



FORM 3 **PHYSICS** **TIME: 1 hr 30 min**

Name: _____

Class: _____

INFORMATION FOR CANDIDATES

- Where necessary take acceleration due to gravity ‘g’ to be 10 m/s².
- The use of a calculator is allowed.
- The number of marks for each question is given in brackets [] at the end of each question.
- You may find these equations useful:

Density	$m = \rho V$		
Pressure	$P = \rho g h$	$F = P A$	
Forces	$W = m g$		
Moments	$Moment = F \times \text{perpendicular distance}$		
Energy	$P.E. = m g h$	$K.E. = \frac{1}{2} m v^2$	$Work Done = F s$
	$Work Done = Energy Converted$		$E = P t$
Heat	$\Delta Q = m c \Delta\theta$		

INSTRUCTIONS TO CANDIDATES

- Use blue or black ink. Pencil should be used for diagrams only.
- Read each question carefully and make sure that you know what you have to do before writing your answer.
- Answer ALL questions.
- All working must be shown.

For Examiner’s Use Only		
Question	Max	Mark
1	8	
2	8	
3	8	
4	8	
5	8	
6	15	
7	15	
8	15	
Written	85	
Practical	15	
Total	100	

This document consists of 12 printed pages.

SECTION A

Each question carries 8 marks. This section carries 40 marks of the total marks for this paper.

1. Matthew and Elisa decide to find the density of seawater. They measured the mass of an empty measuring cylinder and then poured an amount of seawater in the measuring cylinder and measured the mass of the cylinder with water.

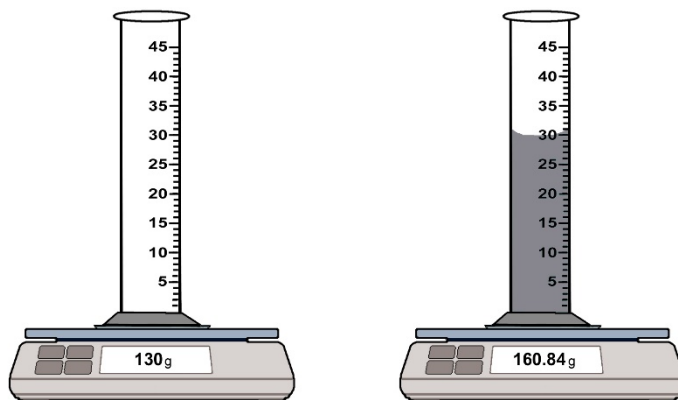


Figure 1

- i) Calculate the mass of the seawater in the measuring cylinder.

_____ [2]

- ii) From the diagram above, record the volume of seawater in the measuring cylinder in cm^3 .

_____ [1]

- iii) Calculate the density of seawater.

_____ [2]

- iv) Mention a precaution Elisa and Matthew must take when reading the volume of the seawater to ensure an accurate result.

_____ [1]

b) Elisa and Matthew find that an egg sinks in fresh water but floats in salty water. (The density of fresh water is 1 g/cm^3)

i) Explain why this happens.

_____ [1]

ii) Suggest a value for the average density of an egg.

_____ [1]

2. In an experiment to prove Hooke's Law, Maria and Gabriel found the following results:

Force (N)	0	1	2	3	4
Length of Spring (mm)	40	49	58		
Extension (mm)	0	9		27	36

a) Fill in the missing values. [3]

b) What is the original length of the spring? _____ mm [1]

c) What can you say about the relationship between force and extension?
_____ [1]

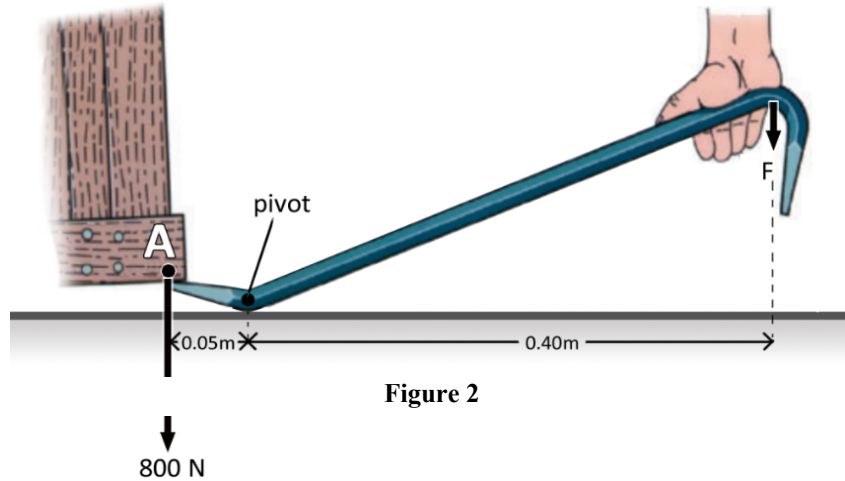
d) What type of graph will Maria and Gabriel obtain if they had to plot a graph of extension against force using the measurements in the table?
_____ [1]

e) Gabriel decides to load the spring with much heavier weights. What do you think will happen? Explain.

_____ [2]

3. John uses a crowbar to lift up a piece of heavy furniture.

a) State the principle (law) of moments.



_____ [1]

b) Calculate the moment produced by the furniture if it makes a downward force of 800 N at Point A.

_____ [2]

c) What is the value of the moment produced by John assuming the system is in equilibrium?

_____ [1]

d) Underline the correct answer:

The direction of the moment produced by John is (clockwise, anticlockwise). [1]

e) The system is in equilibrium. Calculate the downward force F that John is exerting.

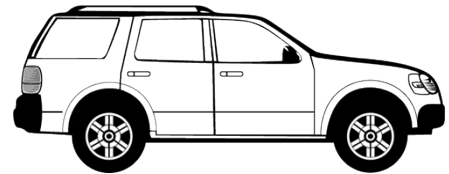
_____ [2]

f) What change should be done to the above setup so that the force that John makes to lift the furniture would be smaller?

_____ [1]

4.

- a) Daniel and Julia pack their bags and go camping with their car. The mass of their car is 2700 kg, whilst Daniel, Julia and their bags have a mass of 160 kg. What is the total mass of the car, bags and passengers?



_____ [1]

- b) Calculate the total weight of the car when Daniel, Julia and their bags are inside the car.

_____ [2]

- c) The area of contact of one tyre with the ground is 0.04 m^2 . What is the area of contact of the **four** tyres in m^2 ?

_____ [1]

- d) Calculate the pressure that the car exerts on the ground when Daniel, Julia and their bags are inside the car.

_____ [2]

- e) Daniel drives onto a sandy beach and the car is stuck in the sand. Julia explains to Daniel that if the pressure made by the tyres on the sand is reduced, they will be able to drive off. Suggest what they can do to decrease the pressure made by the tyres on the sand. Explain.

_____ [2]

5. Maria decided to warm some tomato soup and measure the time taken for its temperature to rise. The graph below shows the temperature of the soup against the time taken to heat it from room temperature.

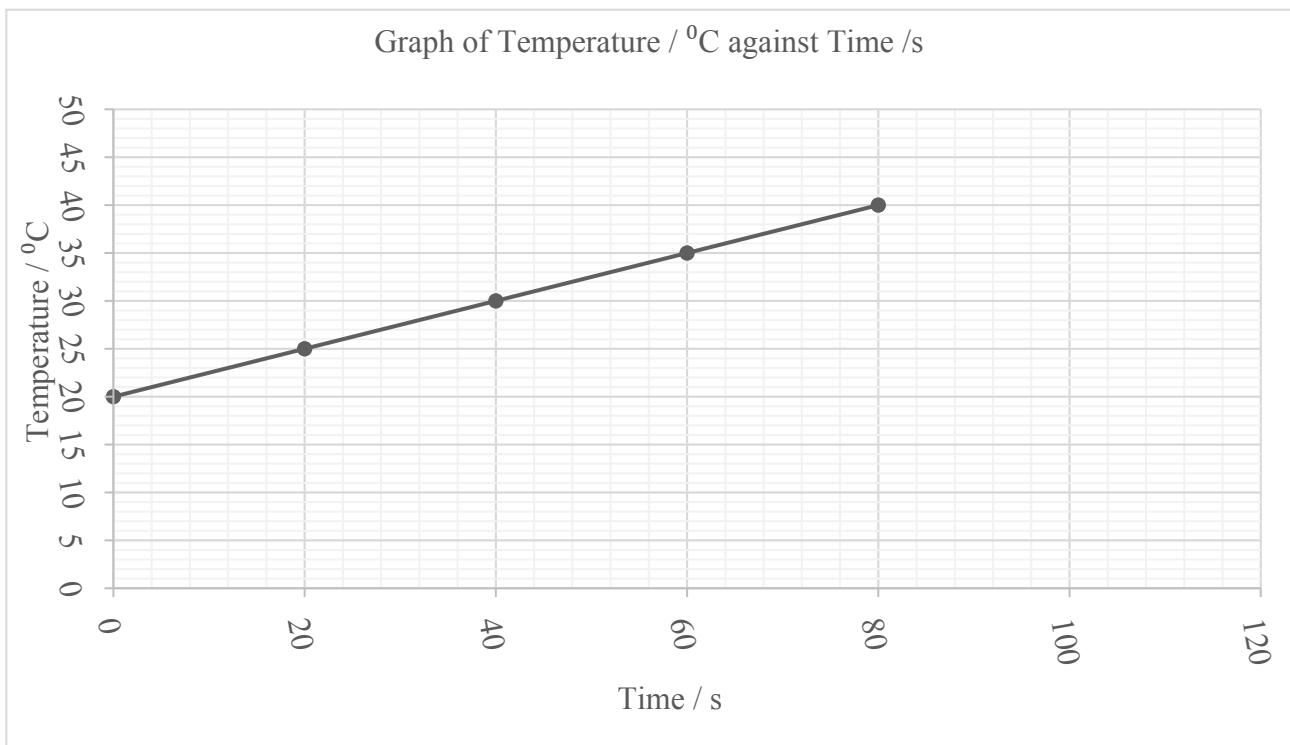


Figure 3

- a) Name the instrument used to measure temperature. _____ [1]
- b) From the graph, find the room temperature. _____ °C [1]
- c) What is the temperature of the soup after 40 seconds? _____ °C [1]
- d) Assuming the rate of temperature rise will remain the same, what is the total time needed to heat the soup from room temperature to 50°C? _____ s [1]
- e) If the specific heat capacity of the tomato soup is $3980 \text{ J/kg}^\circ\text{C}$, and the mass of the soup is 0.5 kg, find the heat energy needed to heat up the soup from 20°C to 50°C.

_____ [2]

f) A lid is placed over the saucepan. How will a lid help to cook the soup faster?

_____ [1]

g) Name a suitable material that could be used as a handle for the saucepan.

_____ [1]

SECTION B

Each question carries 15 marks. This section carries 45 marks of the total marks for this paper.

6. The diagram shows a model of a hydroelectric power station.

a) Briefly explain, in your own words, how the model works in terms of energy changes.

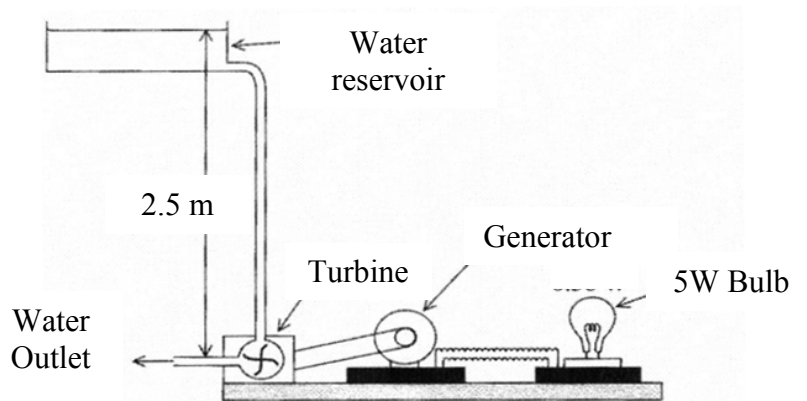


Figure 4

_____ [3]

b) A 5 W bulb is connected as shown in the diagram.

i) How much electrical energy is supplied to the bulb in one second? _____ [1]

ii) Calculate the efficiency of the system if the power input is 12.5 W, given that the lamp is at its normal brightness (5 W).

_____ [1]

iii) Calculate the mass of water which flows through the turbine in one second when the bulb is working at normal brightness.

_____ [3]

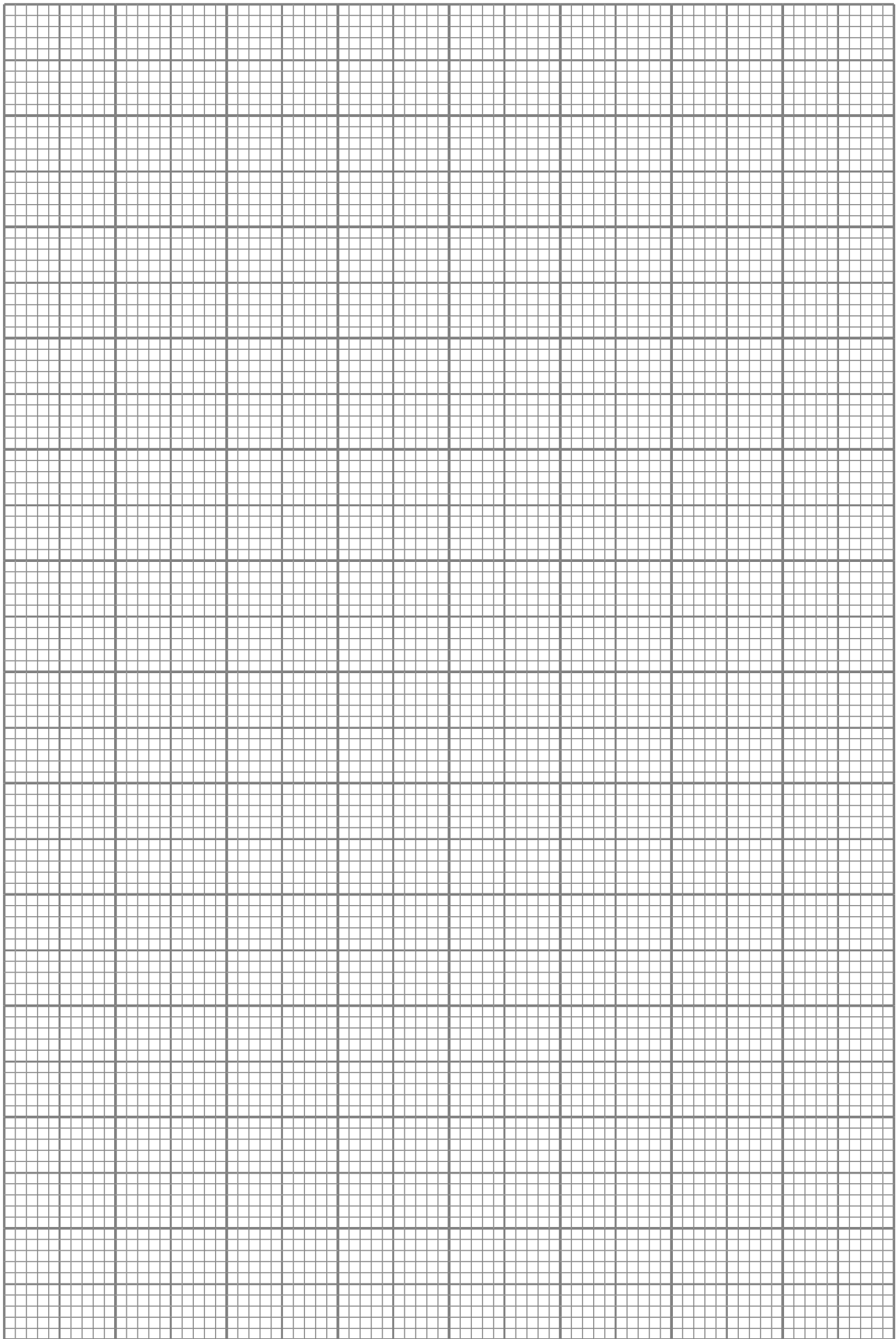
c) There is a relationship between the brightness of the bulb and the height of the water reservoir. In order to find the most appropriate height for the model, the following results were observed.

Potential Energy (J)	0	2.5	5.0	7.5	10.0	12.5	15.0
Height (m)	0	0.5	1.0	1.5	2.0	2.5	3.0

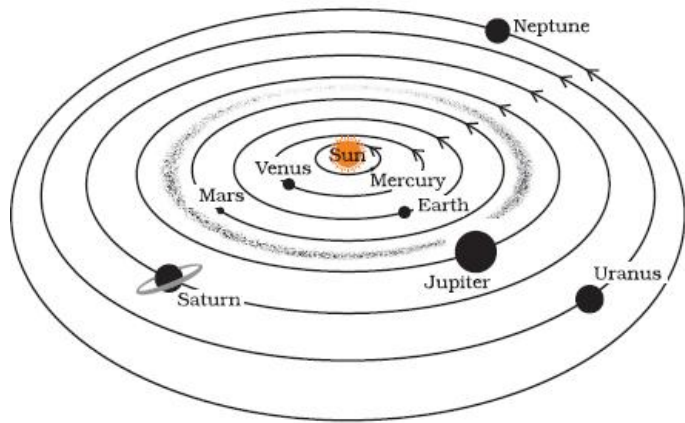
i) Plot a graph of Potential Energy (J) on the y-axis against Height (m) on the x-axis. [5]

ii) Show that the value of the gradient of the graph is equal to the weight of water flowing per second.

_____ [2]



7. Our solar system can be found in one of the billion galaxies that exist in our Universe. The diagram shows our solar system.



a) Give the name of our galaxy.

[1]

b) The planets in our solar system orbit the Sun. Explain the meaning of the term 'orbit'.

[1]

c) Briefly describe the difference between light coming from one of the planets and that coming from a star.

[2]

d) Give ONE other difference between a planet and a star.

[1]

e) What force keeps the planets orbiting the Sun?

[1]

f) How does the force mentioned in part (e) change with increasing distance from the Sun?

[1]

g) The table below shows data about some of the planets making up the solar system.

Planet	Mass ($\times 10^{24}$ kg)	Time to spin once on its own axis (hours)	Time to complete one orbit around the Sun (days)
Venus	4.87	5832	225
Earth	5.97	24	365
Saturn	568	11	10747
Uranus	86.8	17	30589
Neptune	102	16	59800

i) Which one of the above planets has the shortest year cycle? Explain.

_____ [2]

ii) What information from the table above shows the length of a day on each planet? Hence, state which of the planets has the longest day.

_____ [2]

iii) From the above table, which planet has the largest gravitational force? Explain.

_____ [2]

iv) The average density of Earth is 5514 kg/m^3 . Calculate the volume of Earth.

_____ [2]

8. Jake noticed that his hand feels hot when he holds it above a lit match, as shown in the diagram.

a) Name the process by which this takes place. Explain.

_____ [2]

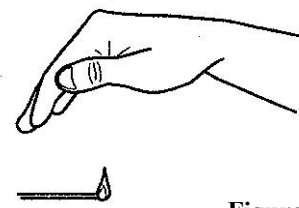


Figure 5

b) The most effective way of saving money in a home is to have an efficient heating/cooling system. Double glazed windows are one example.

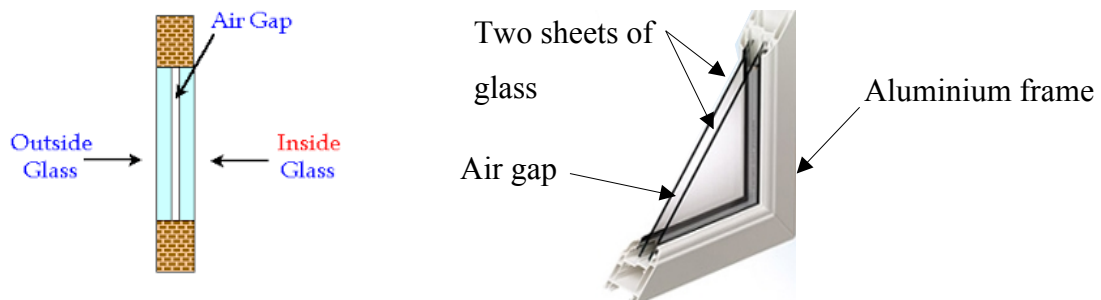


Figure 6

Explain, in terms of the methods of heat transfer, how double glazed windows reduce energy losses when compared to single glass windows.

_____ [2]

c) The thickness of the layer of air between the glass panes affects the amount of heat transfer by conduction and convection as shown in the graph.

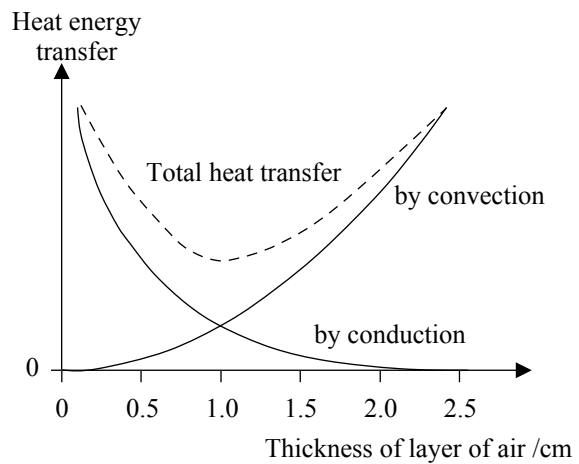


Figure 7

i) The graph shows that heat energy transfer by conduction decreases as the thickness of air increases. Explain.

[2]

ii) What happens to energy transfer by convection as the thickness of air increases?

[1]

iii) Give the value of the thickness of air in which there is the smallest heat energy transfer. Explain why.

[2]

d) Liam and Emily find two containers of the same size but of different colour. One is black and the other white. They want to investigate which is the best **emitter** of heat.

i) Draw a well labelled diagram of the apparatus used to carry out the experiment. [2]

ii) Describe briefly the method they use.

[3]

iii) What conclusion should Liam and Emily arrive at?

[1]