Candidate Name	Centre Number	Candidate Number

OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

General Certificate of Secondary Education

SCIENCE: DOUBLE AWARD	PAPER 6	**1794/6**
SCIENCE: PHYSICS	PAPER 2	**1782/2**
SCIENCE: PHYSICS (NUFFIELD)	PAPER 2	**1787/2**

HIGHER TIER

Tuesday **18 JUNE 2002** Morning 1 hour 45 minutes

Candidates answer on the question paper.
Additional materials required:
Pencil
Ruler (cm/mm)

TIME 1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.

The marks allocated and the spaces provided for your answers are a good indication of the length of answer required.

FOR EXAMINER'S USE		
Qu.	Max	Mark
1	17	
2	7	
3	12	
4	10	
5	10	
6	12	
7	10	
8	11	
9	16	
TOTAL	105	

This question paper consists of 20 printed pages.

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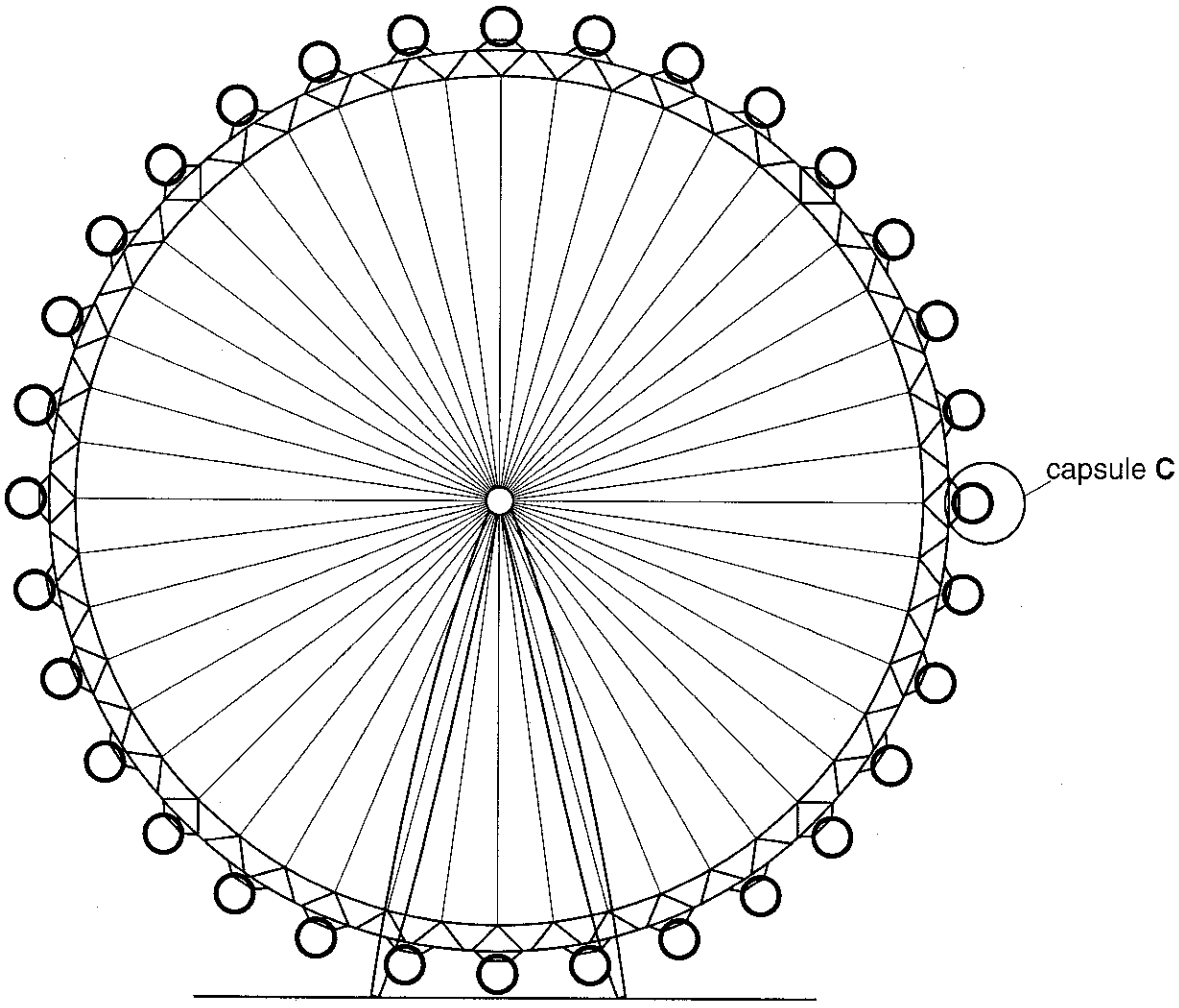
[Turn over

For Examiner's Use

1 The London Eye is a rotating wheel. It carries people in a vertical circle above the River Thames.



The wheel turns without stopping. People step into the moving capsules on the rim of the wheel at the bottom.

The table shows information about the wheel.

circumference of the rim of the wheel	450 m
time to turn once	30 **minutes**
radius of wheel	72 m
mass of one capsule	10 000 kg

(a) Look at the table to find out the circumference of the wheel and the time it takes to turn once.

Calculate the speed of a capsule in metres per **second**.
You **must** show how you work out your answer.

speed = ...m/s [3]

(b) Look at the table to find out the mass of one capsule and the radius of the wheel.

(i) The weight of 1 kg is 10 N. What is the weight of one capsule?

weight = ...N [1]

(ii) Calculate the distance between the bottom and the top of the wheel.

distance = ...m [1]

(iii) Work is done in raising each capsule from the bottom to the top.

Calculate the work done in raising one capsule from the bottom to the top of the wheel.
You **must** show how you work out your answer.

work done = ... unit ..... [3]

(iv) Calculate the moment about the centre of the wheel due to the weight of capsule **C**.

Use the equation below. You **must** show how you work out your answer.

moment of a force = force x perpendicular distance to pivot

moment = ...Nm [2]

[Turn over for remainder of question 1

(c) For the questions in this part the following equations may be useful.

change in gravitational potential energy = mass x gravitational field strength x height moved

kinetic energy = $\frac{1}{2}mv^2$

During the storms in October 2000, high winds blew out some glass from the top capsule.

The mass of the glass was 30 kg.

(i) Calculate the change in the gravitational potential energy of the glass as it fell to the ground.

You **must** show how you work out your answer.

Gravitational field strength = 10 N/kg.

change in gravitational potential energy = ...J [1]

(ii) What was the kinetic energy of the glass just before it hit the ground?

.....J [1]

(iii) The velocity of the glass just before it hits the ground is approximately 54 m/s.

Explain how you would calculate this value using the information given above.

.....

.....

.....[2]

(iv) When it hit the ground at 54 m/s, the glass took 0.1 s to come to rest.

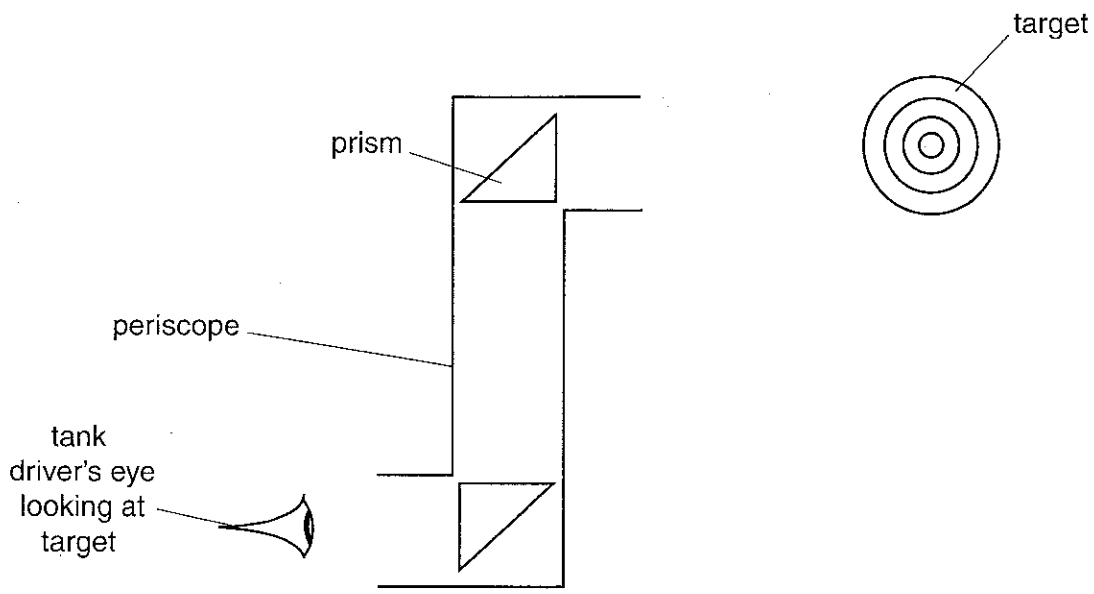
Calculate the deceleration of the glass.

You **must** show how you work out your answer.

deceleration = ... unit ..... [3]

[Total : 17]

2 **(a)** Tank drivers use a periscope to see where they are going.



Describe what happens to the light as it passes through the periscope.

You may draw on the diagram to help you answer the question.

.....

.....

.....

.....[3]

(b) A tank is travelling at night when it is dark.

An aeroplane flying overhead can still detect it with the help of a special camera.

Use your knowledge about the electromagnetic spectrum to explain how this is possible.

.....

.....[2]

(c) Telephone companies now prefer to use optical fibres rather than copper cables for communicating with digital signals.

Suggest **two** physical reasons why.

1 .....

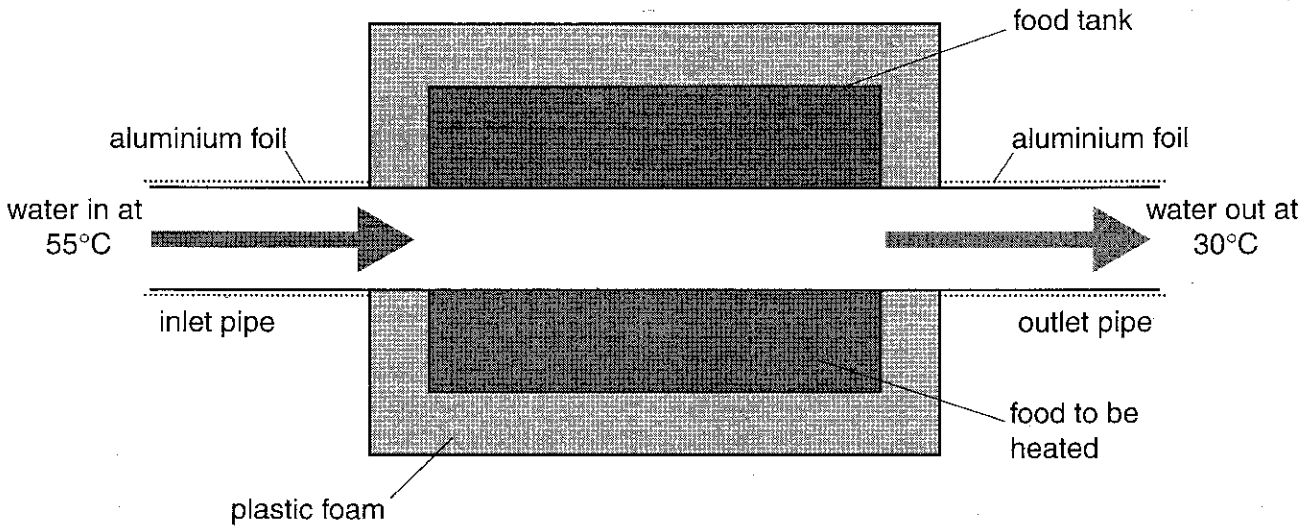
2 .....[2]

[Total : 7]

For Examiner's Use

3 This question is about energy transfers in a food processing plant.

Liquid food is heated by pumping hot water, in copper pipes, through the food tank.



(a) The food tank is wrapped in a layer of **plastic foam**.

(i) What **useful** property does the plastic foam have?

.....[1]

(ii) Why is this property important?

.....

.....[1]

(b) **(i)** The hot water pipes, outside the food tank, are wrapped **tightly** in aluminium foil.

Explain how this helps to reduce the energy lost from the pipes.

.....

.....

.....[2]

(ii) The foil is removed. The inlet pipe loses more energy from its surface than the outlet pipe.

Explain why.

.....

.....

.....[2]

(c) The water in the pipe is heated in a boiler which supplies 7500 joules of energy per second.

Each second, 4500 joules of energy are transferred to the food.

Calculate the efficiency of the food heating system.

Use the equation below. You **must** show how you work out your answer.

$$\textbf{energy efficiency} = \frac{\textbf{useful energy output}}{\textbf{total energy input}}$$

energy efficiency = ...[2]

(d) Energy is transferred from the hot water to the food by conduction through the copper pipe.

Explain why the process of conduction is better through a metal pipe than through a plastic pipe.

.....

.....

.....[2]

(e) The food factory is working to improve the efficiency of the food-heating process.

Write down **two** reasons why it is important to make efficient use of energy.

1 .....

2 .....[2]

[Total : 12]

4 A paint company uses a radioactive material to make sure that dye spreads evenly through the paint when it is being mixed.

This is how it is done to make some green paint.

- Add a radioactive liquid which emits gamma radiation to a can of dark green dye.
- Add the dark green radioactive dye to a large tank of white paint and start to mix.
- When the paint mixture looks even, take out litre cans of paint from different places in the tank.
- Measure the amount of radiation at a distance of 20 cm from each can.
- Repeat after a longer time if necessary.

(a) Explain why they use a radioactive liquid which emits **gamma** radiation.

.....

.....

.....[2]

(b) Six samples of the paint were tested after mixing for 15 minutes.

Here are the results.

test sample	**radiation detected** in counts per minute
A	562
B	558
C	206
D	554
E	833
F	561

Explain why this shows that the paint had not been mixed evenly.

.....

.....

.....[2]

(c) The scientists had to choose a radioactive material with a suitable half-life.

(i) Suggest **one** advantage of choosing a material with a short half-life of a few minutes.

.....

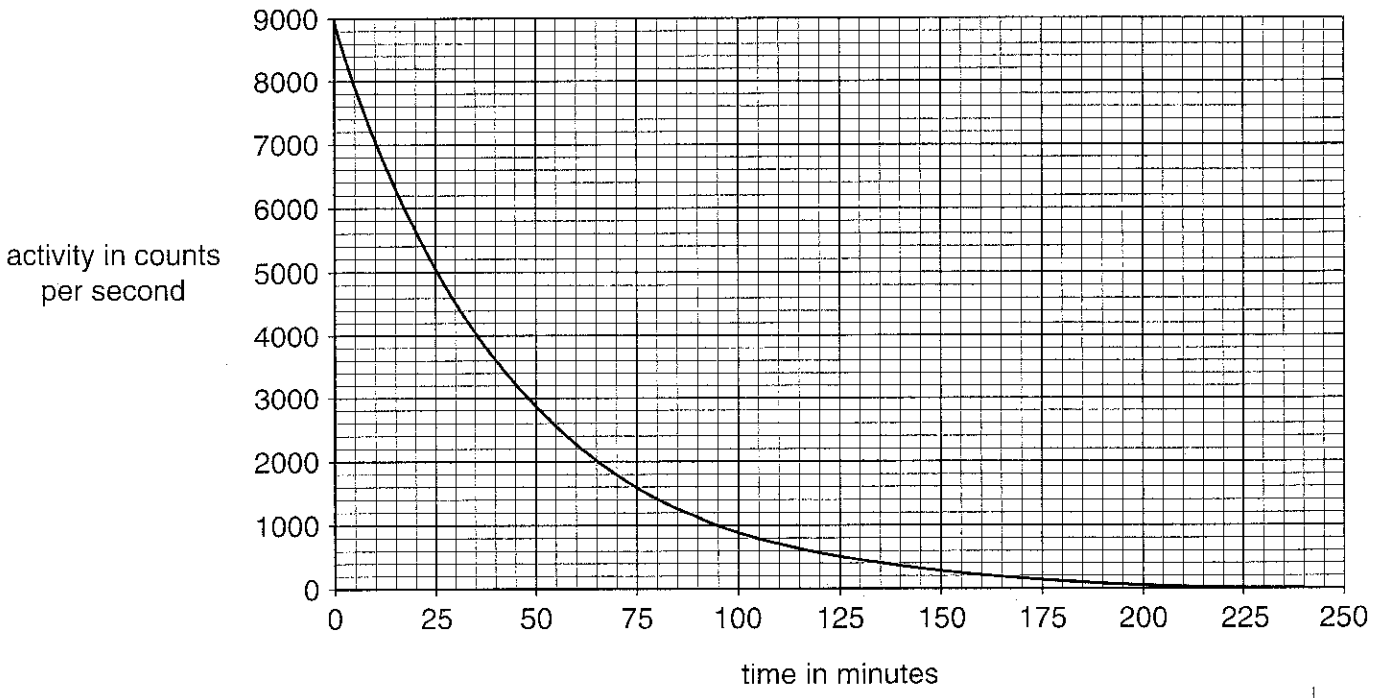
.....[1]

(ii) Suggest **one** advantage of choosing a material with a longer half-life of several days.

.....

.....[1]

They decide to use a radioactive material which has the following decay graph.



(d) What is the half-life of the radioactive isotope?

You **must** show on the graph how you work out your answer.

half-life = ...minutes [2]

(e) A sample of the radioactive material with a count rate of 9000 counts per second was added to 400 litres of paint.
After **twenty** minutes, the paint was evenly mixed.
What is the activity of a **one** litre sample of the paint?
You **must** show how you work out your answer.

activity = ...counts per second [2]

[Total : 10]

For Examiner's Use

5 A teacher uses a long (slinky) spring to show a class different types of waves.

She holds one end of the spring which is lying on a table.

The other end is fixed to the table by a clamp.

The diagrams show two different types of waves as seen from **above** the table.

diagram 1

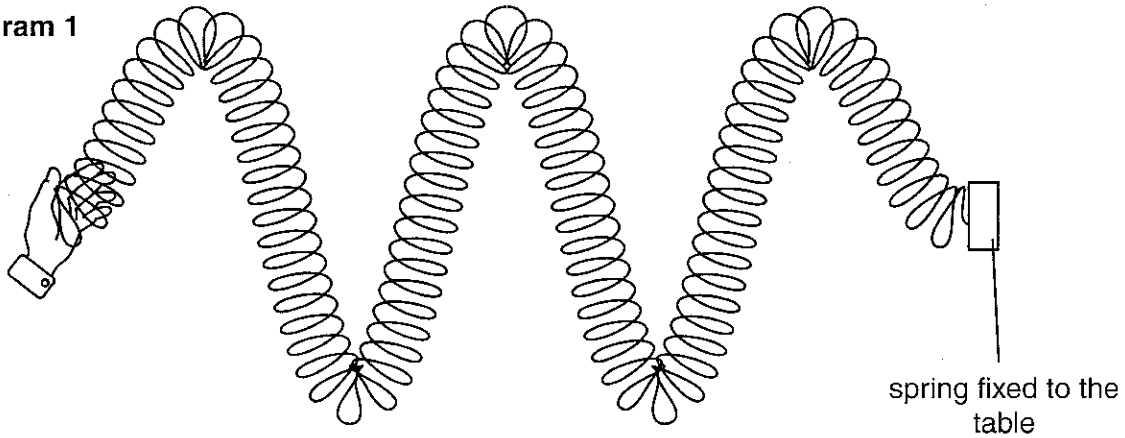
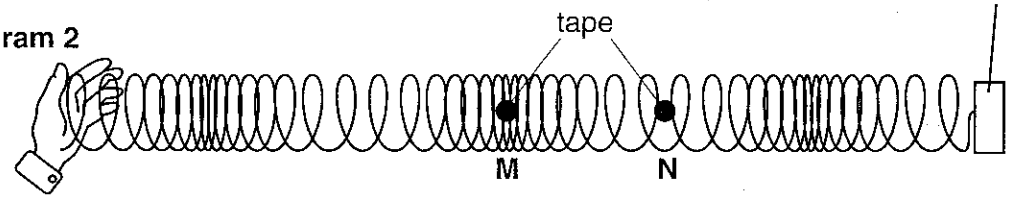


diagram 2



(a) (i) The teacher demonstrates **longitudinal** and **transverse** waves. Describe how she moves the spring to show each type of wave.

.....

.....

.....

.....

.....[3]

(ii) Pieces of tape are attached to the spring in **diagram 2** at **M** and **N**.

Describe what happens to the two pieces of tape as a wave passes along the spring.

.....

.....

.....[2]

(b) The wave shown in **diagram 1** has a frequency of 2 Hz.

(i) What movement can the teacher make with her hand to achieve this?

.....

.....[1]

(ii) The speed of the wave is 1.2 m/s.

Calculate its wavelength.

You **must** show how you work out your answer.

wavelength =.....m [3]

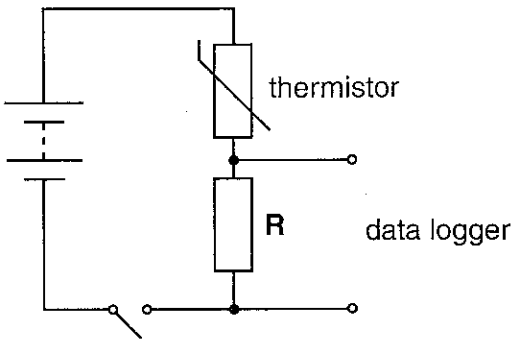
(iii) How can she double the wavelength without changing the distance between her hand and the clamp?

.....

.....[1]

[Total : 10]

6 Charlie sets up this circuit to monitor the temperature in her greenhouse.



(a) (i) At some time in the morning the current through **R** is 0.1 A.

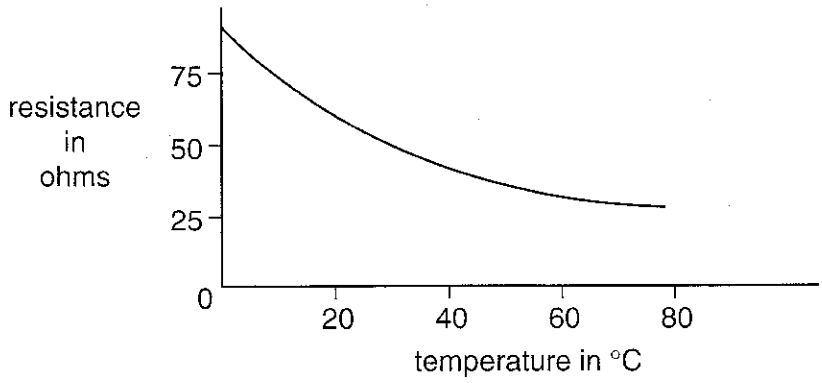
The resistance of **R** is 40 Ω.

Calculate the voltage across **R**.

You **must** show how you work out your answer.

voltage = ... unit ..... [3]

(ii) The graph shows how the resistance of the thermistor varies with temperature.



Later on in the morning, the temperature increases.

Use the graph and your ideas about circuits to explain how this affects the voltage across **R**.

.....

.....

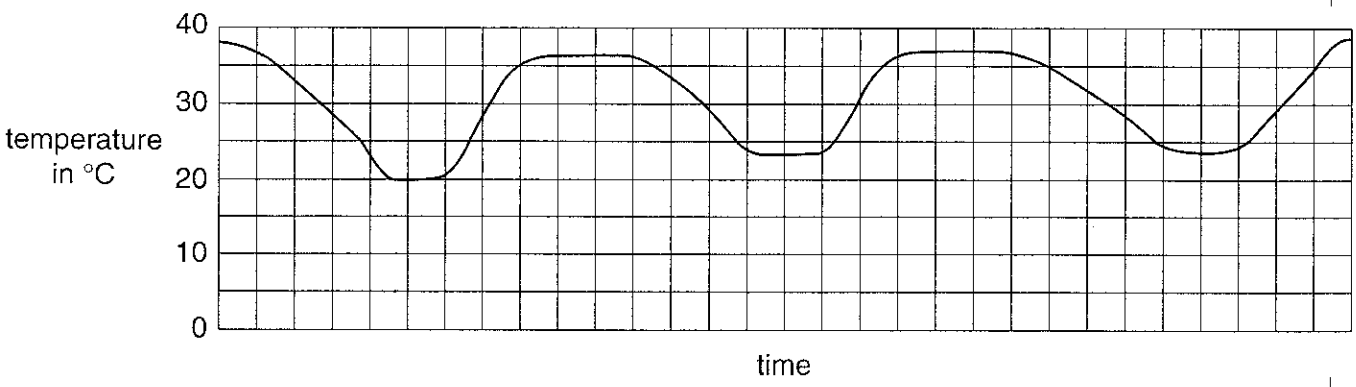
.....[3]

(iii) Use the graph in **(ii)** to explain why the circuit will not accurately monitor temperatures much above 60 °C.

.....

.....[2]

(b) Charlie connects a data logger across **R**. This records the voltage across **R**.
She downloads the data into her computer.
The computer produces a graph of temperature against time.
This is a graph of her results. These are taken over a few days in July.



Look carefully at the graph.

Write down all the information that you can get from the graph.

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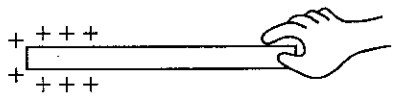
.....[4]

[Total : 12]

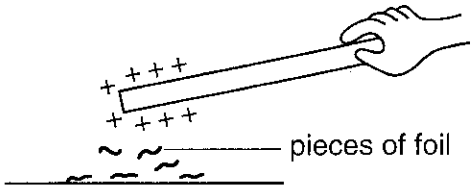
7 **(a)** Frank and Lynne are experimenting with electric charge.

(i) Frank charges a plastic rod by rubbing it with a cloth.



The rod becomes positive.

He moves the end of the rod close to some small pieces of metal foil.



The pieces of foil are attracted towards the rod.

Use your ideas about the movement of electrons to explain what happens.

.....

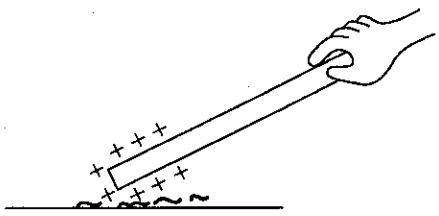
.....

.....

.....

.....[3]

(ii) Lynne charges another plastic rod to make it positive.



She moves the end of the rod and **touches** some small pieces of metal foil.

The pieces of foil are repelled away from the rod.

Use your ideas about the movement of electrons to explain what happens this time.

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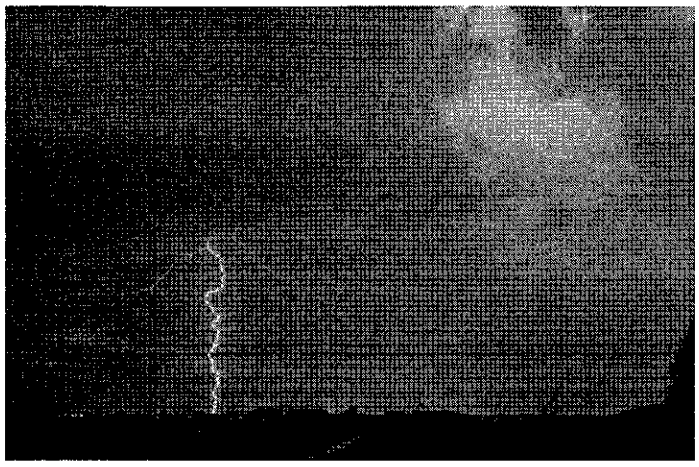
.....

.....

.....[3]

(b) A cloud-to-ground lightning strike occurs when negative charge moves from a cloud to the Earth.



When lightning strikes, 2C of charge flows to Earth.

The average current is 6 kA.

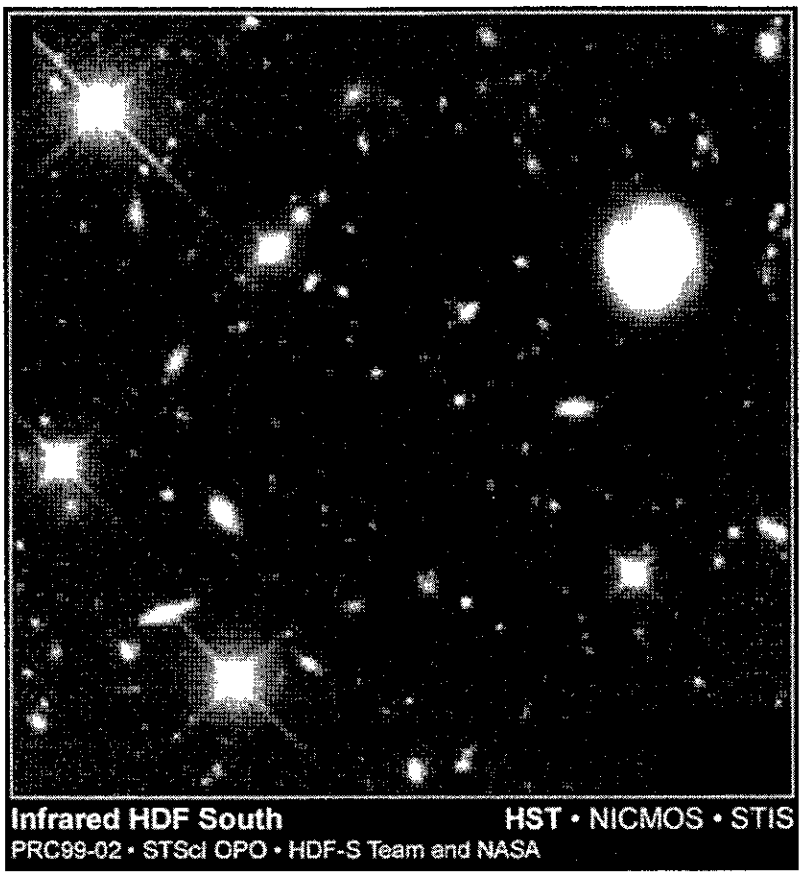
Calculate the time taken for the charge to flow to Earth.

You **must** show how you work out your answer.

time = ... unit ..... [4]

[Total : 10]

8 **(a)** This image was formed by the Hubble Space Telescope.
It contains some of the most distant observed galaxies.



The light from these very distant galaxies shows large **red shifts**.

(i) What does **red shift** mean?

.....[1]

(ii) What do the **large** amounts of red shift tell us about the motion of these galaxies?

.....

.....[2]

(iii) How do these observations of red shifts provide evidence for the Big Bang theory of the Universe?

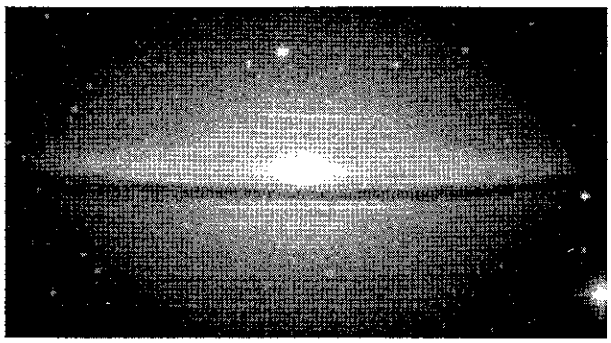
.....

.....[1]

(iv) What does the Big Bang theory predict about the red shift of less distant galaxies?

.....[1]

(b) This image shows the Sombrero Galaxy.



This galaxy is a strong X-ray emitter. The several billions of stars which make up the galaxy rotate about its centre. Stars rotating near its centre are observed to have unusually high velocities. This suggests that there is something very massive at the centre. This is thought to be a black hole, about 1 billion times more massive than our Sun. A black hole is so dense that not even light can escape from it, so it appears dark.

(i) What are **X-rays**?

.....

.....[2]

(ii) What force causes the stars to rotate around the centre of the galaxy?

.....[1]

(iii) Why does the fact that the inner stars have unusually high velocities suggest that there is a very massive black hole at the centre of the galaxy?

.....

.....[1]

(iv) A telescope is focussed just to the left and then just to the right of the centre of the galaxy. The red shift detected on the left is significantly different to the red shift on the right.

Explain why.

.....

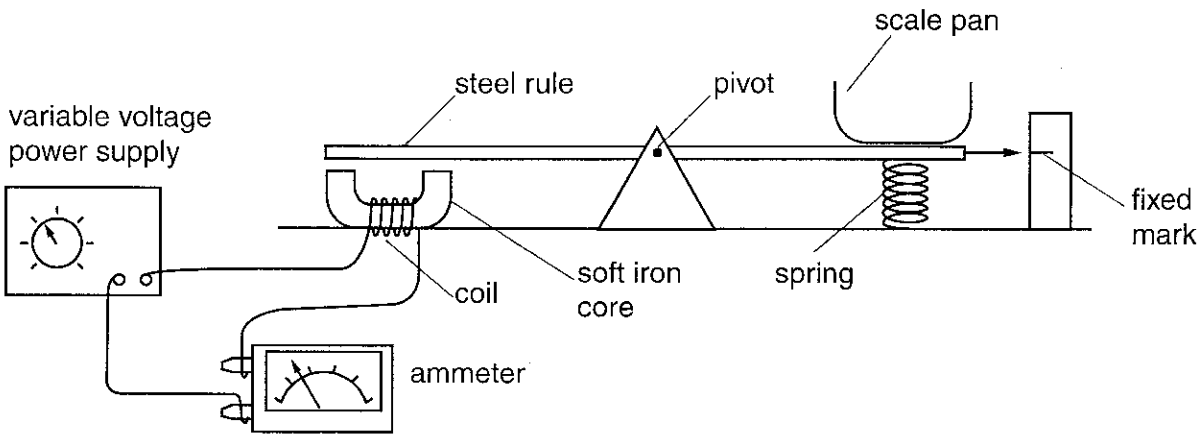
.....

.....[2]

[Total : 11]

For Examiner's Use

9 Ainsley has made a weighing machine that works using electromagnetism.



He pours 10 g of sugar into the scale pan.

The right hand side of the rule tilts down.

The power supply is turned on and the left hand end starts to tilt down.

(a) (i) Explain why the left hand end starts to tilt down.

.....

.....

.....[2]

(ii) He increases the voltage of the power supply.

Explain why the left hand side of the balance tilts down further.

.....

.....

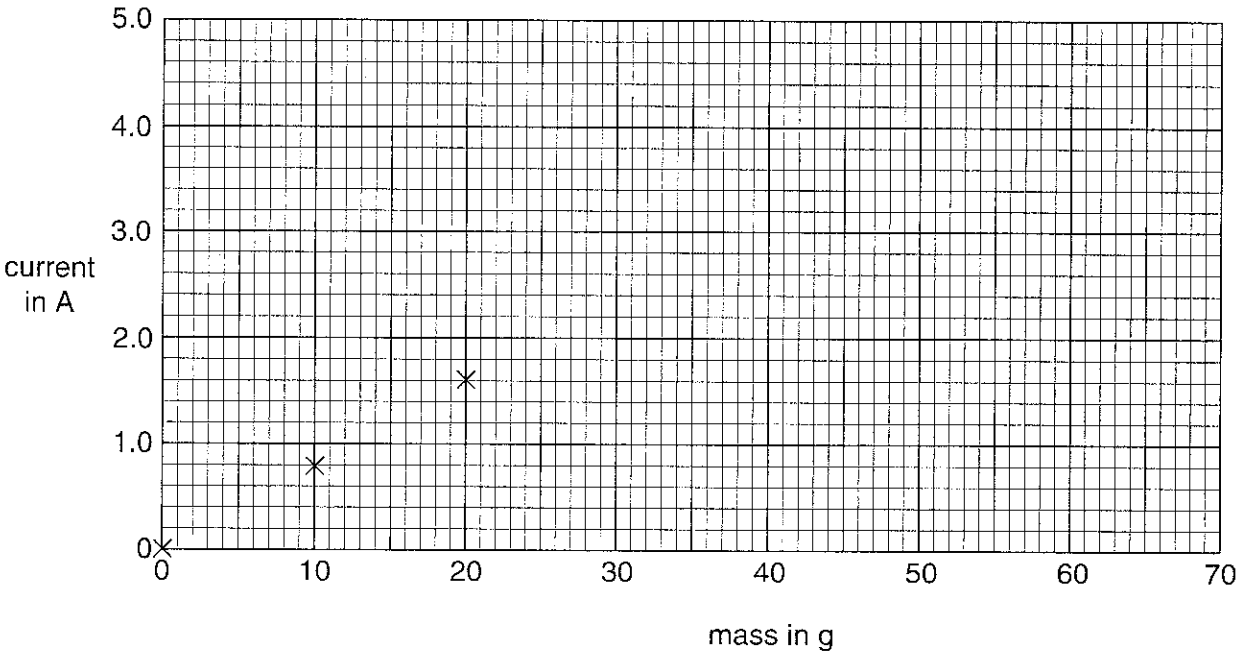
.....[2]

(b) He increases the voltage until the pointer is back to the fixed mark.
He records the current on the ammeter.
He repeats this process for different masses of sugar.
Here is a table of his results.

mass in g	0	10	20	30	40	50	60	70
current in A	0.0	0.8	1.6	2.4	3.1	3.7	4.2	4.6

(i) Plot the points on the grid. Three have been done for you. [1]

(ii) Finish the graph by drawing the best line through the points. [1]



(iii) What mass of sugar needs 4.0 A to balance the weighing machine?

You **must** show clearly **on your graph** how you work out your answer.

mass = ...g [2]

(c) Ainsley wants to weigh heavier amounts of sugar with the balance.

It is not safe to make the current any greater.

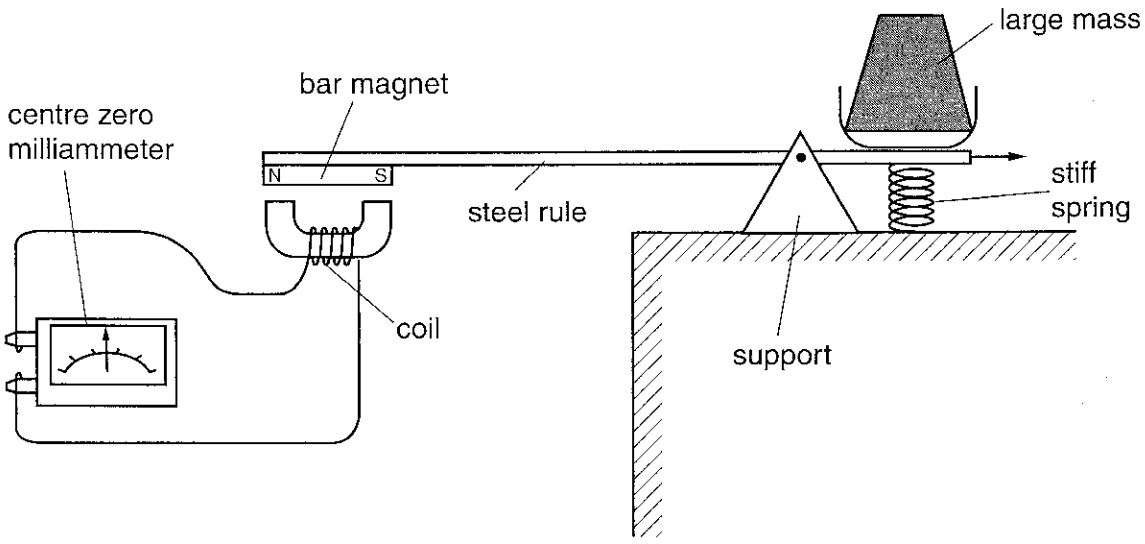
What change could he make to the design of his apparatus?

.....

.....[2]

[Turn over for remainder of question 9

(d) Ainsley's friend Rick uses similar apparatus to make a model seismometer.



The support is firmly fixed to the ground.
The ground shakes during an earthquake.
The magnet moves towards and away from the coil and the milliammeter pointer deflects to the left and to the right.

(i) Explain why the milliammeter pointer deflects.

.....

.....[2]

(ii) Explain why it deflects in both directions.

.....

.....[2]

(iii) Suggest why a large mass is used in the scale pan.

.....

.....[1]

(iv) The support is much nearer to the large mass than the centre of the rule.
Suggest why this makes the seismometer effective at detecting small vibrations.

.....

.....[1]

[Total : 16]

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