Questions

Q1.

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%.

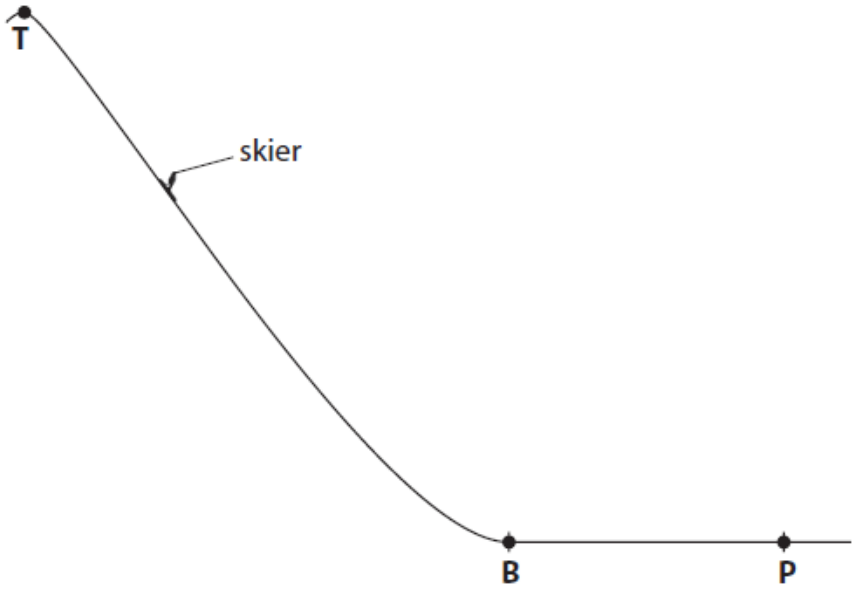
Calculate the amount of light energy output by the lamp in 9.0 hours of use.

light energy output = ... J

(Total for question = 4 marks)

Q2.

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)

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

(3)

mean force = ... N

(Total for question = 5 marks)

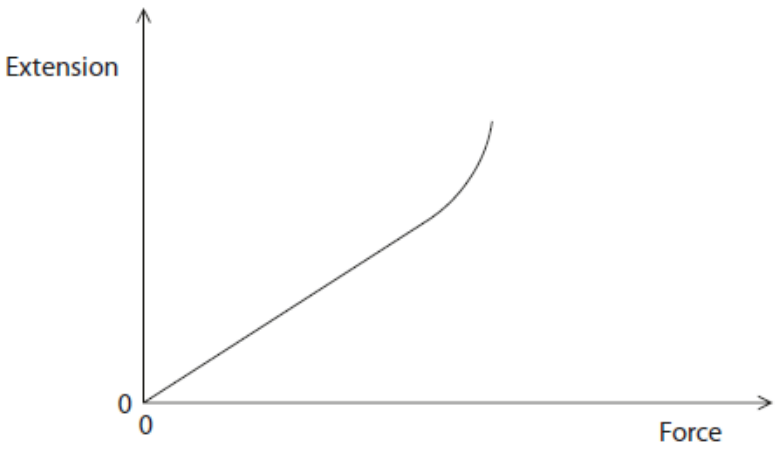
Q3.

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)

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

(1)

☒ **A** electrically

☒ **B** by heating

☒ **C** mechanically

☒ **D** by radiation

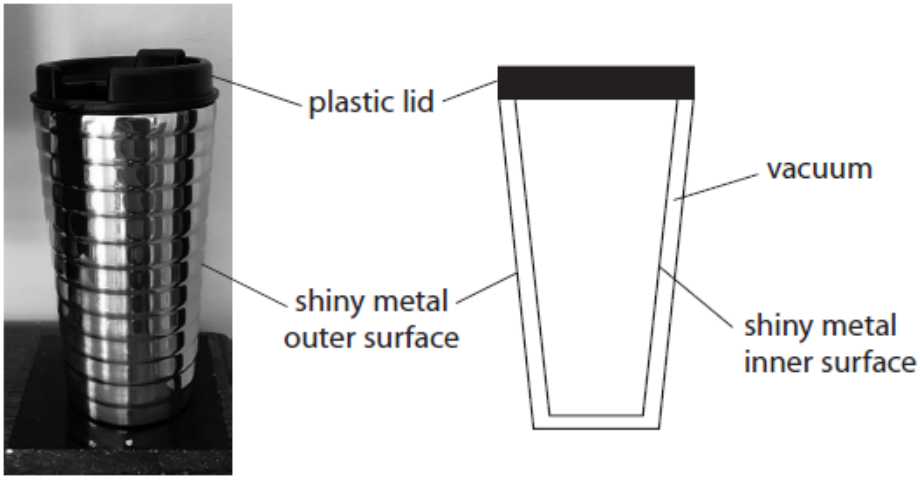
(Total for question = 5 marks)

Q4.

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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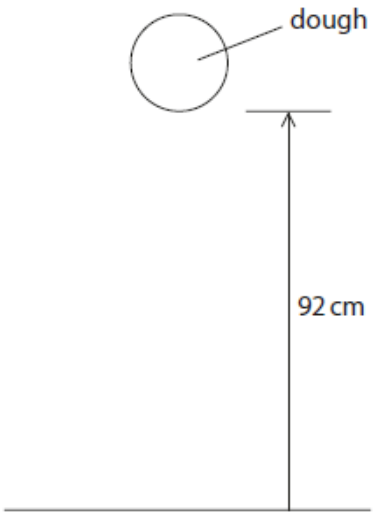
(Total for question = 6 marks)

Q5.

(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

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(Total for question = 7 marks)

Q6.

This question is about energy resources.

(a) The table lists some methods of generating electricity using energy resources.

Place ticks (✓) in the table to show if each method uses a renewable energy resource. One has been done for you.

(3)

Method of generating electricity	Uses a renewable energy resource
coal power station	
diesel generator	
geothermal power station	
hydroelectric power station	
natural gas turbine	
nuclear power station	
solar cell	✓
wind turbine	

(b) Solar cells can be used to generate electricity.

(i) How is energy transferred from the Sun to a solar cell?

(1)

☒ **A** by heating

☒ **B** by radiation

☒ **C** electrically

☒ **D** mechanically

(ii) State one disadvantage of using solar cells to generate electricity.

(1)

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(Total for question = 5 marks)

Q7.

Wind is a renewable resource used to generate electricity.

(a) (i) State **one** advantage and **one** disadvantage of producing electricity using wind turbines.

(2)

Advantage .....

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Disadvantage .....

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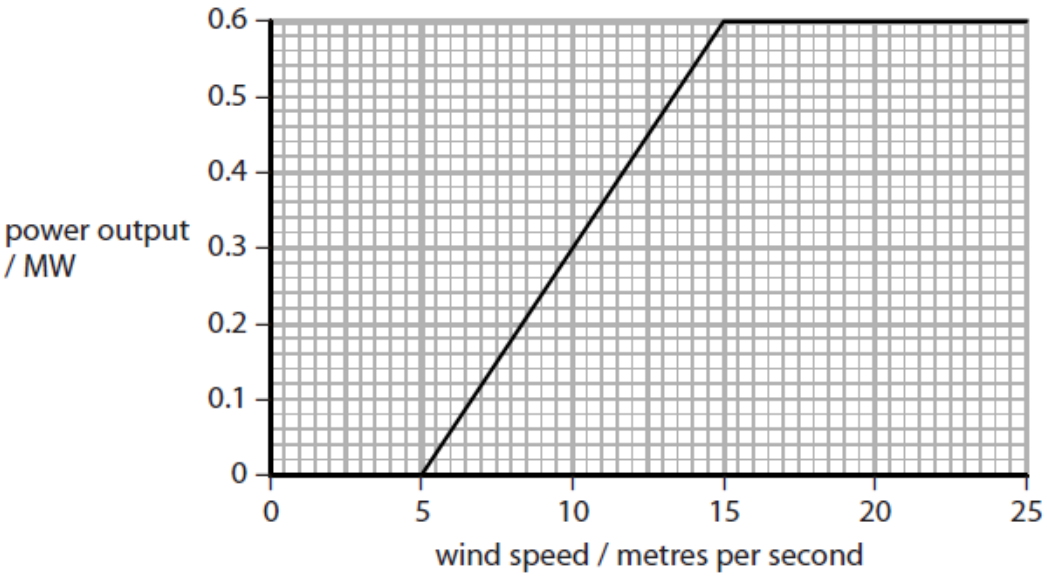
(ii) The graph shows how the power output of a wind turbine varies with wind speed.



Describe how the power output of a wind turbine varies with wind speed.

You should use data points from the graph in your answer.

(3)

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(b) A wind turbine produces an alternating voltage of 600 V.

The voltage needs to be increased to 132 kV before transmission to a nearby town.

The size of the voltage is changed using a transformer.

Describe the structure and operation of a suitable transformer.

You may use a diagram in your answer.

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(Total for question = 10 marks)

Q8.

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.

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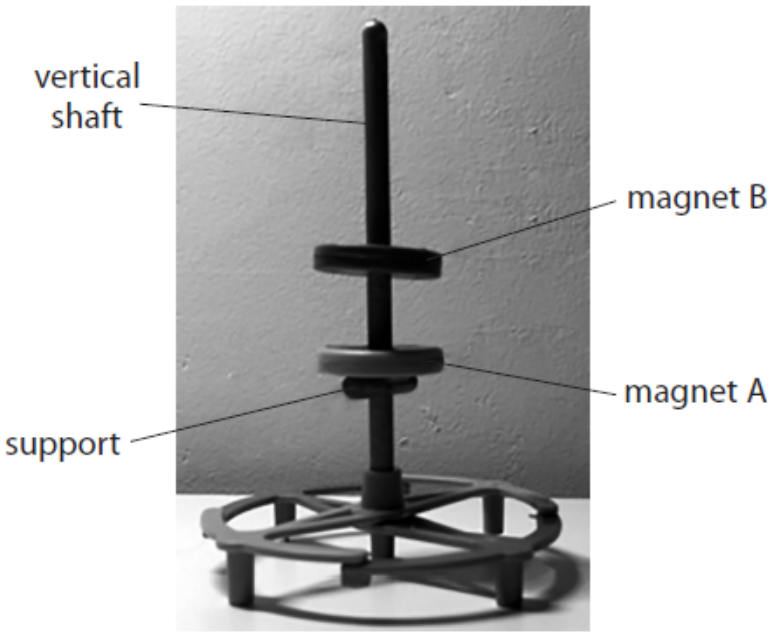
(Total for question = 11 marks)

Q9.

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.

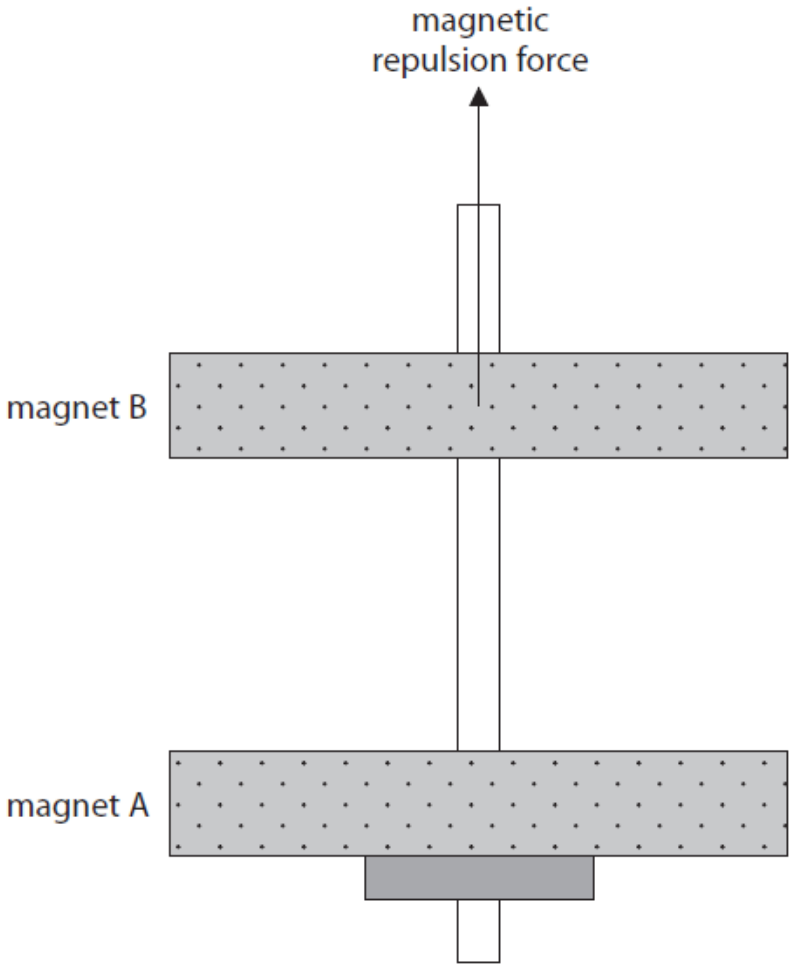
The table shows some energy stores in magnet B.

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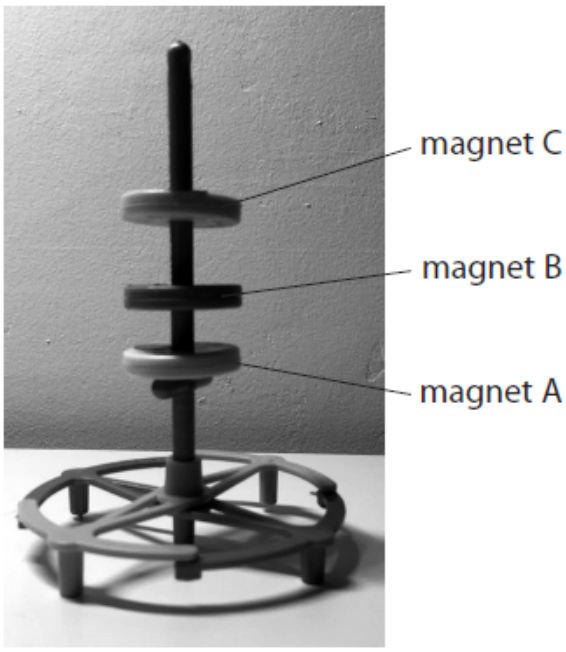
(d) The student removes the masses from magnet B.

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)

Q10.

A dog sits on a water-filled bag to keep cool.

(a) The table shows some data about the dog and the water in the bag.

mass of water in kg	8.7
power output of dog by heating in W	75
specific heat capacity of water in J/kg °C	4200
initial temperature of water in °C	16

The dog sits on the bag for 22 minutes.

(i) Calculate the energy transferred from the dog to the water by heating in 22 minutes.

(3)

energy = ... J

(ii) State an assumption you have made when calculating the energy transferred.

(1)

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(iii) Calculate the temperature of the water after 22 minutes.

(4)

temperature = ... °C

(b) Discuss why conduction is the main way that thermal energy is transferred from the dog to the water.

(3)

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(Total for question = 11 marks)

Q11.

This question is about heating water.

(a) Liquid water boils and becomes a gas at 100 °C.

Describe the differences between the arrangement and motion of particles in a liquid and in a gas.

You may include a diagram in your answer.

(3)

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(b) A teacher uses a 2200 W kettle to heat water.

The kettle is switched on for 2 minutes.

(i) Calculate the energy transferred by the kettle.

(3)

energy transferred = ... J

(ii) State the equation relating change in thermal energy, mass, specific heat capacity and change in temperature.

(1)

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(iii) The mass of water in the kettle is 1.1 kg and its initial temperature is 20 °C.

Calculate the final temperature of the water after it has been heated for 2.0 minutes.

[the specific heat capacity of water is 4200 J/kg °C]

(4)

final temperature = ... °C

(c) The teacher measures the final temperature of the water after heating it for 2 minutes.

(i) Name a piece of equipment the teacher could use to measure the temperature of the water.

(1)

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(ii) Explain why the measured final temperature is different from your calculated value.

(2)

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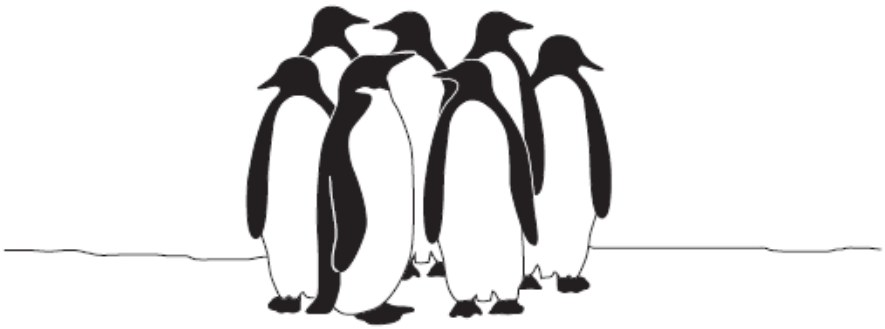
(Total for question = 14 marks)

Q12.

Penguins are adapted to survive in cold conditions.

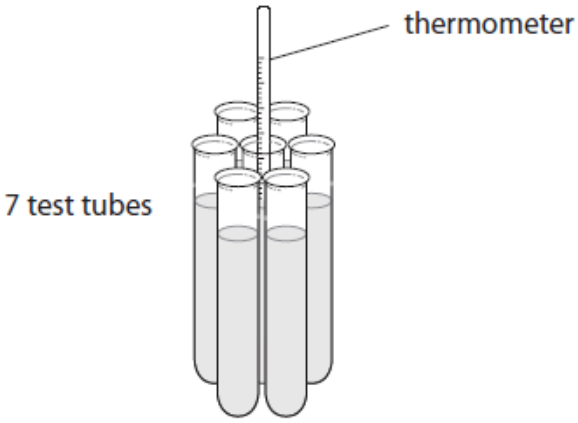
The adaptations help them to maintain a constant body temperature of 39 °C. Penguins also crowd together in groups of many penguins.



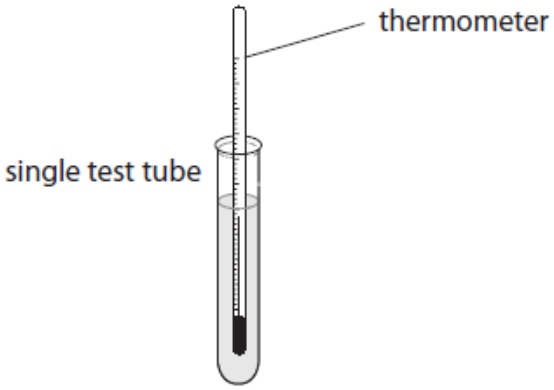
(a) A student wants to investigate how the temperature of a penguin is affected when they crowd together in groups.

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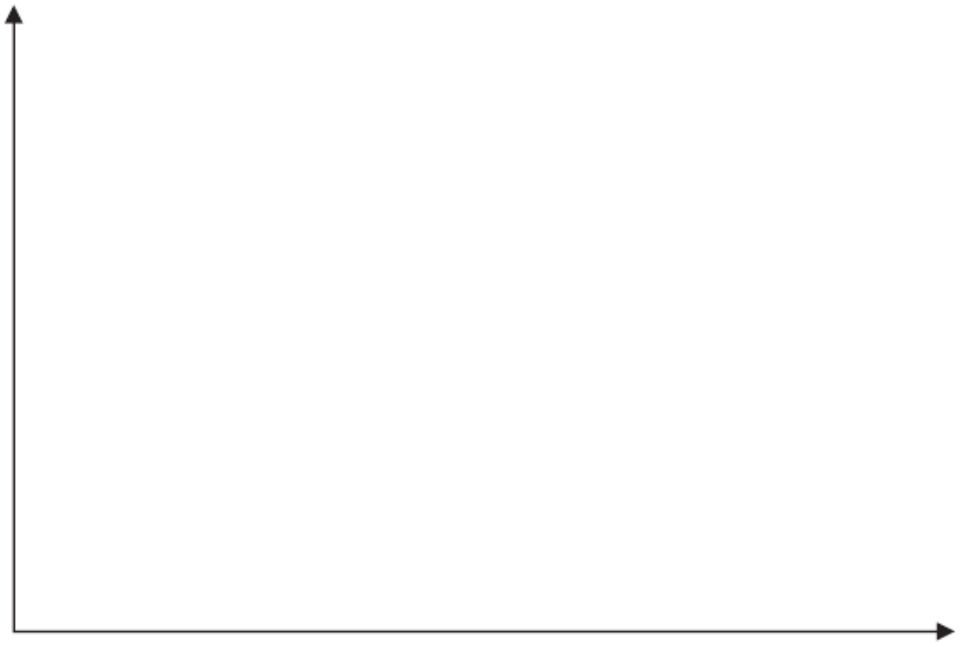
(iv) Draw a sketch graph of the results you predict the student will obtain.

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)