Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						4	4	2	0	/	2	H	Signature	

Paper Reference(s)

4420/2H

Examiner's use only

Team Leader's use only

London Examinations IGCSE

Physics

Paper 2H

Higher Tier

Tuesday 3 November 2009 – Morning

Time: 2 hours

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
1	
2	
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17	
Total	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown at the top of this page. Check that you have the correct question paper.
Answer **ALL** the questions. Write your answers in the spaces provided in this question paper.
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 (☒).
Show all the steps in any calculations and state the units.
Calculators may be used.

Information for Candidates

The total mark for this paper is 120. The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**. There are 17 questions in this question paper.
Any blank pages are indicated.
Useful formulae are given on page 2.

Advice to Candidates

Write your answers neatly and in good English.

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Turn over

FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time	$E = I \times V \times t$
pressure × volume = constant	$p_1 \times V_1 = p_2 \times V_2$
$\frac{\text{pressure}}{\text{kelvin temperature}} = \text{constant}$	$\frac{p_1}{T_1} = \frac{p_2}{T_2}$
$\text{frequency} = \frac{1}{\text{time period}}$	$f = \frac{1}{T}$
$\text{power} = \frac{\text{work done}}{\text{time taken}}$	$P = \frac{W}{t}$
$\text{power} = \frac{\text{energy transferred}}{\text{time taken}}$	$P = \frac{W}{t}$

Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.

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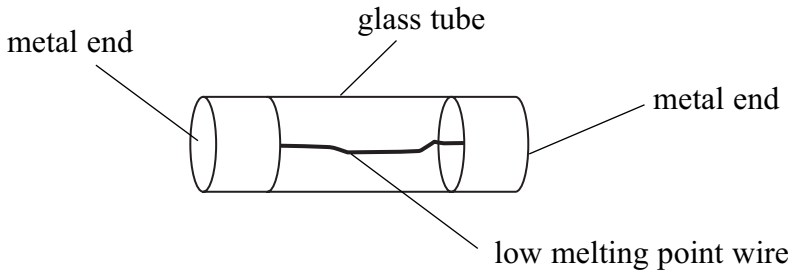
1. A student uses a hair dryer. The hair dryer's plug contains a fuse.

The diagram shows the fuse.



(a) Explain how the fuse prevents too large a current in the hair dryer.

.....

.....

.....

(2)

(b) The hair dryer is rated at 240 V, 1500 W. Calculate the current rating in amps of the hair dryer.

.....

.....

Current = ...A

(3)

Leave blank

(c) The fuse in the hair dryer blows and the student has to replace it.

The following fuses are available:

1 A 3 A 5 A 13 A

(i) Which fuse should the student choose? Put a cross (☒) in the correct box.

☒ 1 A

☒ 3 A

☒ 5 A

☒ 13 A

(1)

(ii) Explain your choice.

.....

.....

(1)

(d) A hair dryer heats up air.

Name one other example of electrical heating used in the home.

.....

(1)

Q1

(Total 8 marks)

Leave blank

2. (a) One source of background radiation is cosmic rays.

Cosmic rays are 90% protons, 9% alpha particles and 1% electrons.

(i) What does an alpha particle consist of?

.....

.....

(2)

(ii) Name a source of background radiation other than cosmic rays.

.....

(1)

(b) Experiments in a laboratory show that alpha particles from radioactive sources can only travel a few centimetres in air.

Why can they travel much further in space?

.....

.....

(1)

(c) Cosmic rays produce radioactive carbon-14 in the atmosphere. As carbon-14 decays, its activity decreases with a long half-life.

(i) What is meant by half-life?

.....

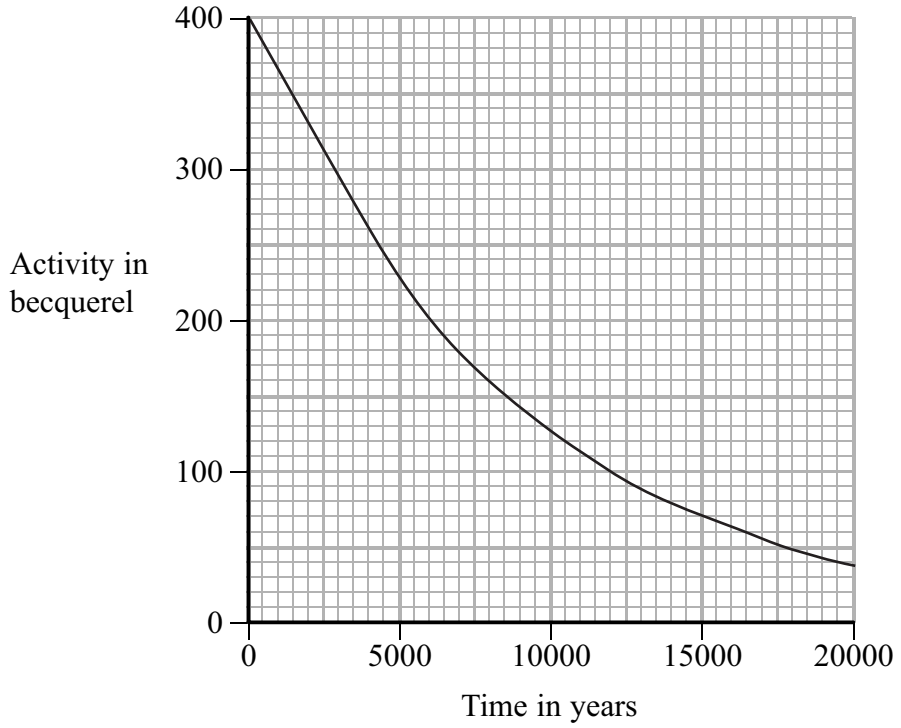
.....

(1)

Leave blank

(ii) The activity of the carbon-14 in a piece of wood can be used to estimate the age of the wood.

The graph shows how the activity of a sample of carbon-14 varies with time.



1 Use the graph to determine the half-life in years of carbon-14.
You must show your method on the graph.

.....

(2)

2 State why it is not possible to use carbon-14 to date a specimen that is more than 60 000 years old.

.....

(1)

(d) State another use of radioactivity.

.....

(1)

Q2

(Total 9 marks)

Leave blank

3. (a) Use words from the box to complete the sentence.

acceleration	**direction**	**distance**
energy	**force**	**velocity**

Each word may be used once, more than once or not at all.

Work done is equal to ..... times .....

moved in the ..... of the force.

(3)

(b) A machine does 2000 J of useful work in 5 s.

Calculate the useful output power in watts of the machine.

.....

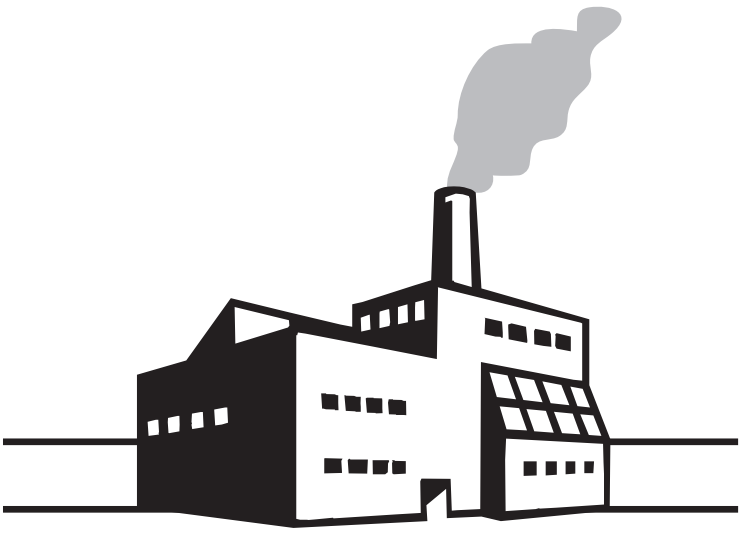
.....

Power = ... W

(2)

(c) An industrialist takes his daughter on a visit to his factory.

He tells her that the factory is 100% efficient because it is working all the time.



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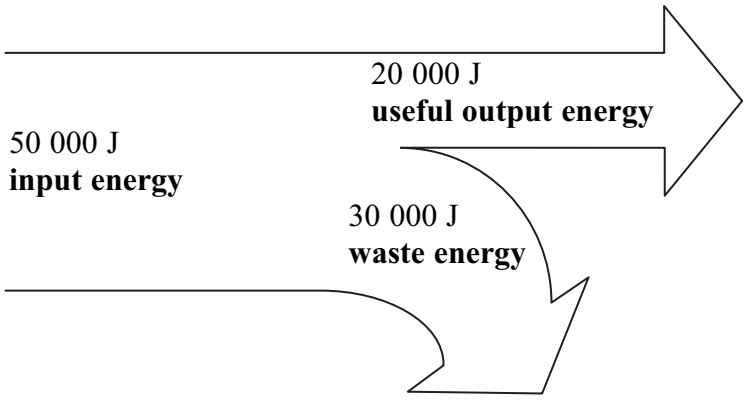
She asks to see a flow diagram for a process that takes place within the factory.
The flow diagram is shown below.



(i) Write down a formula for efficiency using two of the three terms in bold type in the diagram.

.....

.....

(1)

(ii) Calculate the efficiency of the process shown in the diagram.

.....

.....

Efficiency = ...

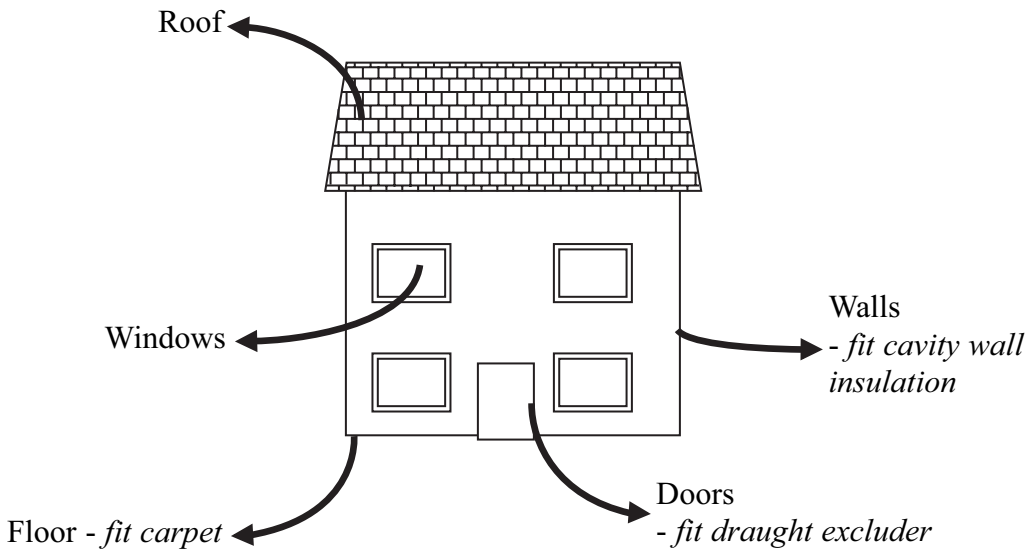
(2)

Q3

(Total 8 marks)

Leave blank

4. (a) The diagram shows heat losses from a house in a cold climate and ways of reducing some of these losses.



State a way of reducing the heat losses from

(i) the roof,

.....

(1)

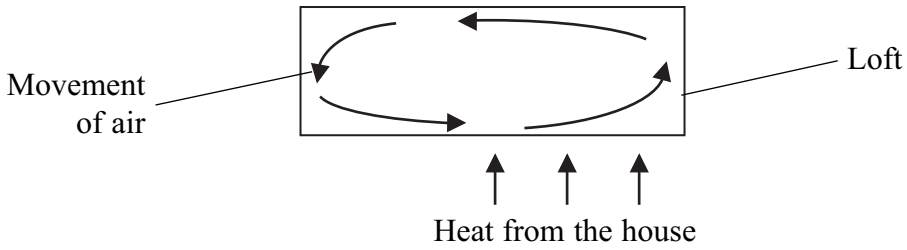
(ii) the windows.

.....

(1)

Leave blank

(b) The movement of air in part of the loft forms a convection current.



Explain the movement of air during convection.

.....

.....

.....

(3) **Q4**

(Total 5 marks)

Leave blank

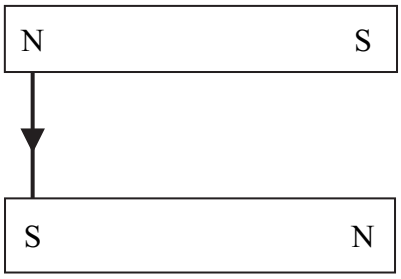
5. (a) A student writes a list of descriptions of magnetic field lines.

One of the boxes below has been completed to show that the description is correct. Complete **two** other boxes which have correct descriptions of magnetic field lines. Put a cross (☒) in the correct boxes.

their direction is from North to South	☒
they show the shape of a magnetic field	☒
they only appear near hard magnetic materials	☒
they show attraction but not repulsion	☒
they can show the strength of a magnetic field	☒

(2)

(b) Two bar magnets are held near to each other on a horizontal surface.
A magnetic field line is shown.



(i) Draw **two** more magnetic field lines on the diagram.

(2)

(ii) The magnets are released. In which direction will they move?

.....

.....

(1)

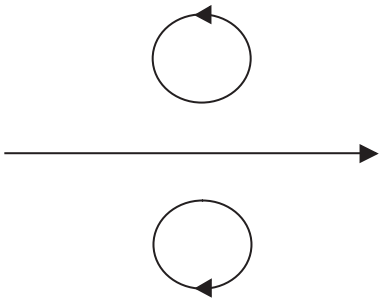
(iii) Explain your answer to part (ii).

.....

(1)

Leave blank

(c) A magnetic field pattern is shown below.



(i) Put a cross (☒) next to the correct words to complete the sentence.

This pattern is produced by
- ☒ a flat circular coil
- ☒ a straight wire
- ☒ a solenoid

when it is carrying a current.

(1)

(ii) A student claims that this is a uniform magnetic field pattern.

Do you agree? Explain your answer.

.....

.....

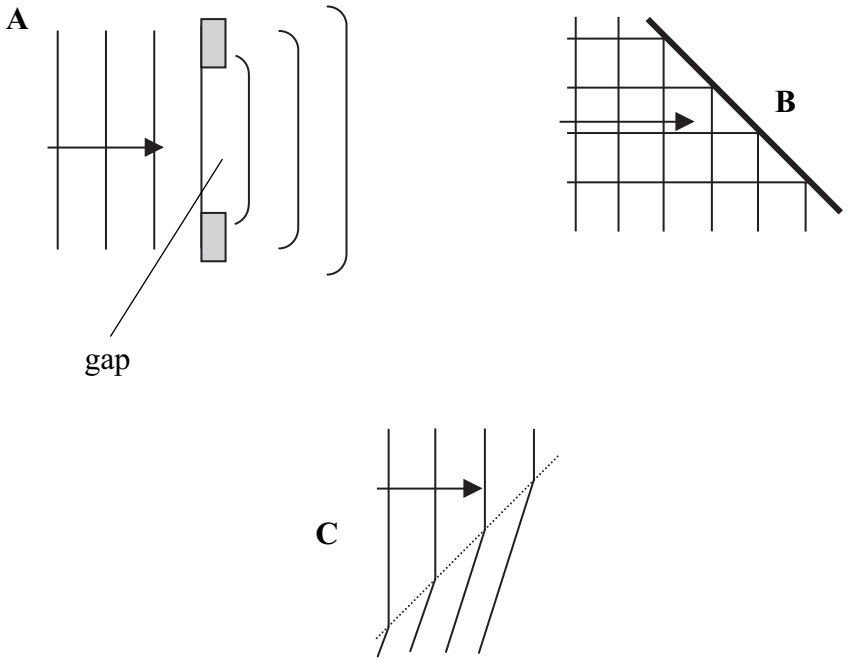
(1)

Q5

(Total 8 marks)

Leave blank

6. (a) Diagrams **A**, **B** and **C** show the behaviour of waves.



Use a word from the box to name each behaviour.

diffraction	**interference**	**reflection**
refraction	**wavefront**	**wavelength**

A .....

B .....

C .....

(3)

Leave blank

(b) Diagram **C** shows a reduction in the speed of the waves.

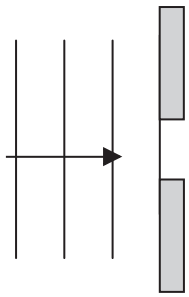
Explain how.

.....

.....

(2)

(c) The gap in **A** is made smaller, as shown below. Draw three waves after the gap.



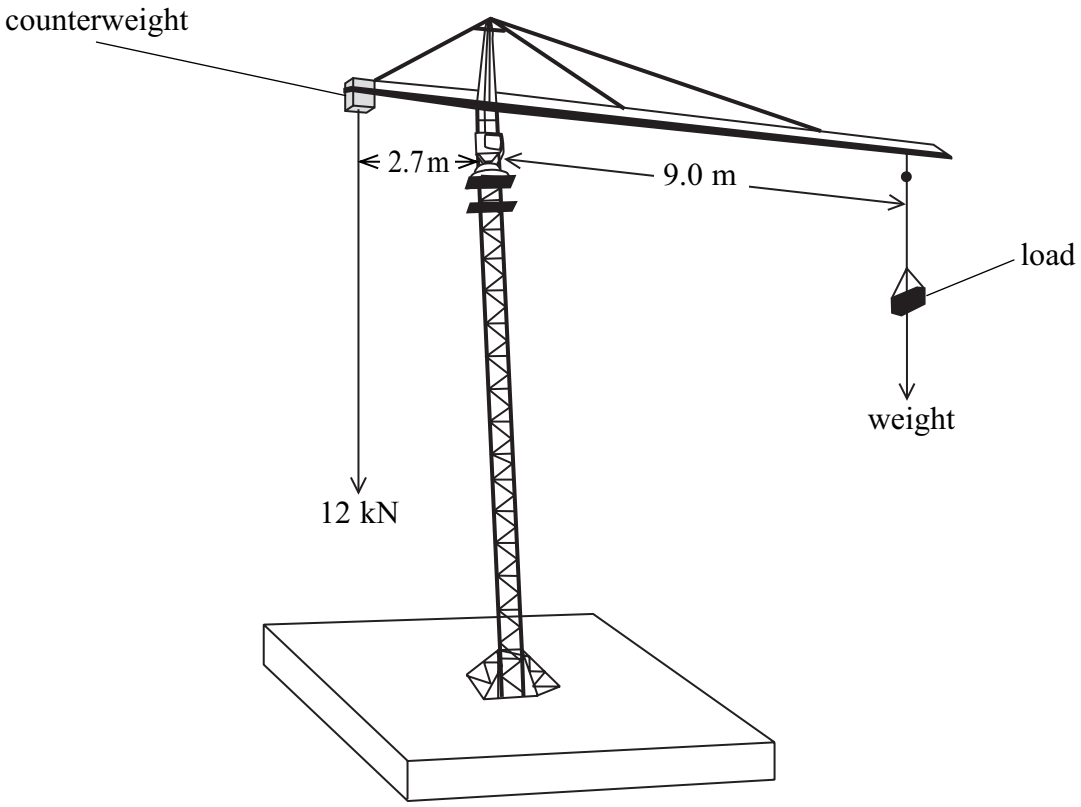
(2)

Q6

(Total 7 marks)

Leave blank

7. The diagram shows a tower crane on a building site.



(a) The crane is in equilibrium.

(i) What does the term equilibrium mean?

.....

.....

(1)

(ii) Calculate the weight, in kN, of the load.

.....

.....

Weight = ... kN

(2)

Leave blank

(b) (i) Weight is a vector quantity.

Explain how you can tell this from the diagram.

.....

.....

(1)

(ii) Give another example of a vector quantity.

.....

(1)

Q7

(Total 5 marks)

Leave blank

8. (a) Absolute zero is –273 °C.

(i) Describe the movement of the particles in a substance at absolute zero.

.....

.....

(1)

(ii) Convert 30 °C to the kelvin scale.

.....

Temperature = ... K

(1)

(b) (i) For a fixed mass of gas

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

Explain fully what the term T represents in this equation.

.....

.....

(1)

(ii) The pressure in a gas cylinder is 1250 kPa when the temperature is 30 °C.

The temperature falls to 15 °C.

Calculate the new pressure in the gas cylinder to the nearest 10 kPa.

.....

.....

.....

Pressure = ... kPa

(3)

Q8

(Total 6 marks)

Leave blank

9. The wind may be used to produce large quantities of electrical energy.

There are advantages and disadvantages of producing electrical energy in this way.

(a) State two advantages other than cost.

Advantage 1 .....

.....

Advantage 2 .....

.....

(2)

(b) State two disadvantages other than cost.

Disadvantage 1 .....

.....

Disadvantage 2 .....

.....

(2)

Q9

(Total 4 marks)

Leave blank

10. An electromagnetic force usually acts on a wire which carries a current in a magnetic field.

(a) Name two devices which use this effect.

1 .....

2 .....

(2)

(b) State two ways in which the force acting on the wire can be increased.

1 .....

.....

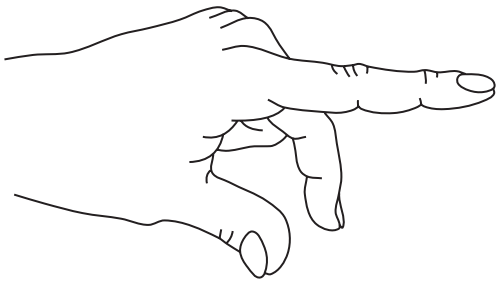
2 .....

.....

(2)

(c) Professor J A Fleming invented a rule to remember the directions involved in this effect. This rule is known as Fleming's left-hand rule.

The diagram shows a left hand with two fingers and the thumb extended.
Draw a straight line from each of them to the correct box for this rule.



direction of magnetic field from north to south
direction of magnetic field from south to north
direction of current from negative to positive
direction of current from positive to negative
direction of force

(3)

Leave blank

(d) Sometimes a wire carries a current in a magnetic field but no electromagnetic force acts on it.

Explain how this can happen.

.....

.....

(1) **Q10**

(Total 8 marks)

Leave blank

11. The photograph shows a carriage on a rollercoaster ride.

The total mass of the carriage and the people in it is 8400 kg.
The carriage is 70 m above ground level.

(a) (i) State the equation for gravitational potential energy (GPE).

.....

(1)

(ii) The carriage moves from ground level to the position shown.
Calculate the increase in GPE and give its unit.

.....

.....

GPE = ...

(2)

(iii) What was the least amount of work done to get the carriage from ground level to the position shown?

.....

(1)

(iv) State one assumption which you made to answer part (iii).

.....

.....

(1)

Leave blank

(b) (i) State the equation that relates kinetic energy, mass and speed.

.....

(1)

(ii) At one stage of the ride the kinetic energy of the carriage and the people in it is 823.2 kJ.

Calculate the speed in m/s at this stage of the ride.

.....

.....

speed = ... m/s

(3)

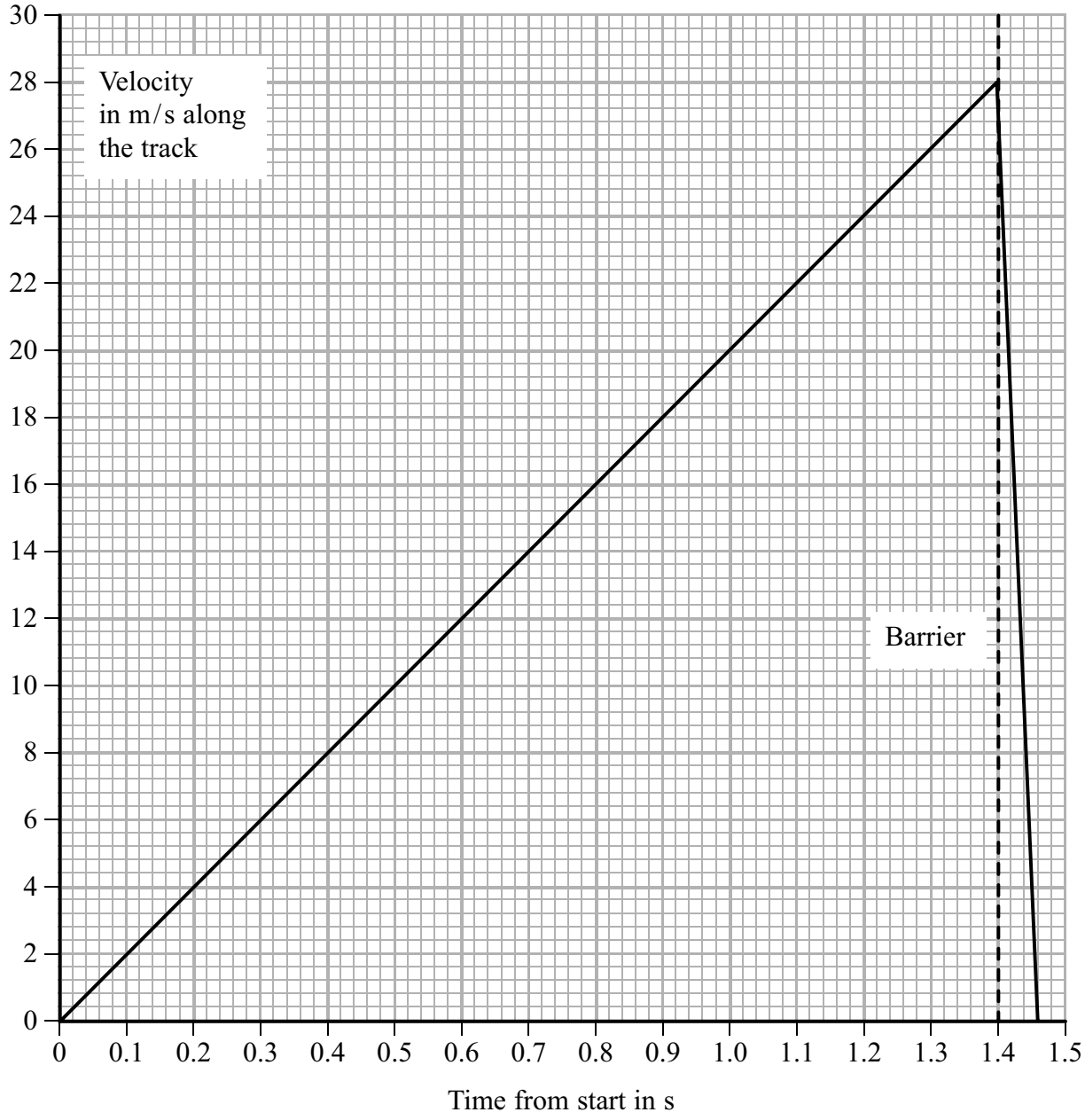
Q11

(Total 9 marks)

Leave blank

12. Crash tests are used to measure the safety of new car designs. In one type of test, a car accelerates along a straight and level track and then crashes into a barrier.

(a) The velocity-time graph shows one set of results.



Leave blank

Use information from the graph to answer the questions.

(i) Calculate the acceleration of the car from the start to the barrier.
Show your working and give the unit.

.....

.....

Acceleration = ...

(3)

(ii) Calculate the distance in metres the car travels from the start to the barrier.
Show your working.

.....

.....

Distance = ... m

(3)

(iii) The car hits the barrier and a short time later it stops.
How long in seconds is this short time?

.....

Time = ... s

(1)

(b) (i) State the equation which relates acceleration, mass and unbalanced force.

.....

(1)

(ii) When another car hits the barrier, it experiences an unbalanced force of 25 000 N and decelerates at 20 m/s^2.
Calculate the mass in kilograms of the car.

.....

.....

Mass = ... kg

(2)

Q12

(Total 10 marks)

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13. A laptop computer has a rechargeable battery.

The battery takes 4 hours to charge fully when a voltage of 6 V is used with a current of 1.2 A.

(a) Use the equation

energy transferred = current × voltage × time

to calculate the energy transferred.

Show your working and give the unit.

.....

.....

.....

Energy = ...

(3)

(b) Complete the sentences.

(i) Voltage is the energy transferred per unit ..... passed.

(1)

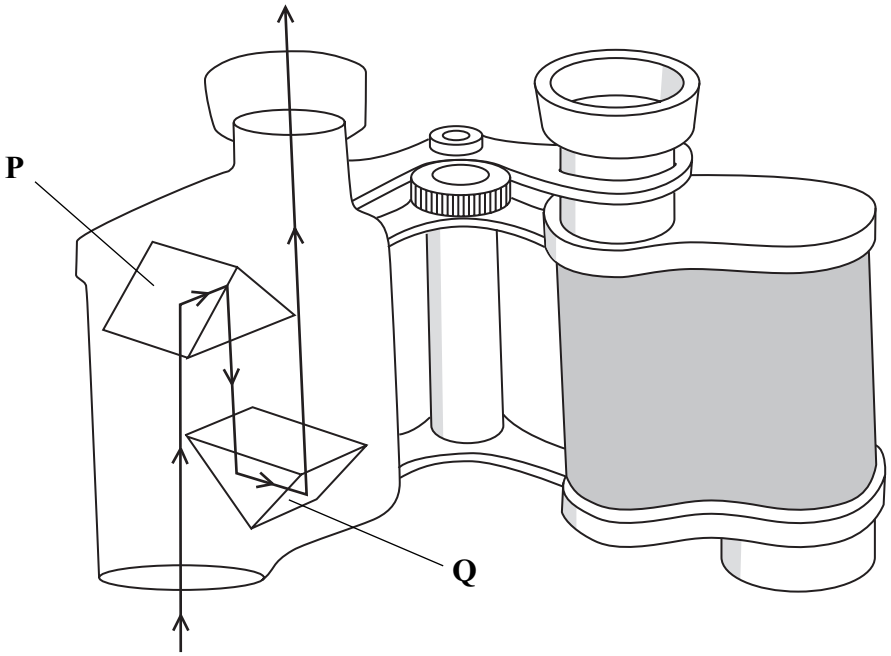
(ii) A volt is a joule per ..... .

(1) **Q13**

(Total 5 marks)

Leave blank

14. (a) The diagram shows a ray of light passing through one side of a pair of binoculars.



(i) Name the parts labelled **P** and **Q**.

.....

(1)

(ii) Name the process shown by the path of the light in parts **P** and **Q**.

.....

(1)

Leave blank

(b) Figures **A** and **B** show rays of light from a lamp on the bottom of a swimming pool.

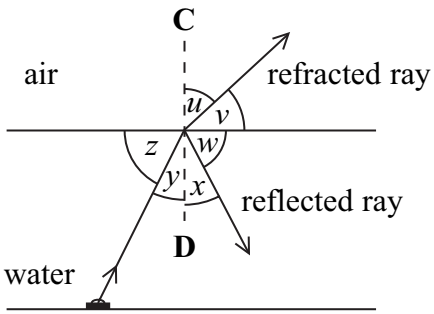


Figure A

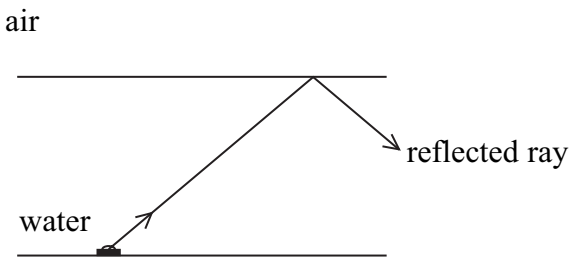


Figure B

(i) Answer these three questions with reference to Figure **A**.

1 What is the name of the dashed line **CD**?

.....

(1)

2 Use two of the letters *u, v, w, x, y* and *z* to write the equation

angle of incidence = angle of reflection

.....

(1)

3 State the equation which relates refractive index *n*, angle of incidence *i* and angle of refraction *r*.

.....

(1)

(ii) Refraction has not occurred in Figure **B**. Explain this.

.....

.....

(1)

(iii) State the equation which relates critical angle *c* and refractive index *n*.

.....

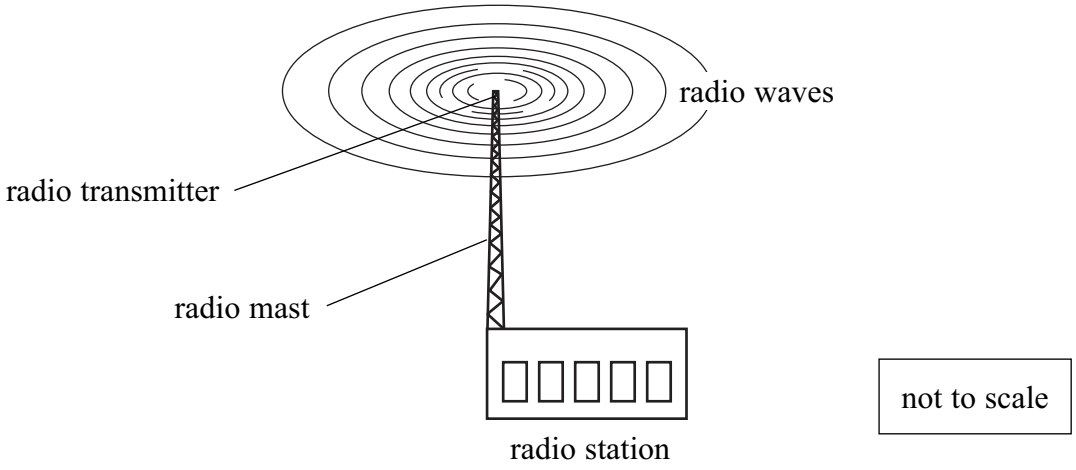
(1)

Q14

(Total 7 marks)

Leave blank

15. A radio station broadcasts at a frequency of 1200 kHz. The radio waves travel outwards from the radio transmitter at a speed of 300 million metres per second (300 000 000 m/s).



(a) (i) State the equation which relates frequency, speed and wavelength.

.....

(1)

(ii) Calculate the wavelength of these radio waves.

Show your working and give the unit.

.....

.....

Wavelength = ...

(3)

(b) Use the equation

$$\text{frequency} = \frac{1}{\text{time period}}$$

to calculate the time period in seconds of these radio waves.

Give the answer to **two** significant figures.

.....

.....

Time period = ...s

(3)

Q15

(Total 7 marks)

Leave blank

16. (a) Three quantities are given in the box.

area	**force**	**pressure**

(i) State the equation which relates them.

.....

(1)

(ii) Use all three quantities from the box to explain why it is easier to use a knife with a sharp edge rather than the same knife with a blunt edge.

.....

.....

.....

(2)

(b) Area can be measured in square metres (m^2), force in newtons (N) and pressure in pascals (Pa).

Give a pair of values for force and area which would result in a pressure of 5 kPa.

.....

.....

.....

(2) **Q16**

(Total 5 marks)

Leave blank

17. In a nuclear reactor, energy is released in the form of kinetic energy of the fission products. This energy is used to heat water.

(a) How is the heated water used to generate electricity?

.....

.....

.....

.....

.....

.....

(3)

(b) One possible fission process for an atom of uranium-235 in a nuclear reactor is

$$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{236}_{92}U \rightarrow {}^{92}_{36}Kr + {}^{141}_{56}Ba + 3\,{}^{1}_{0}n$$

(i) There are two equations in the process. Each equation is balanced.

Complete the sentence.

In a balanced nuclear equation, the total number of .....

and ..... is the same on both sides.

(1)

(ii) Write down the symbols of the pair of isotopes in the process.

.....

(1)

(iii) Write down the symbols of the daughter nuclei in the process.

.....

(1)

Leave blank

(iv) The process begins when a slow-moving neutron collides with a uranium-235 nucleus.

Name the part of the nuclear reactor which causes the neutrons to be slow-moving.

.....

(1)

(v) Explain how the process can lead to a chain reaction.

You may include a labelled diagram.

.....

.....

.....

.....

(2) **Q17**

(Total 9 marks)

TOTAL FOR PAPER: 120 MARKS

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