reading changes with time.

It shows the change in temperature when the container is full of water and when the container is empty.



(i) Describe the relationship between temperature and time when the container is full of water.

(2)

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(ii) Explain the differences between the two curves on the graph.

(3)

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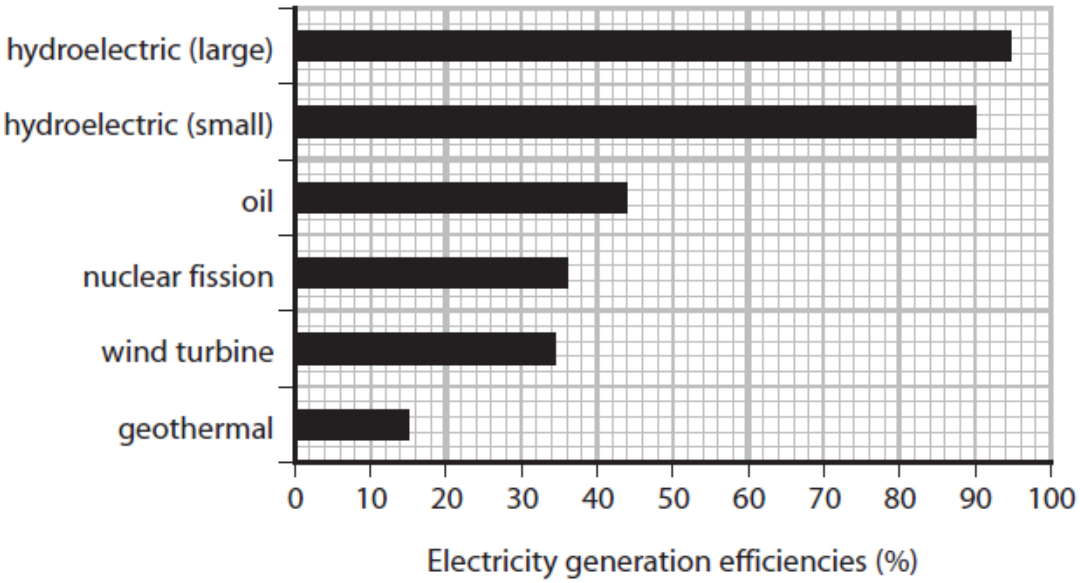
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(Total for question = 9 marks)

Q7.

The chart shows the efficiencies of different methods of generating electricity.



(a) The chart shows that the geothermal power station has an efficiency of 15%.

Explain what is meant by an efficiency of 15%.

(2)

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(b) A small hydroelectric power station has a useful energy output of 6.0 kJ.

Calculate the total energy input for this power station using information from the chart.

(4)

total energy input = ... kJ

(c) (i) Name a fuel used in the reactor of a nuclear power station.

(1)

.....

(ii) These sentences describe the process of nuclear fission.

Complete these sentences by writing a suitable word in each blank space.

(5)

A nucleus absorbs a ..... .

The nucleus formed splits because it is
..... .

The nucleus splits into two smaller nuclei called
.....

nuclei and two or three ..... .

The energy released is transferred into the
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energy store of the fission products.

(Total for question = 12 marks)

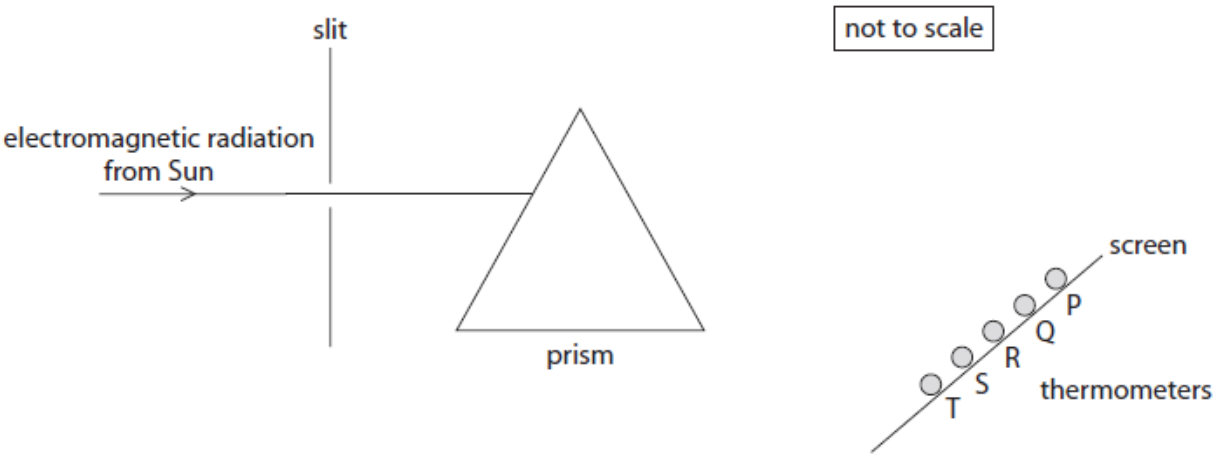
Q8.

The diagram shows the apparatus used to demonstrate the existence of electromagnetic radiation just beyond the visible spectrum.

Electromagnetic radiation from the Sun passes through a slit and a prism.

The electromagnetic radiation refracts through the prism onto the screen.

Five thermometers are placed in front of the screen.



(a) Complete the table to show the missing parts of the electromagnetic spectrum.

(3)

Thermometer	Part of electromagnetic spectrum
P	
Q	red light
R	
S	violet light
T	

(b) Suggest why the lower part of each thermometer should be painted black.

(2)

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(c) The equipment is left for a short period of time.

The thermometers now show higher temperatures than before.

State the part of the electromagnetic spectrum in this demonstration that would give the largest temperature increase.

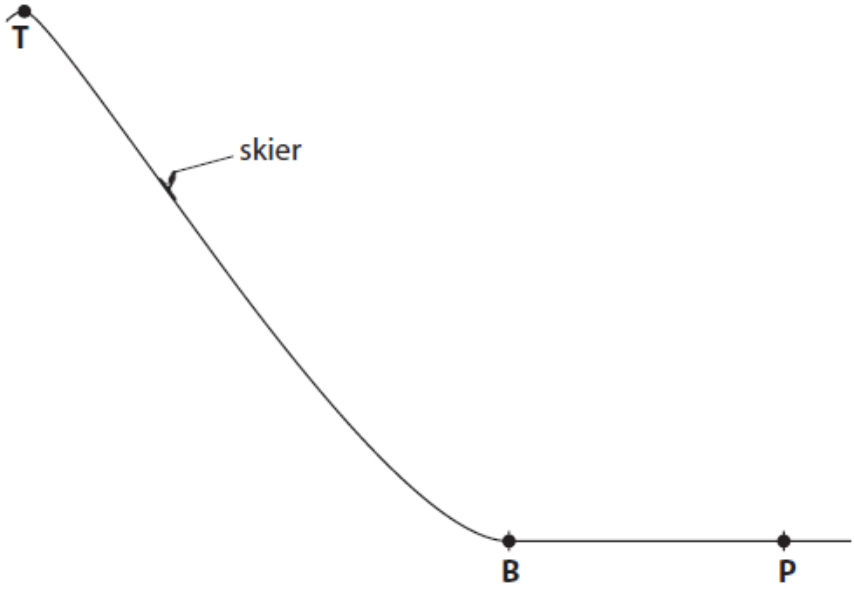
(1)

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(Total for question = 6 marks)

Q9.

The diagram shows a skier of weight 830 N skiing down a very steep slope.



The skier starts from rest at point **T**.

The force of gravity accelerates him down the slope.

(a) When he reaches point **B** his kinetic energy is 5.5×10^4 J.

State the gravitational potential energy of the skier at **T**.

You should assume there is no friction on the slope.

(1)

gravitational potential energy = ... J

(b) The skier stops at point **P** due to friction.

The distance from **B** to **P** is 73 m.

(i) State the relationship between work done, force and distance moved in the direction of the force.

(1)

.....

(ii) Calculate the mean frictional force as the skier moves from **B** to **P**.

(3)

mean force = ... N

(Total for question = 5 marks)

Q10.

Funcube-1 is a satellite that was launched into orbit around the Earth.



(Source: © Shutterstock)

(a) The rocket carrying Funcube-1 burns fuel to accelerate upwards.

As the rocket burns fuel, the energy in its chemical store reduces and the energy in its kinetic store and gravitational store changes.

(i) State how the kinetic store of the rocket changes as the rocket burns fuel.

(1)

.....

(ii) State how the gravitational store of the rocket changes as the rocket burns fuel.

(1)

.....

(b) The rocket engine stops burning fuel.

The rocket continues to go further away from the surface of the Earth.

The table gives some statements about the rocket's energy stores.

Add ticks (Π) to the table to show which two statements are correct.

(2)

Statement	Correct (✓)
gravitational store increases	
gravitational store stays the same	
gravitational store decreases	
kinetic store increases	
kinetic store stays the same	
kinetic store decreases	

(c) Funcube-1 goes into a circular orbit above the surface of the Earth.

(i) State the name of the force responsible for keeping Funcube-1 in orbit.

(1)

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(ii) Funcube-1 has an orbital radius of 7100 km and an orbital period of 5800 s.

Calculate the orbital speed, in km / s, of Funcube-1.

(2)

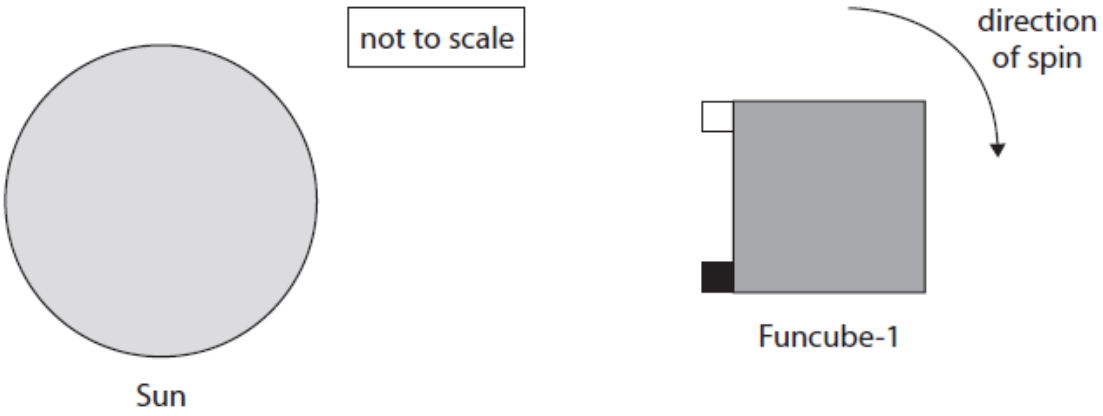
orbital speed = ... km / s

(d) Funcube-1 spins and is heated by the Sun.

The diagram shows two coloured metal bars attached to a face of Funcube-1.

The surface of one metal bar is dull and black.

The surface of the other metal bar is shiny and white.



Temperature probes measure the temperature of each metal bar.

Use ideas about thermal energy transfer to explain how the temperature of each metal bar changes as Funcube-1 spins.

(4)

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(Total for question = 11 marks)

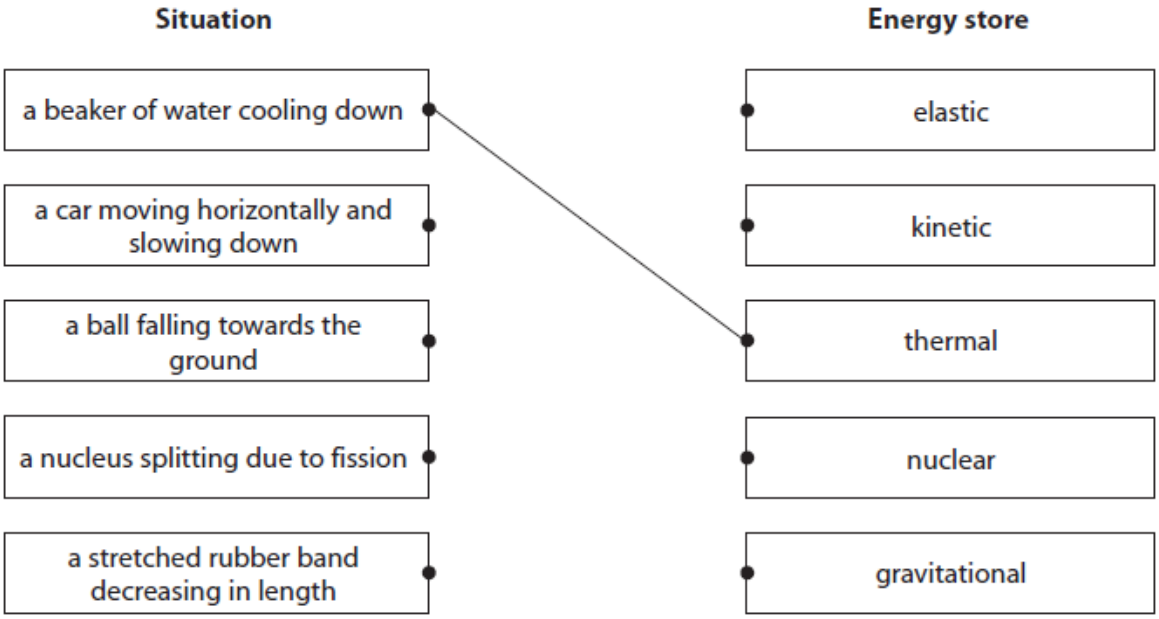
Q11.

(a) The boxes give some situations and some energy stores.

Draw one straight line from each situation to the energy store that decreases for that situation.

The first one has been done for you.

(4)



(b) Energy is transferred when a filament lamp is connected to a battery.

(i) Which method of energy transfer takes place between the battery and the lamp?

(1)

☒ **A** electrical

☒ **B** heating

☒ **C** mechanical

☒ **D** radiation

(ii) Which method of energy transfer takes place between the lamp and the surroundings?

(1)

☒ **A** electrical

☒ **B** light radiation

☒ **C** mechanical

☒ **D** sound radiation

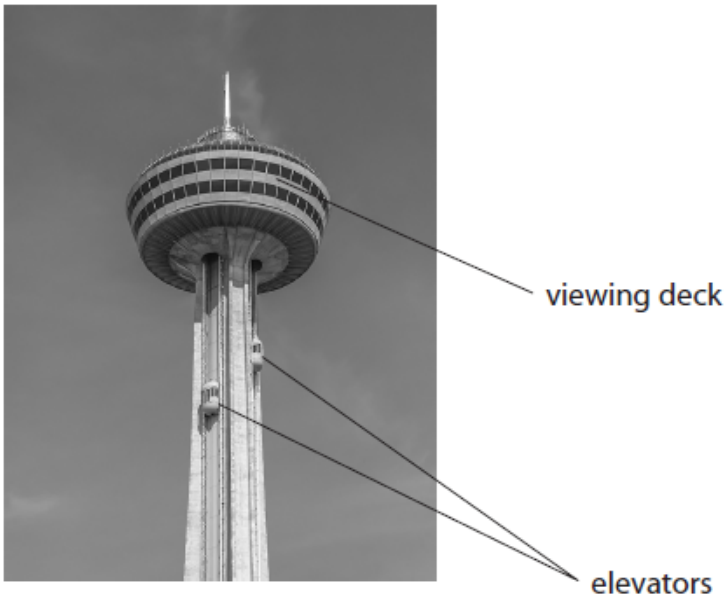
(Total for question = 6 marks)

Q12.

Some questions must be answered with a cross in a box ☒. If you change your mind

about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The Skylon Tower in Canada has external elevators. The elevators transport people from the bottom of the tower to a viewing deck at the top of the tower.



(Source: © Denis Pepin/Shutterstock)

(a) (i) An elevator moves upwards at a constant speed.

Which energy store of the elevator increases as the elevator moves upwards?

(1)

☒ **A** chemical

☒ **B** gravitational

☒ **C** kinetic

☒ **D** magnetic

(ii) The elevator is pulled upwards using a motor.

Thick steel cables connect the elevator to the motor.

How is energy transferred usefully from the motor to the elevator?

(1)

☒ **A** by heating

☒ **B** by radiation

☒ **C** electrically

☒ **D** mechanically

(b) The viewing deck at the top of the tower rotates and completes one full rotation every hour.

The mechanism that rotates the viewing deck is powered by a 2.2 kW motor.

(i) Which of these is the definition of the term **power?**

(1)

☒ **A** the amount of charge transferred

☒ **B** the amount of energy transferred

☒ **C** the rate of charge transferred

☒ **D** the rate of energy transferred

(ii) Which of these is the same power as 2.2 kW?

(1)

☒ **A** 0.0022 W

☒ **B** 0.022 W

☒ **C** 220 W

☒ **D** 2200 W

(iii) How many seconds does the viewing deck take to complete one full rotation?

(1)

☒ **A** 24 s

☒ **B** 60 s

☒ **C** 3600 s

☒ **D** 86 400 s

(Total for question = 5 marks)

Q13.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

A student investigates four cars P, Q, R and S.

(a) How is energy transferred usefully from the engine of a car to its wheels?

(1)

☒ **A** by heating

☒ **B** by radiation

☒ **C** electrically

☒ **D** mechanically

(b) The engine of a car burns petrol, which transfers energy usefully from the chemical store of the petrol to the kinetic store of the car.

The useful power output of car P's engine is 47 kW.

(i) Calculate the useful energy output of car P's engine during a 15 minute period.

(3)

useful energy output = ... J

(ii) State the formula linking efficiency, useful energy output and total energy output.

(1)

(iii) During the 15 minute period, 2.0×10^8 J of energy is transferred from the chemical store of the petrol.

Calculate the efficiency of car P's engine.

(2)

efficiency = ...

(c) The student extends her investigation by collecting data for cars P, Q, R and S.

She records the useful power output of their engines, their masses and their maximum speeds.

The table shows her data.

Car	Engine useful power output in kW	Mass in kg	Maximum speed in m/s
P	47	721	41
Q	92	1143	51
R	194	915	62
S	198	1226	68

Using information from the table, discuss the relationships between useful power output, mass and maximum speed.

(4)

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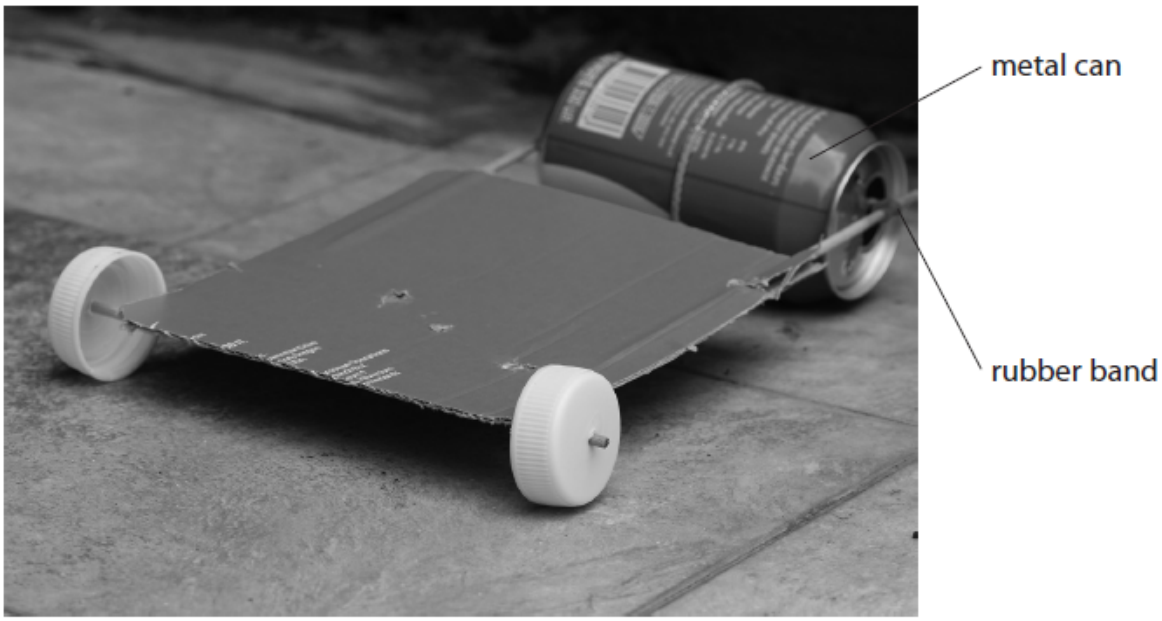
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(Total for question = 11 marks)

Q14.

The photograph shows a toy car. When the toy car is pulled backwards, energy is stored in the elastic store as the rubber band is twisted.



(Source: Mama Belle and the kids/Shutterstock)

When the car is released, some of the energy from the elastic store is transferred to the kinetic store of the car.

The remaining energy is transferred into the thermal store of the surroundings.

(a) State what is meant by the principle of conservation of energy.

(1)

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(b) The car is pulled backwards so that there is 165 J of energy in its elastic store.

When the car is released, this energy is transferred to the car's kinetic energy store with an efficiency of 15 %.

(i) State the formula linking efficiency, useful energy output and total energy output.

(1)

(ii) Calculate the energy transferred into the thermal store of the surroundings.

(4)

energy transferred to thermal store = ... J

(iii) Draw a labelled Sankey diagram for this energy transfer.

(3)

(c) The car is pulled backwards again.

When released, 45 J of energy transfers into the car's kinetic store.

The car travels a distance of 7.5 m during this energy transfer.

(i) State the useful work done on the car.

(1)

work done = ... J

(ii) Calculate the mean accelerating force acting on the car.

(3)

accelerating force = ... N

(Total for question = 13 marks)

Q15.

The photograph shows a recyclable box designed for transporting cold food.



The box has these design features

- thick walls made from several layers of cardboard with air trapped between the layers
- a thick lid made from layers of cardboard

Cold food and ice packs are placed in the box.

(a) Give a reason why there is a net transfer of energy from the outside of the box to the inside of the box during transportation in a hot country.

(1)

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(b) Explain how the box is designed to reduce energy transfer by **conduction**.

(2)

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(c) Explain how the box is designed to reduce energy transfer by **convection**.

(2)

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(d) A student suggests that painting the inner surfaces of the box a different colour would help to reduce the rate of energy transfer to the cold food.

Explain which colour the inner surfaces of the box should be painted.

(2)

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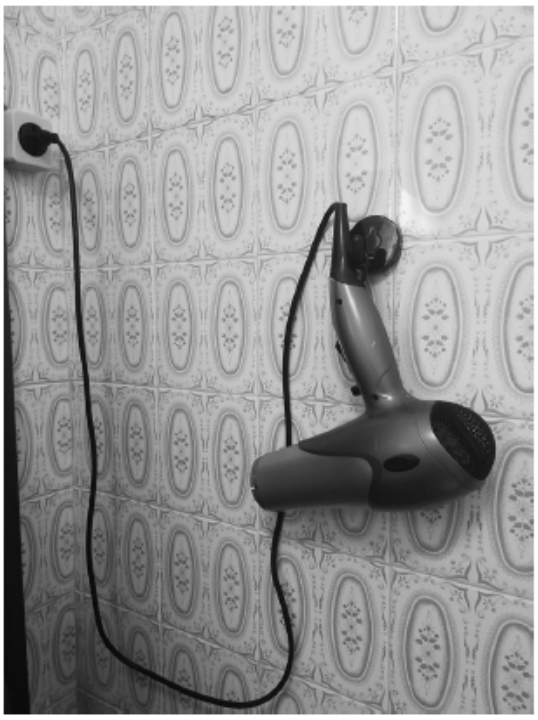
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(Total for question = 7 marks)

Q16.

The photograph shows a hair dryer plugged into the mains supply.

The hair dryer contains a fuse.



© Cristina Bernardo/Shutterstock

(a) State which wire in the hair dryer should be in series with the fuse.

(1)

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(b) The fuse is an electrical safety feature used in mains-operated domestic appliances.

State two other electrical safety features that can be used in mains-operated domestic appliances.

(2)

1 .....

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2 .....

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(c) The hair dryer has a current of 9.6 A.

The mains supply voltage is 230 V.

(i) State the formula linking power, current and voltage.

(1)

(ii) Calculate the power of the hair dryer.

Give the unit.

(3)

power = ... unit .....

(iii) The hair dryer contains a coil of wire which is used to heat air passing through the hair dryer.

Explain why the coil of wire heats up when there is a current in it.

(3)

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(d) Explain how a fuse protects a domestic appliance.

(3)

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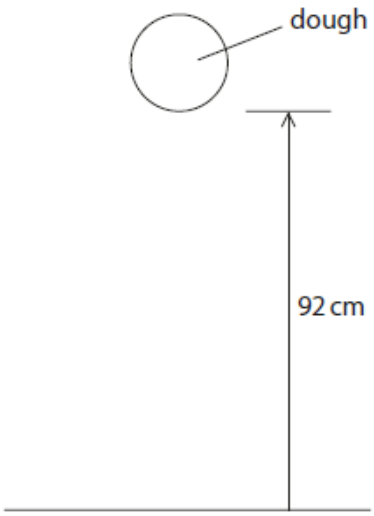
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(Total for question = 13 marks)

Q17.

(a) The diagram shows a ball of dough, of mass 580 g, held at a height of 92 cm above the floor.



Calculate the increase in gravitational potential energy (GPE) stored in the ball of dough when it is above the floor.

(3)

GPE = ... J

(b) The ball of dough hits the floor and does not rebound.

Describe the energy transfers taking place from when the dough is dropped to after it has hit the floor.

You should refer to energy stores as well as transfers between energy stores at these stages.

- before the dough is dropped
- just before the dough hits the floor
- after the dough has hit the floor

(4)

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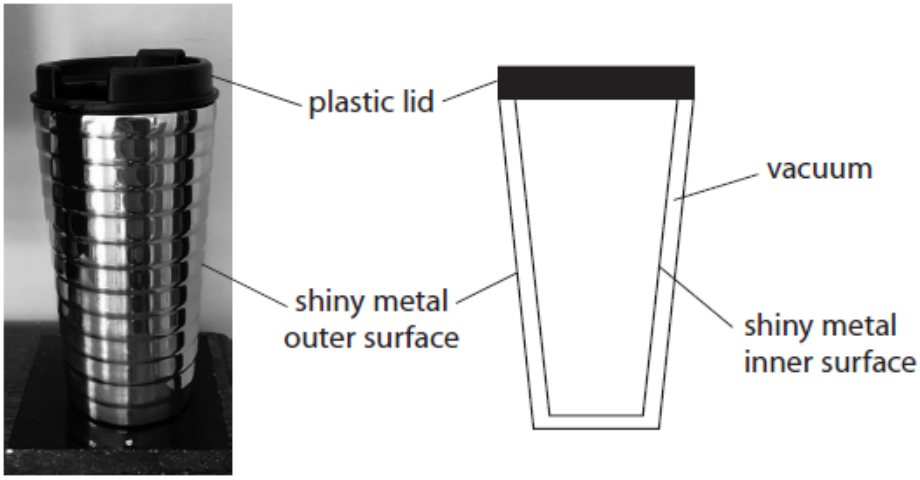
(Total for question = 7 marks)

Q18.

A teacher makes a hot drink.

He puts the drink in a cup designed to keep the drink hot.

The photograph and cross-section diagram both show the cup.



Explain how the design of the cup keeps the drink hot.

Refer to methods of energy transfer in your answer.

(6)

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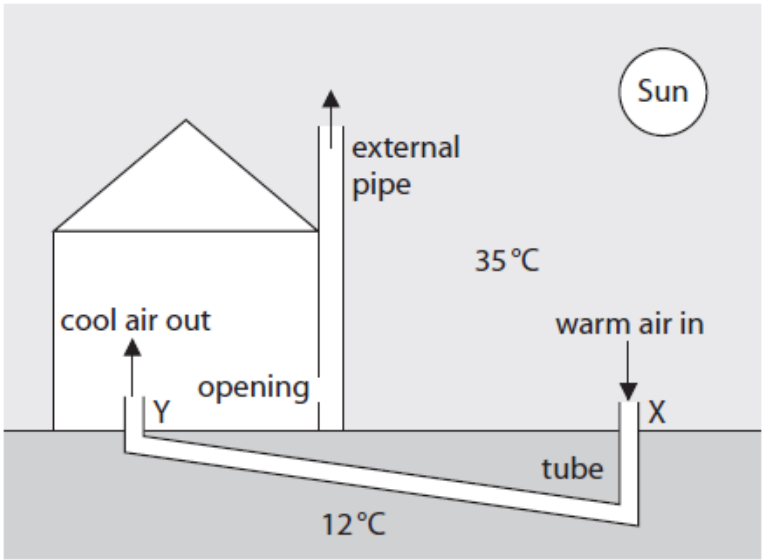
(Total for question = 6 marks)

Q19.

The diagram shows a building in a hot climate.

The air temperature is 35 °C and the underground temperature is 12 °C.

The external pipe is heated by the Sun. This causes cool air to enter the house through a tube in the ground.



(a) How is energy transferred to the external pipe from the Sun?

(1)

☒ **A** conduction

☒ **B** convection

☒ **C** evaporation

☒ **D** radiation

(b) Explain why air moves upwards through the external pipe.

(3)

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(c) Warm air enters the tube at point X.

Cool air leaves the tube at point Y.

Explain how the air is cooled as it travels through the tube.

(3)

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(d) The external pipe is painted to increase the air flow through the building.

Explain what colour of paint would give the greatest increase in air flow.

(3)

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(Total for question = 10 marks)

Q20.

(a) (i) State Hooke's Law.

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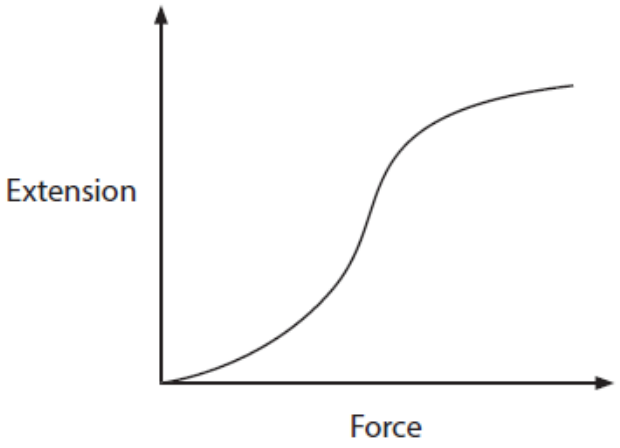
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(ii) The graph shows how the extension of a rubber band varies with the force applied.



Explain how the graph shows that the rubber band does not obey Hooke's Law.

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(b) Diagram 1 shows a model aeroplane powered by a rubber band.

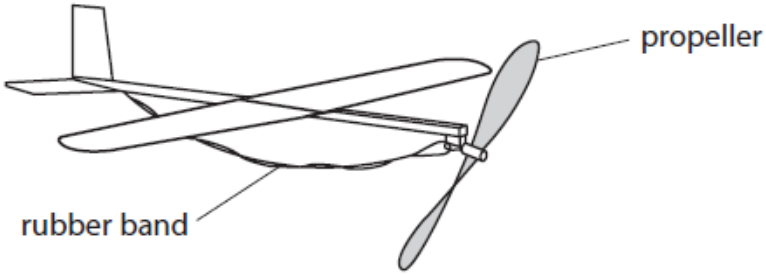


Diagram 1

A person rotates the propeller of the model aeroplane, which twists the rubber band.

He then releases the propeller and it spins.

Energy transfer occurs during this process.

The box lists words associated with energy.

kinetic	gravitational	electrostatic
mechanical	elastic	magnetic
heating	chemical	radiation

Use words from the box to complete the passage.

(3)

The person does ..... work to twist the rubber band.

As the person twists the rubber band it extends, increasing the .....

energy store of the rubber band. When the rubber band is released it does mechanical work,

increasing the ..... energy store of the propeller.

(c) Diagram 2 shows the aeroplane flying horizontally to the right.

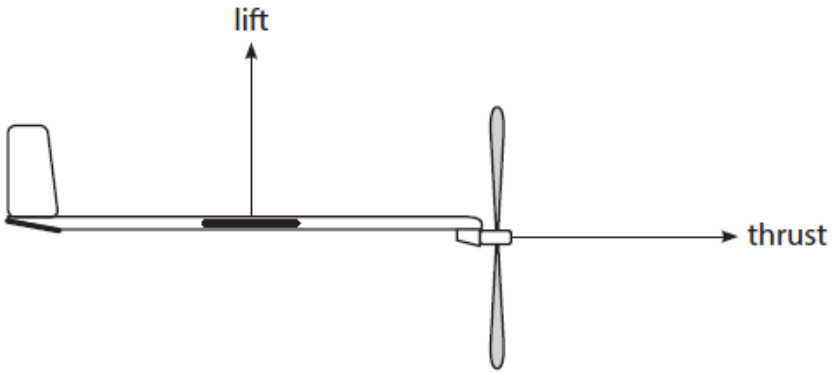


Diagram 2

The aeroplane flies at a constant speed.

Diagram 2 shows two forces acting on the aeroplane.

Draw labelled arrows on diagram 2 to show two more forces acting on the aeroplane.

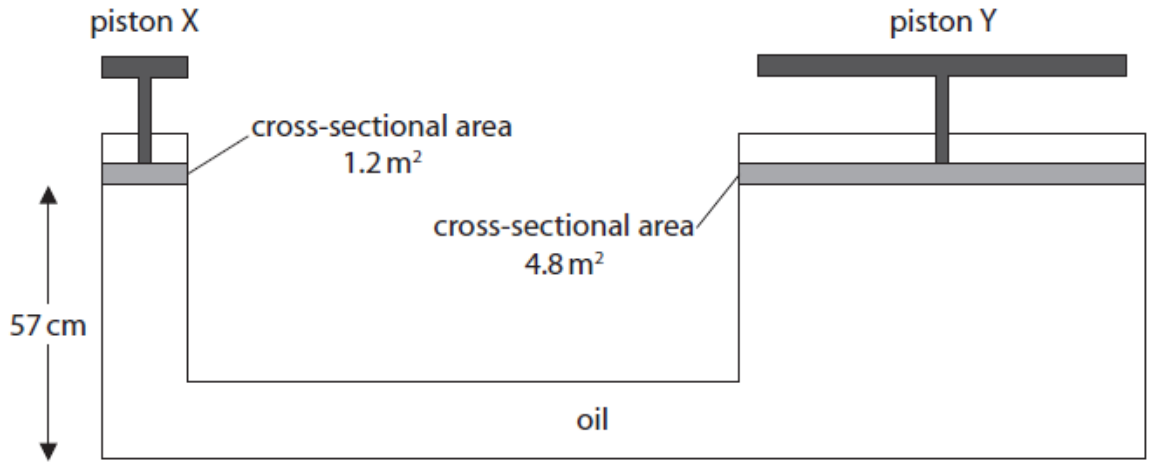
(4)

(Total for question = 11 marks)

Q21.

The diagram shows a device called a hydraulic lift.

The hydraulic lift consists of a tube of oil with a piston at each end.



(a) Calculate the pressure difference between the bottom of piston X and the bottom of the oil.

[density of oil = 820 kg/m^3]

(3)

pressure difference = ... Pa

(b) A 24 kg mass is placed on piston X.

(i) Calculate the weight of the 24 kg mass.

Give the unit.

(3)

weight =..... unit.....

(ii) Calculate the extra pressure on the oil due to the mass.

(2)

extra pressure = ... Pa

(iii) The oil transfers the same extra pressure to piston Y.

Calculate the force acting upwards on piston Y due to the extra pressure.

(3)

force = ... N

(c) Piston Y starts at rest, rises slowly and then comes to rest.

State how the following energy stores have changed from before the motion to after the motion is complete.

(4)

Energy store	Change
gravitational potential energy of piston X	
gravitational potential energy of piston Y	
chemical energy of piston Y	
kinetic energy of piston Y	

(Total for question = 15 marks)

Q22.

Diagram 1 shows a hydro-electric power station.

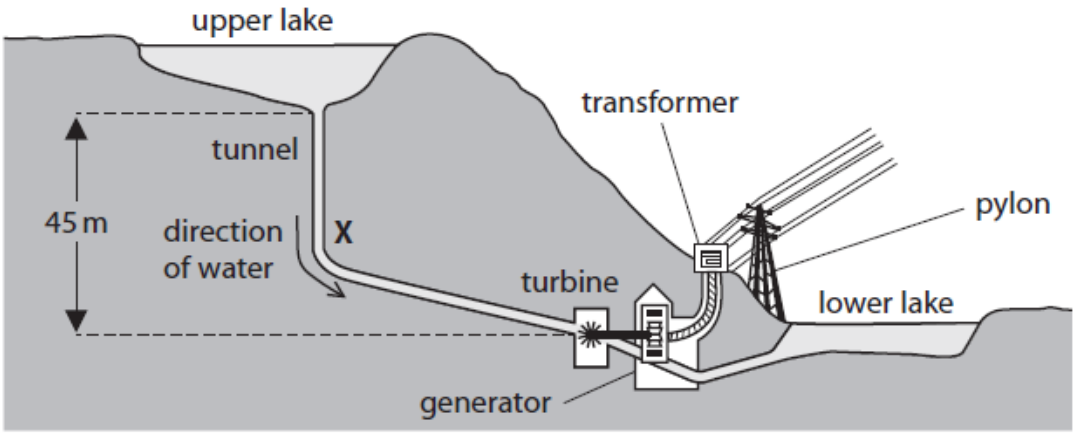


Diagram 1

(a) Water falls from the upper lake and passes position X in the tunnel.

After falling to position X, 1.25×10^3 kg of water has 3.2×10^5 J of energy in its kinetic store.

Calculate the speed of the water at position X.

[kinetic energy = $\frac{1}{2} \times$ mass $\times$ speed^2]

(3)

speed = ... m/s

(b) Water with a mass of 1.25×10^3 kg falls through a height of 45 m from the upper lake to the turbine.

(i) Calculate the decrease in the gravitational potential energy (GPE) store of the water between the upper lake and
the turbine.

(3)

decrease in GPE = ... J

(ii) State how much work has been done on the water by the Earth.

(1)

work done = ... J

(iii) State the method of energy transfer required for this work to be done.

(1)

.....

(c) (i) State the formula linking total energy output, useful energy output and efficiency.

(1)

(ii) Diagram 2 shows a Sankey diagram for the generator in the hydro-electric power station.

The generator is designed to transfer energy electrically to the transformer.

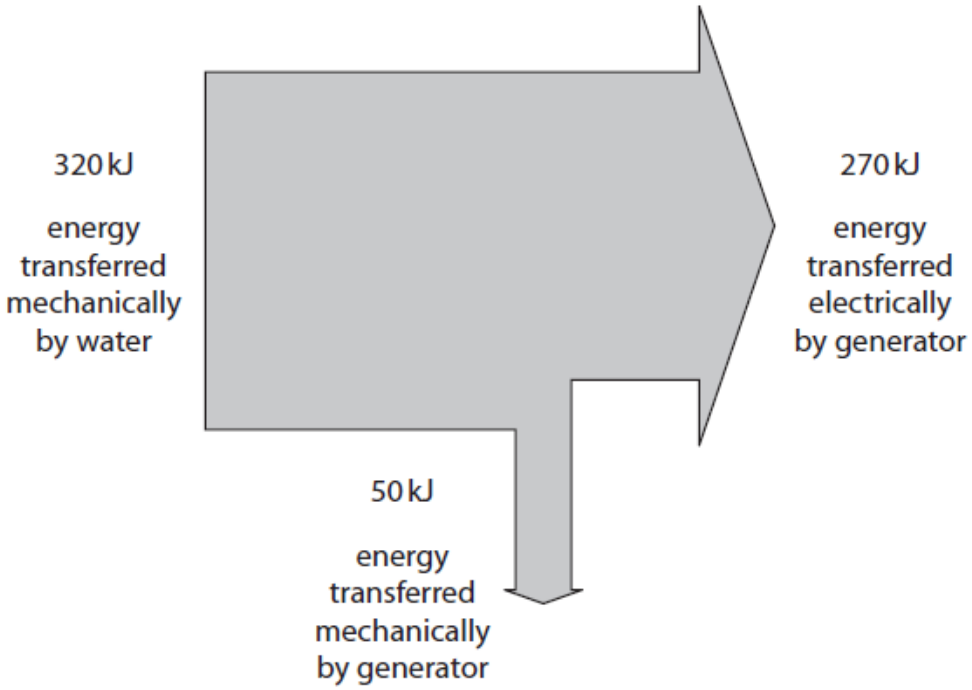


Diagram 2

Which of these is the correct expression for calculating the efficiency of the process shown in diagram 2?

(1)

☒ **A** $\frac{50}{270} \times 100\,\%$

☒ **B** $\frac{270}{320} \times 100\,\%$

☒ **C** $\frac{50}{320} \times 100\,\%$

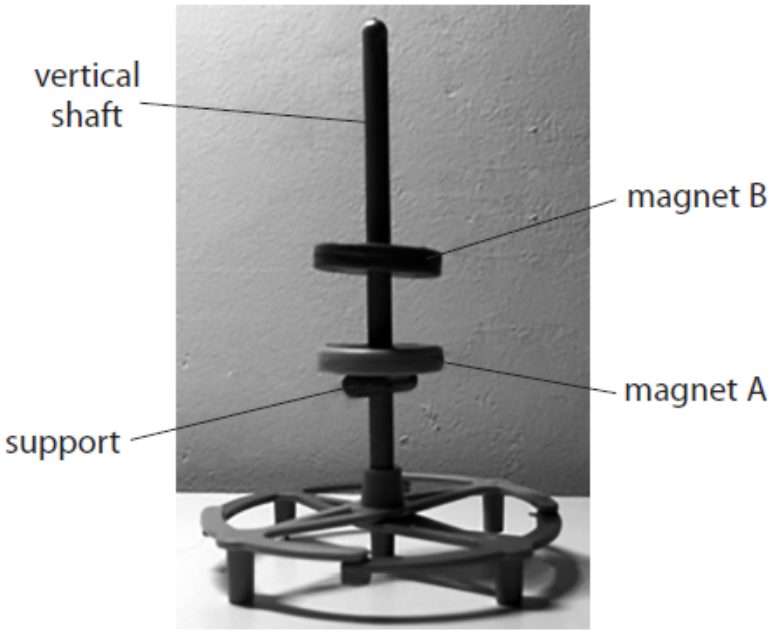
☒ **D** $\frac{320}{270} \times 100\,\%$

(Total for question = 10 marks)

Q23.

Photograph 1 shows a child's toy.

The toy has two magnets on a vertical shaft.



Photograph 1

(a) Magnet A rests on a support near the bottom of the vertical shaft.

A student places magnet B at the top of the vertical shaft and releases it from rest.

Magnet B is repelled by magnet A causing it to come to rest again at the position shown.

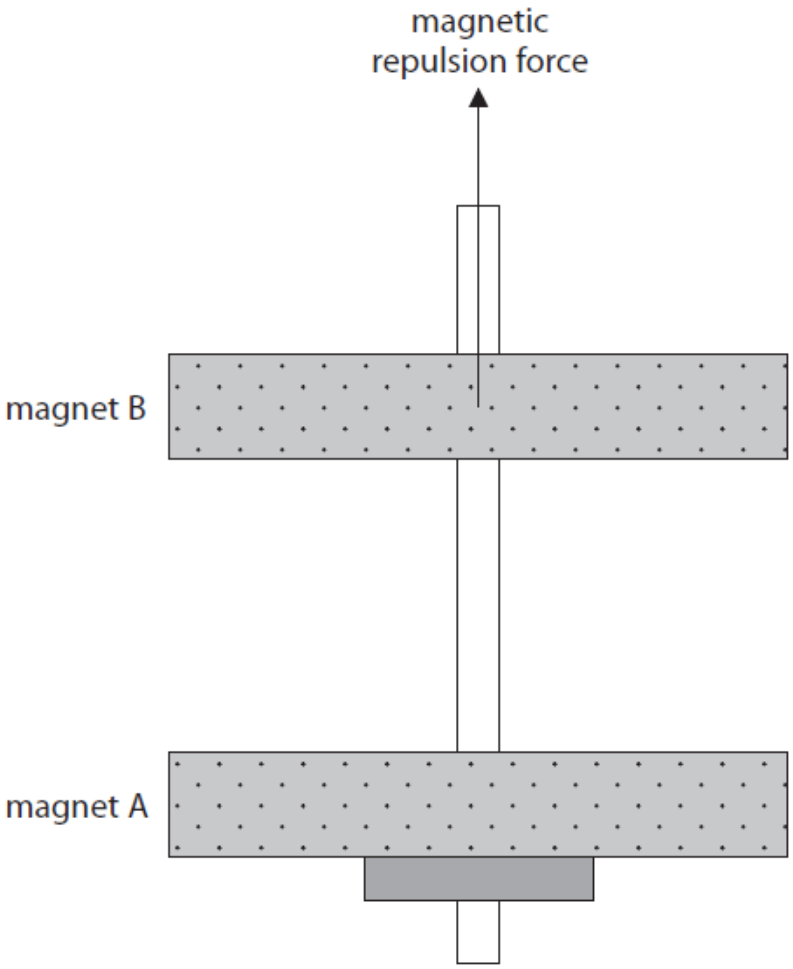
The table shows some energy stores in magnet B.

Put ticks (✓) in the correct boxes to show whether the amount of energy in each store of magnet B increases, decreases or stays the same when compared to its value at the top of the vertical shaft.

(3)

Energy store in magnet B	Increases	Decreases	Stays the same
gravitational			
magnetic			
kinetic			

(b) This is a diagram of the toy shown in photograph 1.



One of the forces acting on magnet B is shown.

Draw another labelled arrow on the diagram to show the other force acting on magnet B.

(2)

(c) The student adds a 10 g mass on top of magnet B when it is stationary above

magnet A and observes that the distance between the magnets decreases.

He carries out an investigation to see how the distance changes as more masses are added.

In your answer, you should refer to

- the measuring equipment required
- the independent and dependent variables
- a way to check the reliability of the data

You may draw a diagram to help your answer.

(5)

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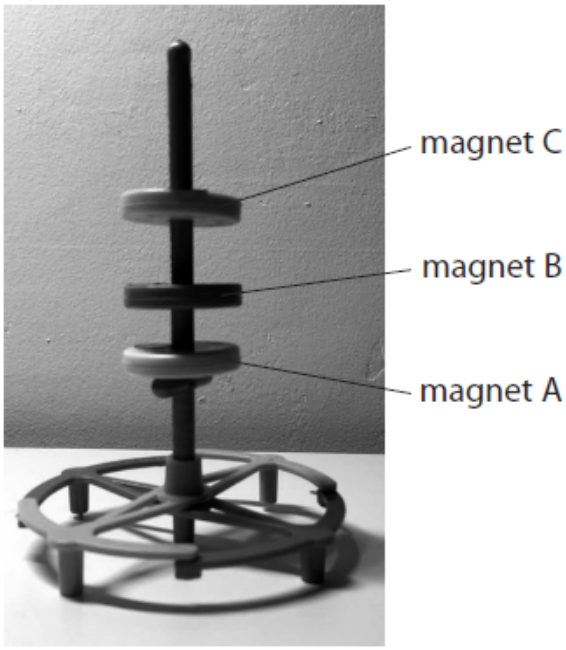
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(d) The student removes the masses from magnet B.

He then adds magnet C on to the vertical shaft.



Photograph 2

Photograph 2 shows that when magnet C is added, magnet B moves further down the shaft until it is at rest again.

Explain why the distance between magnet A and magnet B has decreased.

(3)

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(Total for question = 13 marks)

Q24.

Hailstones are small pieces of ice that sometimes fall to the ground during storms.

(a) (i) Describe how to determine the density of a hailstone.

Assume that hailstones are spherical.

(4)

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(ii) The mean volume of a hailstone is 1.1 cm^3.

The mean mass of a hailstone is 0.94 g.

Calculate the mean density of a hailstone.

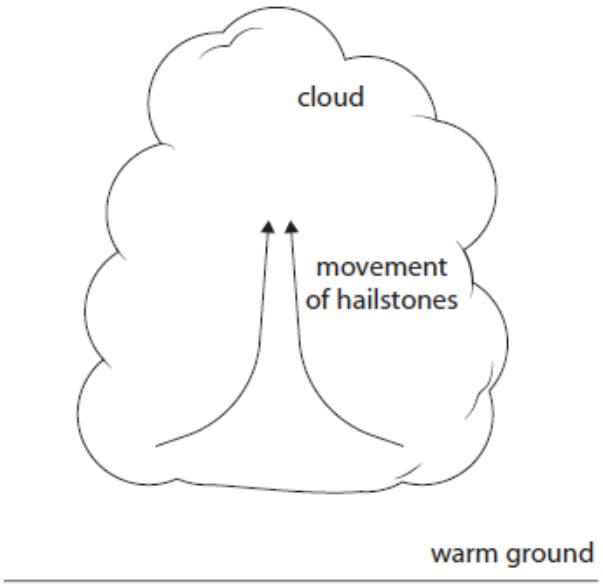
Give the unit.

(3)

density =..... unit .....

(b) Hailstones can be lifted to the top of clouds.

The diagram shows the movement of some hailstones in a cloud.



Suggest how hailstones are lifted to the top of the cloud by convection.

(2)

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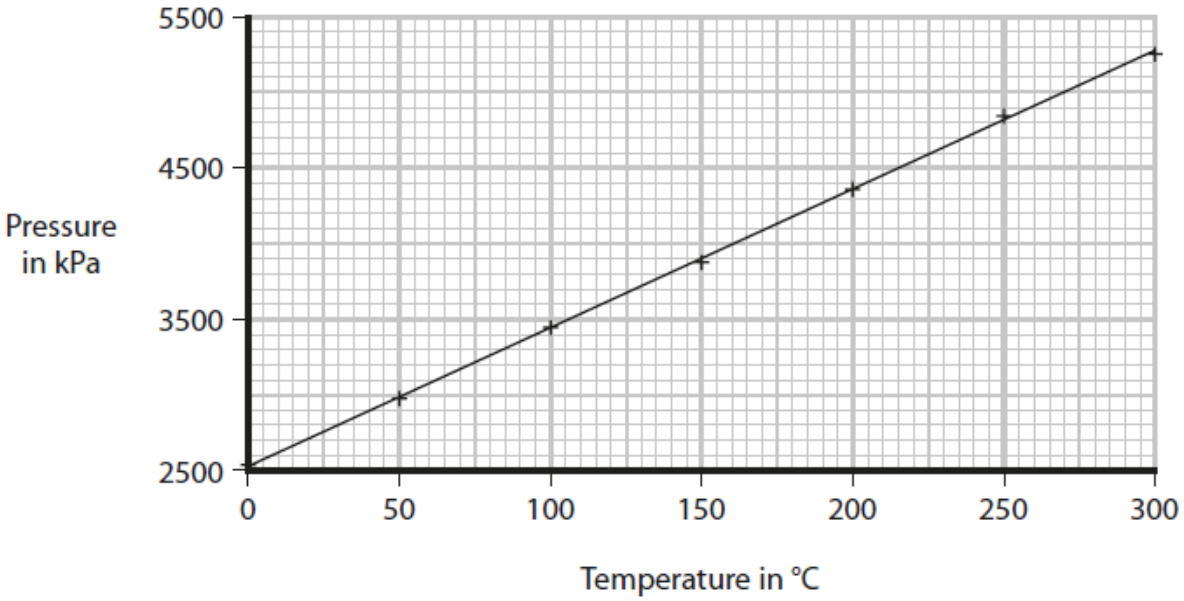
(Total for question = 9 marks)

Q25.

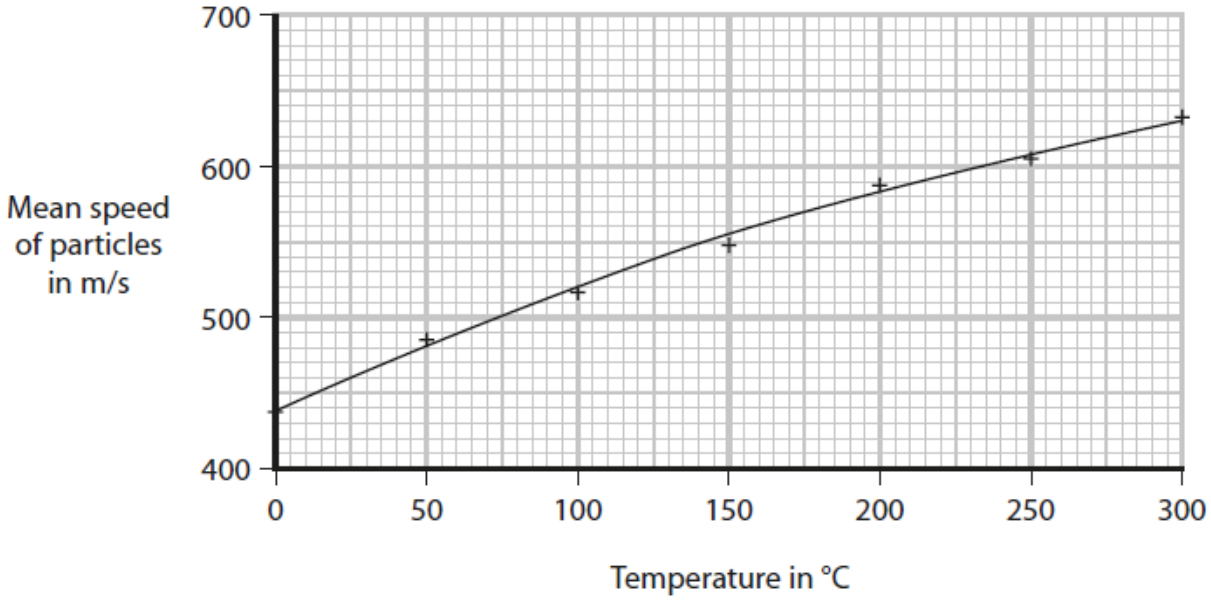
A student uses a computer simulation to investigate the motion of particles in a gas.

He records the pressure of the gas and the mean speed of the particles in the gas at different temperatures.

The graphs show his results.



Graph 1



Graph 2

(a) Give a reason why the student does not start the *y*-axis scale from zero on either of his graphs.

(1)

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(b) Describe the relationships shown by the graphs.

(3)

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(c) Explain why the value of temperature chosen in the simulation should not decrease below –273 °C.

(2)

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(d) The student then calculates the kinetic energy of a single gas particle at each temperature.

(i) Using the curve of best fit on graph 2, determine the mean speed of a gas particle when the gas temperature is 100 °C.

(1)

mean speed = ... m/s

(ii) The mass of a single gas particle is 5.3×10^{-26} kg.

Calculate the average kinetic energy of a gas particle when the temperature of the gas is 100 °C.

(3)

kinetic energy = ... J

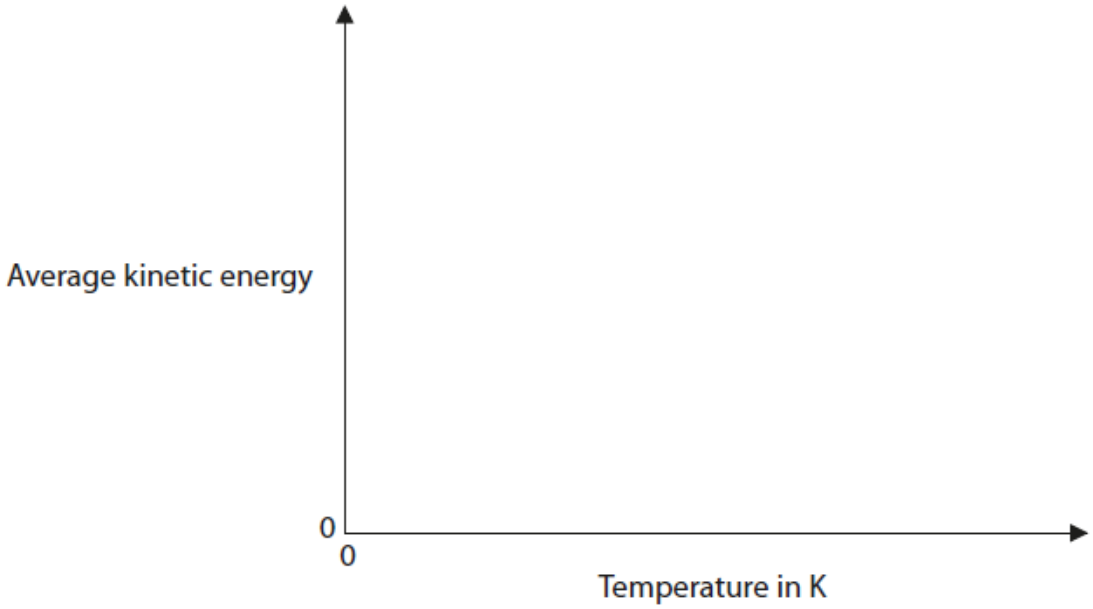
(iii) Calculate the temperature of the gas in kelvin when its temperature is 100 °C.

(1)

temperature = ... K

(iv) On the axes, sketch a graph of the average kinetic energy of the gas particles against temperature in kelvin.

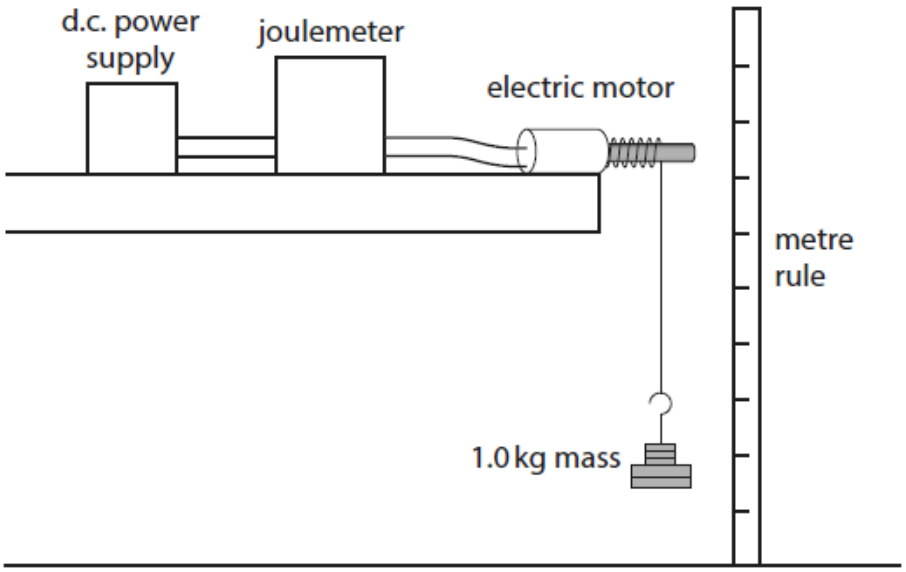
(2)



(Total for question = 13 marks)

Q26.

A student uses this apparatus to investigate how the efficiency of an electric motor varies with its input voltage.



This is the student's method.

- connect the electric motor to a d.c. power supply and a joulemeter
- attach a 1.0 kg mass to the electric motor using a length of string
- set the voltage of the power supply to 10 V and switch on the power supply
- switch off the power supply when the mass has been lifted through a distance of 50 cm

- record the input energy to the motor from the joulemeter
- calculate the energy transferred to the gravitational store of the mass
- calculate the efficiency of the motor

The student repeats this process, setting the power supply to a different voltage each time.

(a) State how the student could improve the reliability of her results.

(1)

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(b) Give two control variables for the investigation.

(2)

1 .....

2 .....

(c) Show that the gravitational store of the 1.0 kg mass increases by 5.0 J when it is lifted through a distance of 50 cm.

(2)

(d) The table shows the student's results.

Power supply voltage in V	Joulemeter reading in J	Motor efficiency (%)
3.0	99.4	5.0
3.5	25.5	19.6
4.0	16.5	30.3
5.0	13.5	37.0
6.0	12.6	39.7
8.0	12.8	39.1
10.0	12.7	

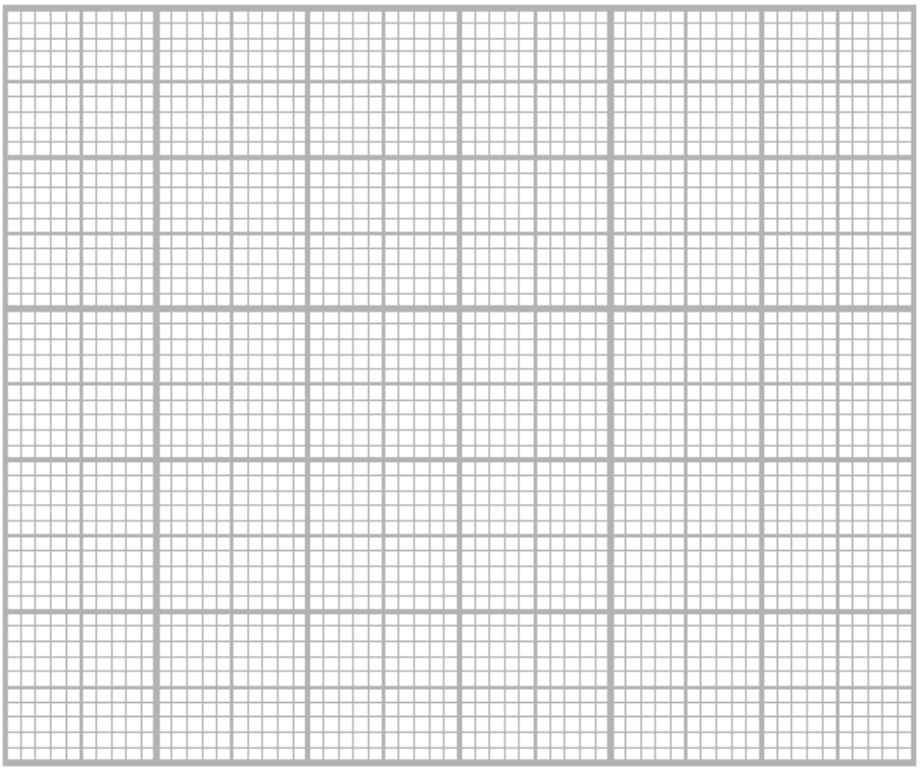
(i) Calculate the motor efficiency when the power supply is set to a voltage of 10 V.

(3)

efficiency = ... %

(ii) Plot a graph of the motor efficiency on the y-axis against the power supply voltage on the x-axis.

(3)



(iii) Draw a curve of best fit.

(2)

(iv) Using the graph, determine the minimum power supply voltage that will allow the electric motor to operate at maximum efficiency.

(1)

power supply voltage = ... V

(Total for question = 14 marks)

Q27.

When a meteor explodes, light waves and sound waves are produced at the same time.

(a) (i) State the formula linking average speed, distance moved and time taken.

(1)

(ii) A person standing 1860 m away from the site of a meteor explosion hears the sound of the explosion 5.6 s later.

Calculate the speed of sound in air.

(2)

speed of sound = ... m/s

(iii) A scientist stands a long way from the meteor explosion.

Explain why he hears the explosion at a different time to when he sees it.

(2)

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(b) Sound is a longitudinal wave.

Describe what is meant by the term **longitudinal wave**.

(2)

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(c) In 2013, a meteor exploded above Russia.

Just before the meteor exploded, it was travelling at a speed of 19.2 km/s.

The mass of the meteor was estimated to be 1.25×10^7 kg.

(i) State the formula linking kinetic energy, mass and speed.

(1)

(ii) Calculate the energy in the kinetic store of the meteor just before the meteor exploded.

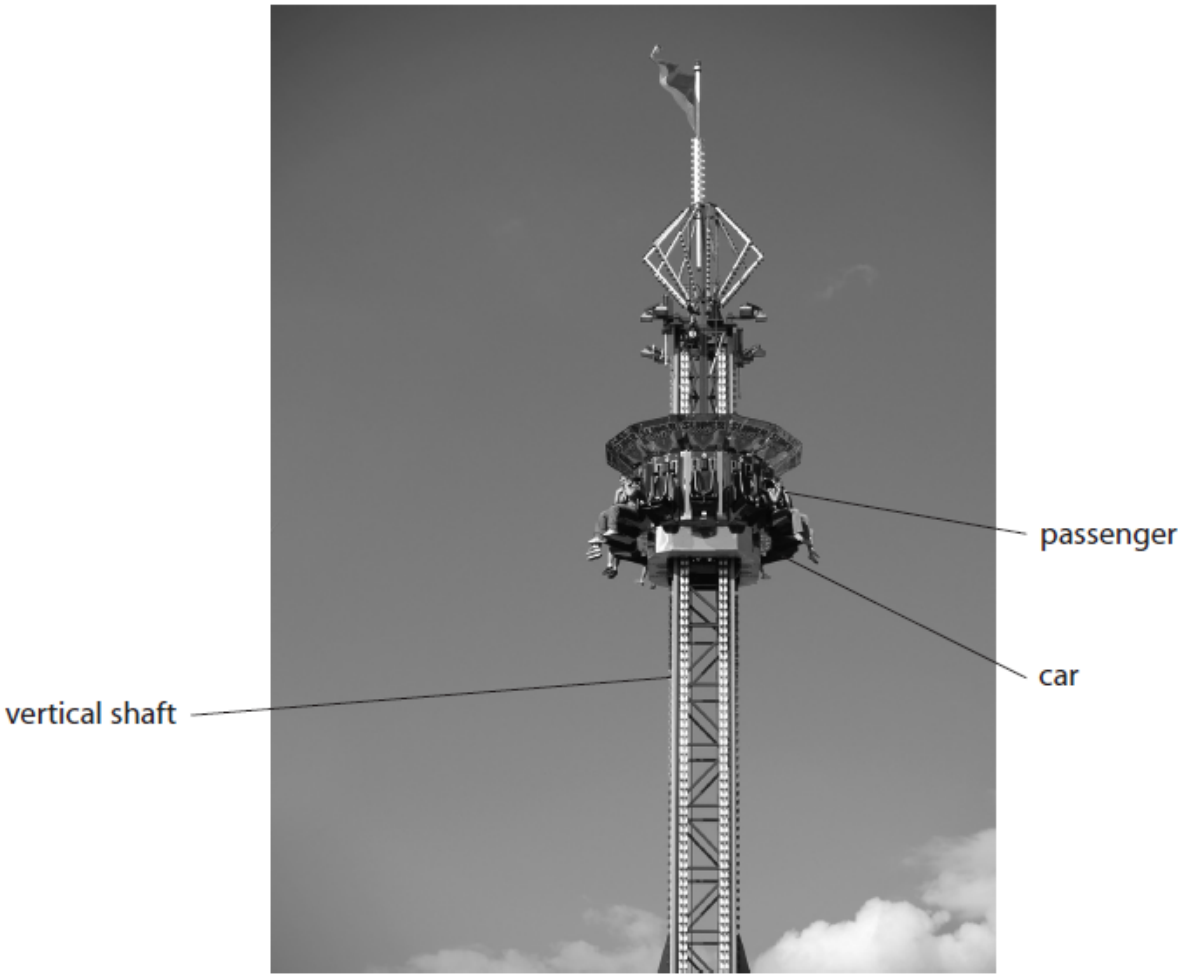
(2)

energy in kinetic store = ... J

(Total for question = 10 marks)

Q28.

The photograph shows a vertical drop ride at an amusement park.



(Source: Kenneth Sponsler/Shutterstock)

The car is pulled to the top of a vertical shaft and then released from rest.

The car then falls freely because of the force of gravity.

(a) Calculate the speed of the car when it has fallen 18 m.

(3)

speed = ... m / s

(b) (i) State the formula linking kinetic energy, mass and speed.

(1)

(ii) The mass of the car and its passengers is 2.1 tonnes.

Calculate the kinetic energy of the car when it has fallen 18 m.

[1 tonne = 1000 kg]

(2)

kinetic energy = ... J

(c) The actual speed of the car when it has fallen 18 m is lower than the value calculated in (a).

Describe the energy transfers occurring from immediately before the car was released to when the car has fallen 18 m.

Refer to stores and transfers in your answer.

(4)

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(Total for question = 10 marks)

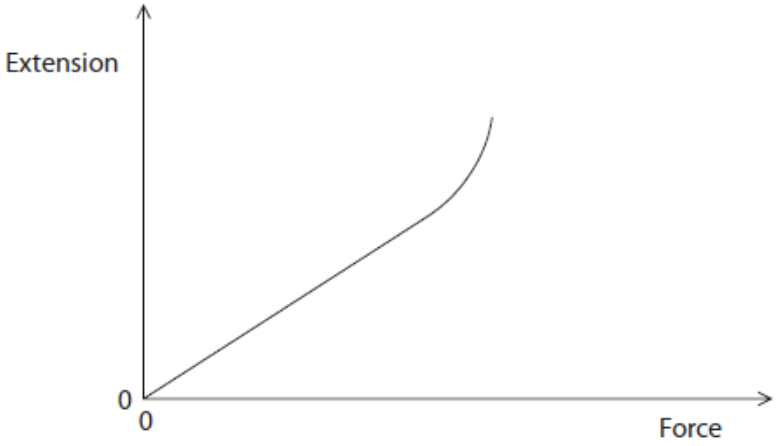
Q29.

This question is about stretching a spring.

(a) The graph shows how the extension of a spring varies when a force is applied to the spring.

The line on the graph shows that the spring has been extended past its elastic limit.

The line has a straight section and a curved section.



(i) Draw a cross on the line to show the elastic limit of the spring.

(1)

(ii) Sketch another line to show how the extension will change when the force is decreased from its maximum value back to 0.

(2)

(b) (i) State which energy store of the spring increases when it is stretched. Assume the spring does not reach its elastic limit.

(1)

.....

(ii) How is this energy transferred to the spring?

(1)

☒ **A** electrically

☒ **B** by heating

☒ **C** mechanically

☒ **D** by radiation

(Total for question = 5 marks)

Q30.

The photograph shows a large hurdle on an athletics track.



© Sony Ho/Shutterstock

(a) The bar of the hurdle is made of wood and is painted black and white.

The temperature of the hurdle increases when the Sun shines on it.

Explain which part of the bar reaches the highest temperature.

(2)

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(b) The air near the bar receives energy by heating.

Explain how a convection current is formed in the air near the bar.

(4)

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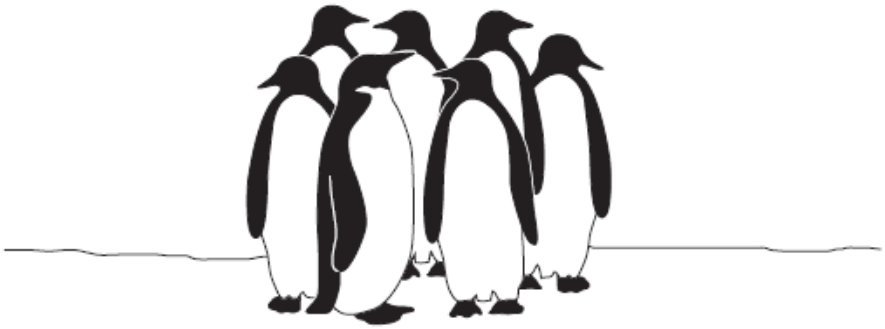
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(Total for question = 6 marks)

Q31.

Penguins are adapted to survive in cold conditions.

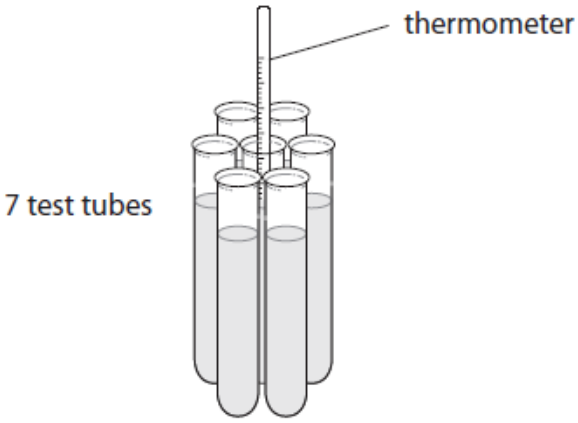
The adaptations help them to maintain a constant body temperature of 39 °C. Penguins also crowd together in groups of many penguins.



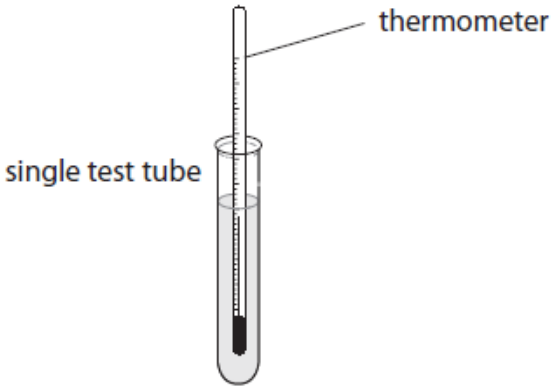
(a) A student wants to investigate how the temperature of a penguin is affected when they crowd together in groups.

She uses this apparatus.

Each test tube represents a penguin.



represents a huddle of 7 penguins



represents a single penguin

(i) These statements describe the method she should use.

The statements are in the wrong order.

Put them into the correct order by numbering the boxes.

Some have been done for you.

(3)

Statements	Order
record the data in a table	8
take the temperature of the two test tubes	
tie 7 test tubes together	1
heat the water to 90 °C	2
take the temperatures every minute	
place equal volumes of water in all test tubes	
put thermometers into the middle test tube and single test tube	
record data for 15 minutes	

(ii) The student draws a table to record her results.

Add suitable headings to her table.

(2)

Time/	.....	
	.....	.....

(iii) Predict how the temperature change for the single test tube will differ from the temperature change for the group of test tubes.

(1)

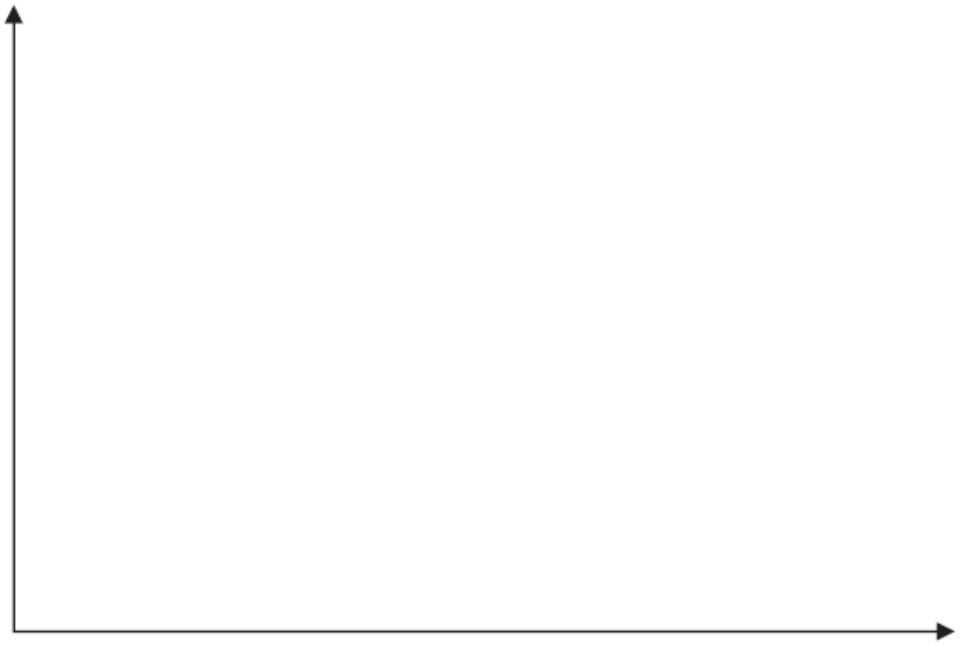
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(iv) Draw a sketch graph of the results you predict the student will obtain.

Label and use the axes below.

(4)



(v) Explain your prediction using ideas about thermal energy transfer.

(3)

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(b) Here are two adaptations that help penguins to maintain a constant body temperature.

- Most of their bodies are covered with layers of fat.
- They have flat overlapping feathers.

Explain why these features help penguins to maintain a constant body temperature.

(3)

Layers of fat .....

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.....

Flat overlapping feathers .....

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(Total for question = 16 marks)

Q32.

Wi-Fi signals are electromagnetic waves that can be transmitted at frequencies of 2.4 GHz and 5.2 GHz.

(a) (i) State a similarity of the Wi-Fi signals at 2.4 GHz and 5.2 GHz.

(1)

.....

(ii) The two Wi-Fi signals have different frequencies.

State another difference between the Wi-Fi signals.

(1)

.....

(b) (i) State the formula linking speed, frequency and wavelength.

(1)

(ii) Calculate the wavelength of Wi-Fi signals transmitted at 5.2×10^9 Hz.

[speed of light = 3.0×10^8 m / s]

(2)

wavelength = ... m

(c) (i) Which type of wave is a Wi-Fi signal?

(1)

☒ **A** longitudinal

☒ **B** mechanical

☒ **C** sound

☒ **D** transverse

(ii) Describe the difference between a transverse wave and a longitudinal wave. You may draw a diagram to help your answer.

(2)

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(Total for question = 8 marks)

Q33.

The photograph shows a truck with a crane that is used to move large bags of building materials.



(Source: © Alistair Petrie/Alamy Stock Photo)

(a) (i) State the formula linking work done, force and distance moved.

(1)

(ii) A bag of building materials has a weight of 8750 N.

Calculate the work done on the bag when it is lifted a vertical distance of 230 cm from the ground until it is stationary again.

Give the unit.

(3)

work done = ... unit .....

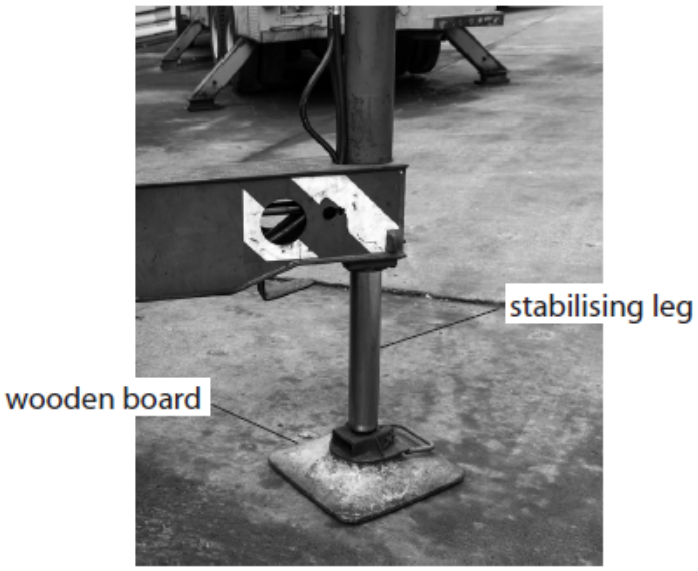
(iii) The crane takes 7.0 s to lift the bag.

Calculate the mean power output of the crane when it is lifting the bag.

(2)

mean power output = ... W

(b) The truck has a stabilising leg which is positioned on a wooden board.



(Source: © JARIRIYAWAT/Shutterstock)

(i) Give a reason why the wooden board is used.

(1)

.....

.....

(ii) State the formula linking pressure, force and area.

(1)

(iii) The wooden board is a square with side length 0.50 m.

The pressure the board exerts on the ground is 148 kPa.

Calculate the force exerted by the board on the ground.

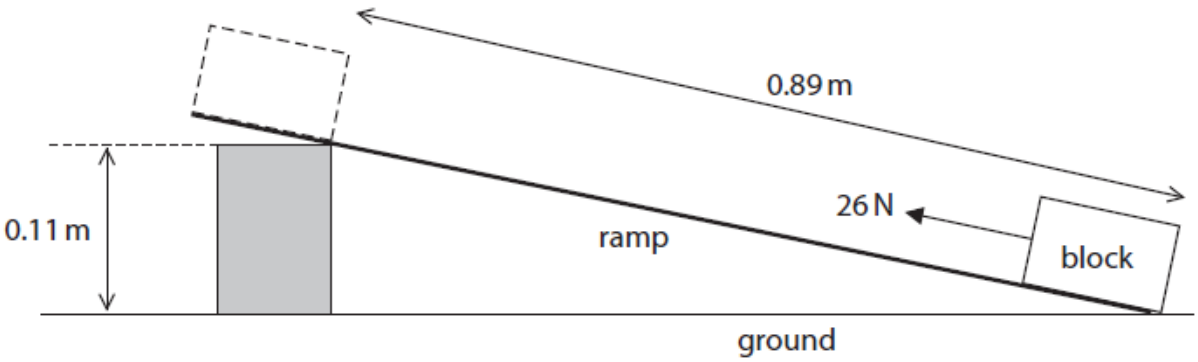
(4)

force = ... N

(Total for question = 12 marks)

Q34.

A student uses this apparatus to investigate the force needed to pull a block along a ramp.



(a) (i) State the formula linking work done, force and distance moved in the direction of the force.

(1)

(ii) The student pulls the block 0.89 m along the ramp with a force of 26 N.

Show that the work done on the block by the 26 N force is about 23 J.

(2)

(iii) The block has a mass of 1.3 kg and moves vertically upwards 0.11 m.

Calculate the increase in the gravitational potential energy (GPE) store of the block between the bottom and the top of the ramp.

(3)

increase in GPE = ... J

(iv) Explain why the work done to move the block along the ramp is greater than the increase in the GPE store of the block.

(2)

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(b) The student suggests it is better to use a less steep ramp to raise the block through the same vertical height.

Discuss an advantage and a disadvantage of using a less steep ramp.

(4)

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(Total for question = 12 marks)