Paper Reference

7 5 4 0 / 0 2

Surname

Initial(s)

Signature

London Examinations GCE

Physics

Ordinary Level

Paper 2

Monday 12 January 2009 – Morning

Time: 2 hours

Materials required for examination	**Items included with question papers**
Nil	Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.

Information for Candidates

Calculators may be used.
Where necessary, assume the acceleration of free fall, $g = 10$ m/s^2.
The total mark for this paper is 100. The marks for parts of questions are shown in round brackets: e.g. **(2)**.
This paper has 5 questions. All blank pages are indicated.

Advice to Candidates

Write your answers neatly and in good English.
In calculations, show **all** the steps in your working.

Turn over

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Answer ALL the questions.

1. **This question is about motion.**

    (a) Define the following terms:

        (i) momentum

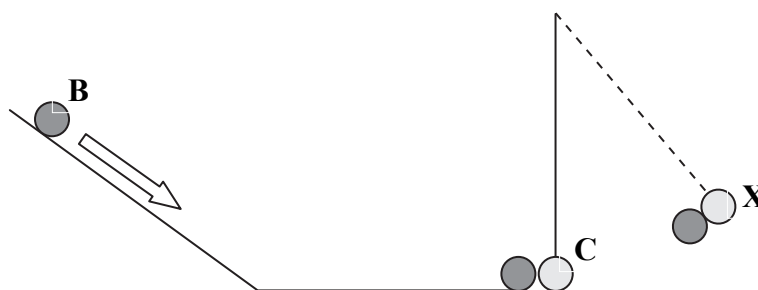   ....
        (1)

        (ii) kinetic energy

        ....
        (1)

        (iii) gravitational potential energy.

        ....
        (1)

    (b) An object moves down a slope with constant acceleration. Its initial speed is 0.30 m/s and after 0.20 s its speed is 1.2 m/s. Calculate the distance travelled by the object during this time.

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        ....
        (2)

    (c) The diagram shows part of a 'chain reaction'.

        A ball **B** of mass 0.020 kg rolls down a slope. It collides with a ball **C** of mass 0.010 kg. **C** is suspended by a string. The speed of **B** just before it collides with **C** is 1.2 m/s. After collision the balls stick together and rise to their highest position at **X** before falling back again.

        Show that the speed of the two balls immediately after collision is 0.80 m/s.

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        ....

        ....
        (3)

(d) (i) Calculate the kinetic energy of the two balls after collision.

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(2)

(ii) In rising to **X** the two balls have increased their gravitational potential energy. What is the value of this increase?

....

(1)

(iii) Calculate the vertical height by which the two balls rise.

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....

....

(2)

(e) Students try to determine the constant speed of **B** along the horizontal surface before it collides with **C**.

(i) State two problems that might arise using a ticker-timer and tape to determine the speed of **B**.
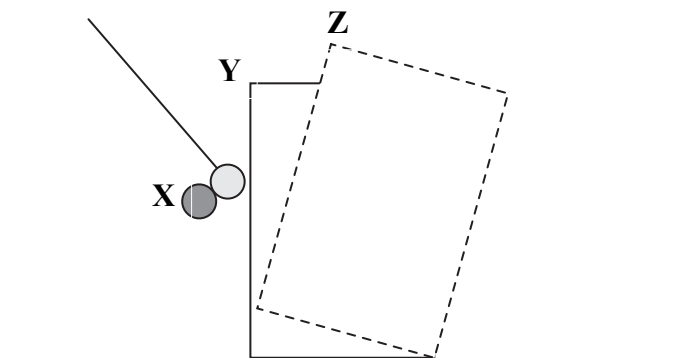
1 ....

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2 ....

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(2)

(ii) State a method by which the speed of **B** could be determined.

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(1)

(f) In the next part of the 'chain reaction' the balls at **X** strike a uniform block of wood which begins to topple and moves from position **Y** to position **Z** before falling back again.

For the chain reaction to continue the block of wood must topple over completely.

(i) What is meant by the term **centre of gravity**?

....

....

(1)

(ii) Draw two lines to locate the centre of gravity of the block in position **Z**. Mark the centre of gravity with a dot labelled **G**.

(1)

(iii) Explain why the block in position **Z** will not topple over completely.

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(1)

(iv) State one change that could be made to the start of the chain reaction in (c) to make the toppling of this block more likely.

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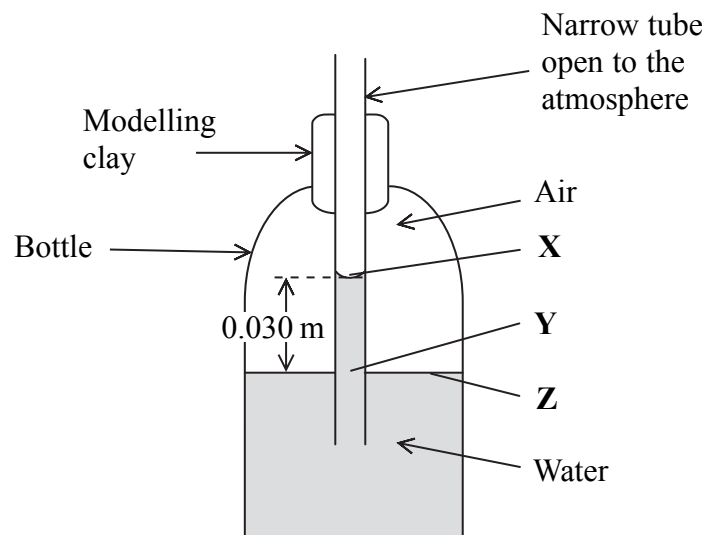
(1)

Q1

(Total 20 marks)

2. **This question is about heat and pressure.**

The diagram below shows a simple thermometer. When the bottle becomes warm, water moves up the narrow tube.

(a) (i) Give **one** advantage and one disadvantage of using thin glass instead of thick glass for the bottle.

Advantage..

....

Disadvantage...

....

(2)

(ii) Explain why this simple thermometer would not be reliable around 4 °C.

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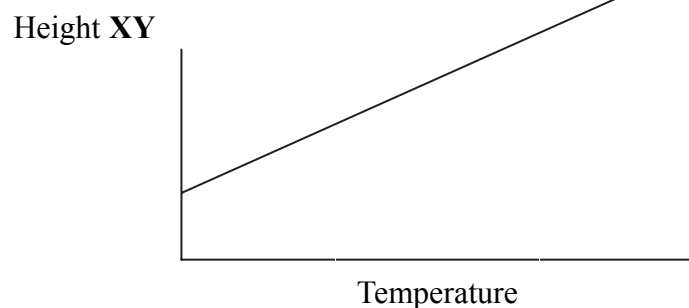
(3)

(b) The water in the bottle has a mass of 0.40 kg. The thermometer is taken from a room where the temperature is 25 °C and left in a room where the temperature is 28 °C. Calculate the amount of heat energy gained by the water.
[Specific heat capacity of water is 4200 J/(kgK)]

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(3)

(c) The graph below shows how the height **XY** of the water in the narrow tube varies with temperature.

(i) On the axes above draw a graph to show how the height **XY** would vary with temperature if the narrow tube was sealed at the top. Explain your graph.

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(3)

(ii) Explain why a mercury-in-glass thermometer works satisfactorily even though it is sealed at the top.

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(1)

(d) (i) Calculate the pressure difference between **X** and **Y** in the diagram on page 5. [Density of water is 1000 kg/m³]

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(2)

(ii) Atmospheric pressure is 100 000 Pa. Calculate the total pressure at the liquid surface **Z**.
Explain your answer.

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(2)

(e) Compare the molecular spacing and movement of water and air molecules.

Spacing ....

....

....

....

Movement..

....

....

....

(4)

Q2

(Total 20 marks)

3. This question is about electricity.

(a) A portable electrical generator can provide 720 W of electrical power at 240 V a.c. It uses a petrol engine which consumes 0.35 litres of petrol in 30 minutes.

(i) Calculate the current produced when the generator supplies 720 W.

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(2)

(ii) Calculate the electrical energy transferred in 30 minutes at this power.

....

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(3)

(iii) One litre of petrol contains 29 MJ (29 000 000 J) of chemical energy. Calculate the chemical energy in 0.35 litres of petrol.

....

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(1)

(iv) Use your answers to (ii) and (iii) to calculate the efficiency of this generator.

....

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....

(2)

(b) The 240 V a.c. output from this 720 W generator is fed to a transformer which can then produce an output of 12 V a.c.

   (i) If the transformer is ideal, what is its maximum output power? Give a reason for your answer.

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(2)

  (ii) Calculate the maximum current that can be produced at 12 V.

....

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(2)

  (iii) This ideal transformer has 2400 turns on the primary coil. Calculate the number of turns on the secondary coil.

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(3)

(c) A semiconducting diode can be used to convert a.c. to d.c.

(i) State how a semiconducting diode converts a.c. to d.c.

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(1)

(ii) On the axes below, sketch a voltage–time graph showing two complete cycles of an a.c. supply.
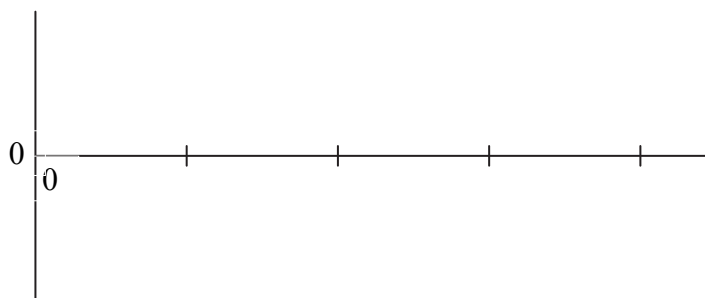
(2)

(iii) On the axes below, sketch a voltage–time graph showing the effect of using a single semiconducting diode to convert this a.c. supply to d.c.
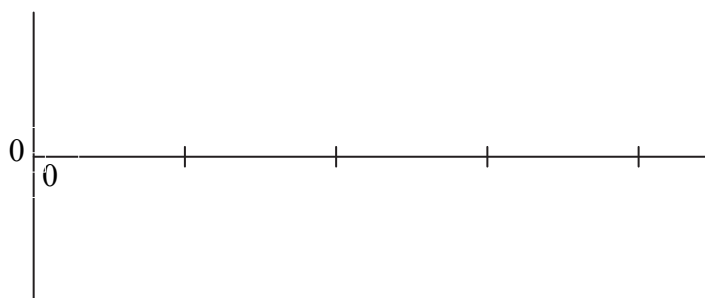
(2) **Q3**

(Total 20 marks)

4. **This question is about lenses.**

    The ray diagram shows two converging lenses arranged as an astronomical telescope.

    Not to scale

    Objective lens

    Eyepiece lens

    Light from a star
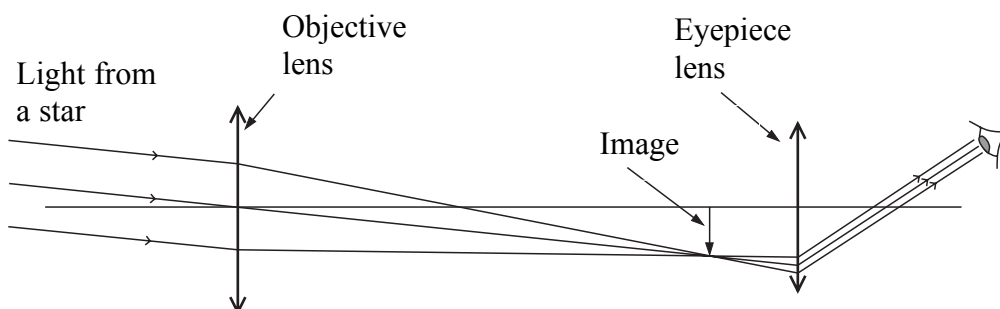
    Image

    (a) Parallel rays of light from a distant star are refracted by the objective lens to form an image as shown.

    (i) What is meant by the term **refraction**?

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    ....

    (1)

    (ii) Explain why light rays are refracted as they enter and then leave a glass lens.

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    ....

    ....

    ....

    (3)

    (iii) What distance on a scale diagram could be measured to find the focal length of the objective lens? Give a reason for your answer.

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    (2)

(iv) Is the image formed by the objective lens real or virtual? Give a reason for your answer.

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(2)

(v) The eyepiece lens acts as a magnifying glass. Is the image observed through the eyepiece lens upright or inverted? Give a reason for your answer.

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(2)

(b) In a particular telescope the magnification depends on the focal length of the eyepiece lens. The table below shows the magnification produced by different eyepiece lenses.

Magnification	180	90	60	45	36	30	26
Focal length of eyepiece lens/mm	5	10	15	20	25	30	35

(i) On the grid opposite, plot a graph of magnification (y-axis) against focal length of eyepiece lens (x-axis). Draw a smooth curve through the points.

(5)

(vertical axis labeled with values: 200, 180, 160, 140, 120, 100, 80, 60, 40, 20, 0)

(horizontal axis labeled with values: 0, 5, 10, 15, 20, 25, 30, 35)
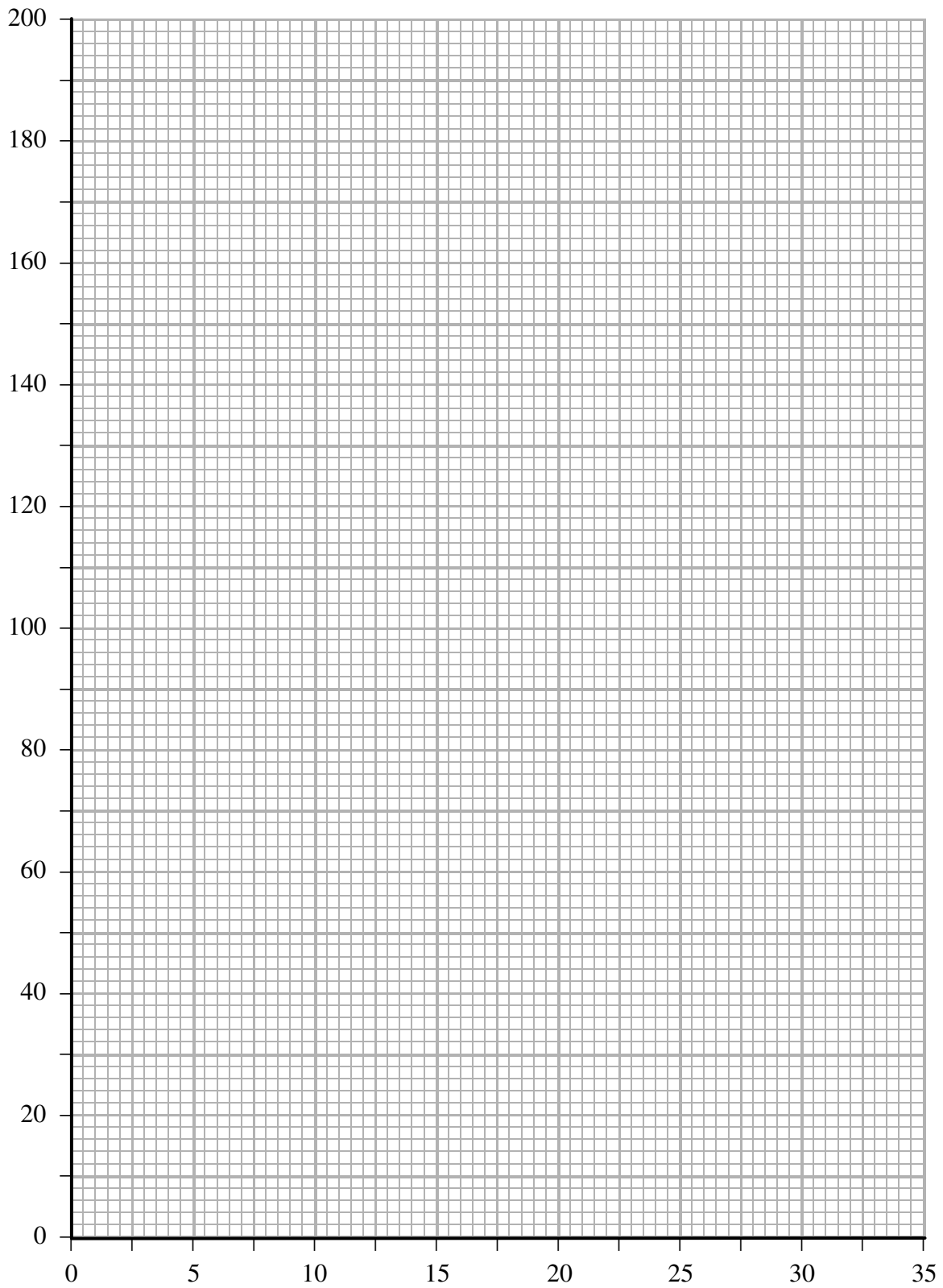
(ii) Use your graph to find the focal length of the eyepiece lens which would produce a magnification of 50.

....

(1)

(iii) On the grid show clearly how you used the graph to obtain your answer.

(1)

(iv) The magnification of a telescope can be calculated using the equation below.

$$\text{Magnification} = \frac{\text{Focal length of objective lens}}{\text{Focal length of eyepiece lens}}$$

Use the data in the table on page 12 to calculate a value for the focal length of the objective lens of this telescope.

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(3)

(Total 20 marks)

Q4

5. **This question is about electromagnetic induction and the design of an experiment.**

(a) The diagram shows a bar magnet which is released and falls freely through a flat circular coil. As the magnet falls an e.m.f. is induced in the flat circular coil which is connected to an electronic recorder.

Freely falling
bar magnet

Electronic
recorder

Flat circular
coil
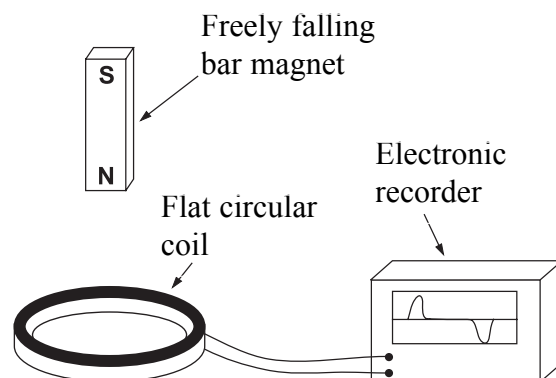
(i) Explain why an e.m.f. is induced as the magnet falls through the coil.

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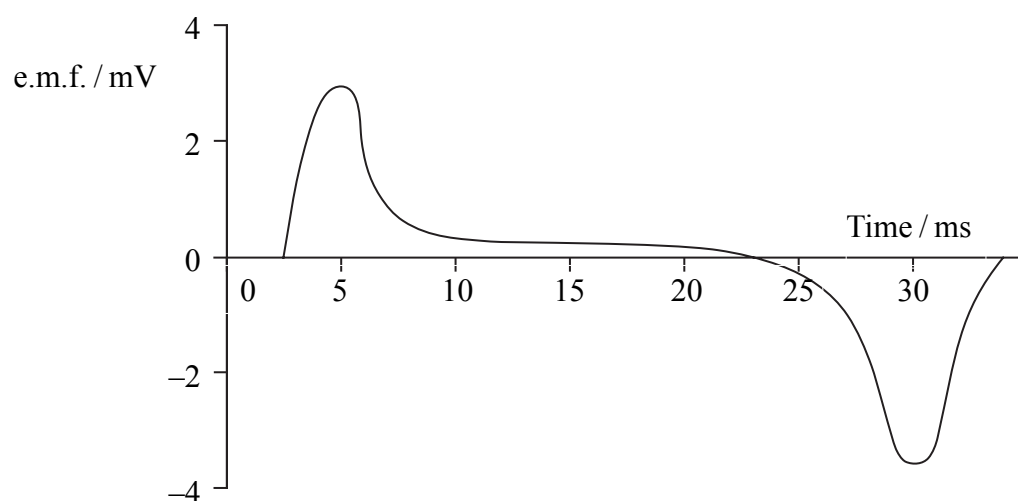...

(2)

(ii) The electronic recorder displays the induced e.m.f. as a voltage–time graph, as shown below. The two peaks show the time at which first the N pole and then the S pole pass through the coil.

e.m.f. / mV

Time / ms

Give a reason why the e.m.f. of the first peak is positive and the second is negative.

....

....

(1)

(iii) The bar magnet is 8.0 cm long. The time between the two peaks is 25 ms (0.025 s).
Calculate the average speed of the bar magnet as it passes through the coil.

....

....

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(2)

(b) A student decides to investigate how the average speed of another bar magnet depends on the height from which it is dropped.
Describe how the student would perform this investigation using the apparatus shown.
Your account should include:

(i) One additional piece of apparatus that would be needed.

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(1)

(ii) Three measurements that must be taken.

1 ....

2 ....

3 ....

(3)

(iii) A description of how the apparatus would be used.

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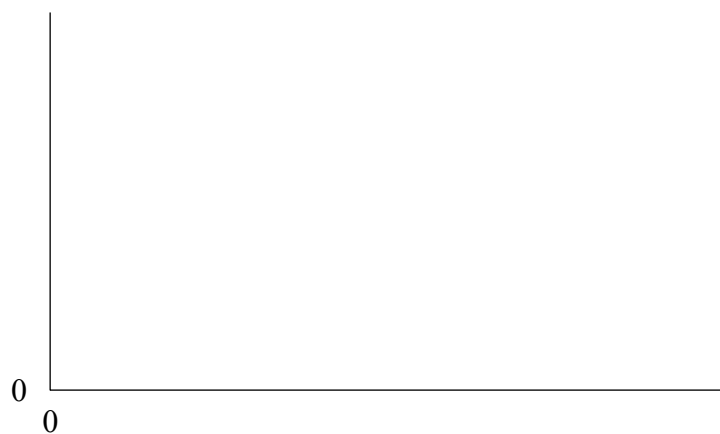
(5)

(iv) The headings and units of a table suitable for recording the measurements.

(2)

(v) A labelled sketch graph to show the expected results.

(2)

(c) State and explain one change you would expect in the appearance of the peaks if the height was increased.

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(2) **Q5**

(Total 20 marks)

TOTAL FOR PAPER: 100 MARKS

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