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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Tuesday 12 January 2021

Morning (Time: 2 hours) | Paper Reference **4PH1/1PR 4SD0/1PR**

Physics

Unit: 4PH1
Science (Double Award) 4SD0
Paper: 1PR

You must have:
Ruler, protractor, calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show all steps in any calculations and state the units.
- 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 ☒.

Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time $\quad E = I \times V \times t$

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{power} = \frac{\text{energy transferred}}{\text{time taken}} \qquad P = \frac{W}{t}$$

$$\text{orbital speed} = \frac{2\pi \times \text{orbital radius}}{\text{time period}} \qquad v = \frac{2 \times \pi \times r}{T}$$

(final speed)^2 = (initial speed)^2 + (2 × acceleration × distance moved)

$$v^2 = u^2 + (2 \times a \times s)$$

pressure × volume = constant $\quad p_1 \times V_1 = p_2 \times V_2$

$$\frac{\text{pressure}}{\text{temperature}} = \text{constant} \qquad \frac{p_1}{T_1} = \frac{p_2}{T_2}$$

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

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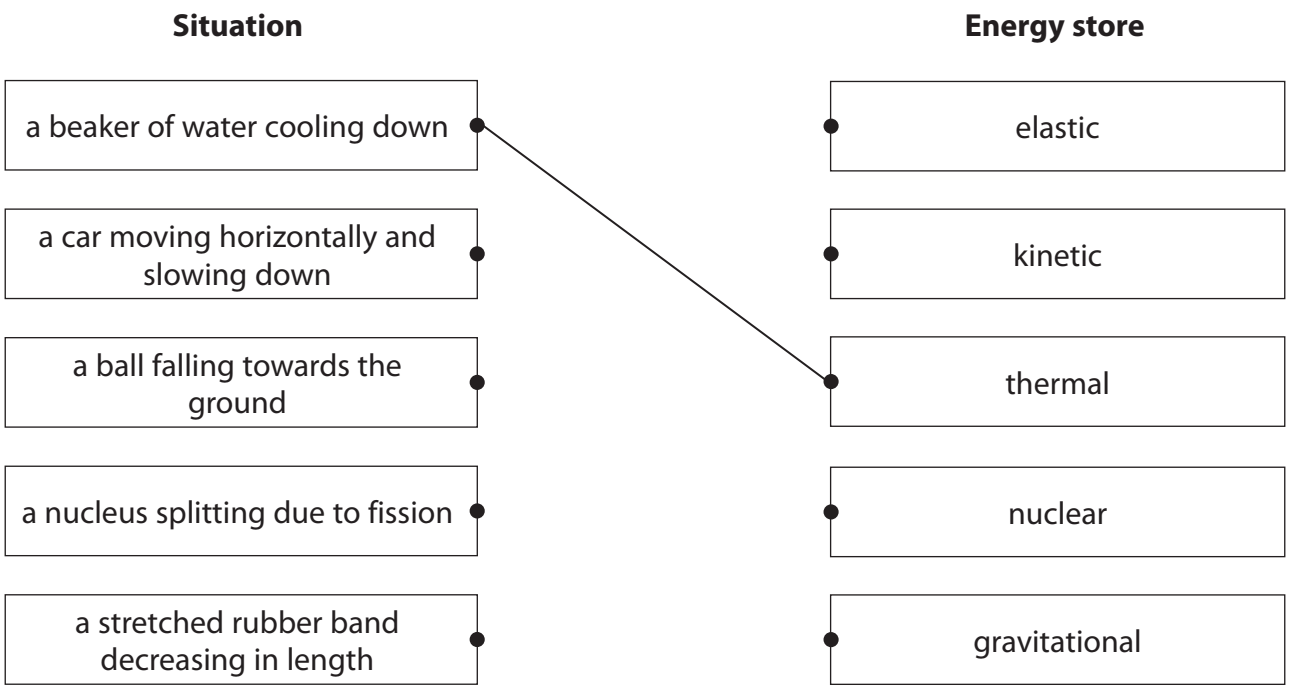
Answer ALL questions.

1 (a) The boxes give some situations and some energy stores.

Draw one straight line from each situation to the energy store that decreases for that situation.

The first one has been done for you.

(4)



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(b) Energy is transferred when a filament lamp is connected to a battery.

(i) Which method of energy transfer takes place between the battery and the lamp?

(1)

- ☒ **A** electrical
- ☒ **B** heating
- ☒ **C** mechanical
- ☒ **D** radiation

(ii) Which method of energy transfer takes place between the lamp and the surroundings?

(1)

- ☒ **A** electrical
- ☒ **B** light radiation
- ☒ **C** mechanical
- ☒ **D** sound radiation

(Total for Question 1 = 6 marks)

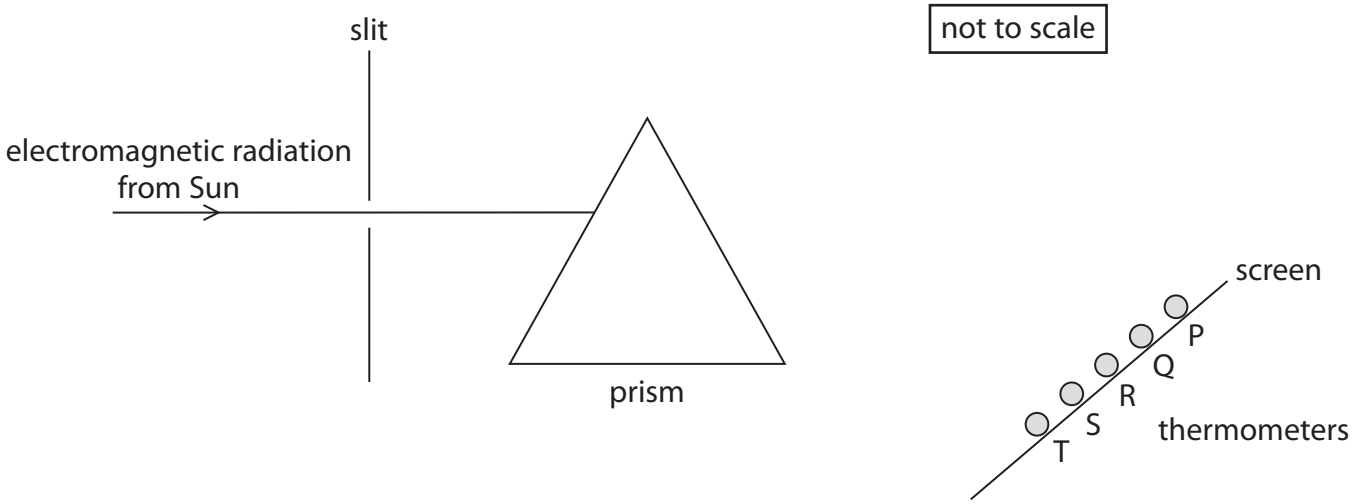
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2 The diagram shows the apparatus used to demonstrate the existence of electromagnetic radiation just beyond the visible spectrum.

Electromagnetic radiation from the Sun passes through a slit and a prism.

The electromagnetic radiation refracts through the prism onto the screen.

Five thermometers are placed in front of the screen.



(a) Complete the table to show the missing parts of the electromagnetic spectrum.

(3)

Thermometer	Part of electromagnetic spectrum
P	
Q	red light
R	
S	violet light
T	

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(b) Suggest why the lower part of each thermometer should be painted black.

(2)

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(c) The equipment is left for a short period of time.

The thermometers now show higher temperatures than before.

State the part of the electromagnetic spectrum in this demonstration that would give the largest temperature increase.

(1)

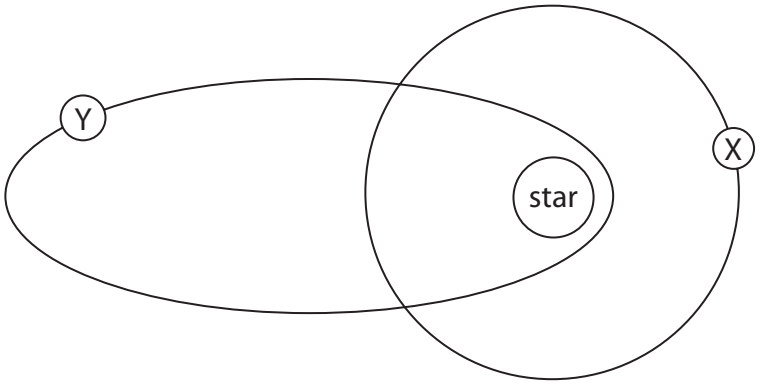
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(Total for Question 2 = 6 marks)

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3 The diagram shows two objects orbiting a star.

not to scale



(a) Object X has a circular orbit around the star.

State the type of object that has a circular orbit around a star.

(1)

.....

(b) Object Y has an elliptical orbit around the star.

State the type of object that has an elliptical orbit around a star.

(1)

.....

(c) Object X completes an orbit of the star in 35 days.

The radius of its orbit is 1.5×10^{11} m.

Calculate the orbital speed of object X.

(3)

orbital speed = ... m/s

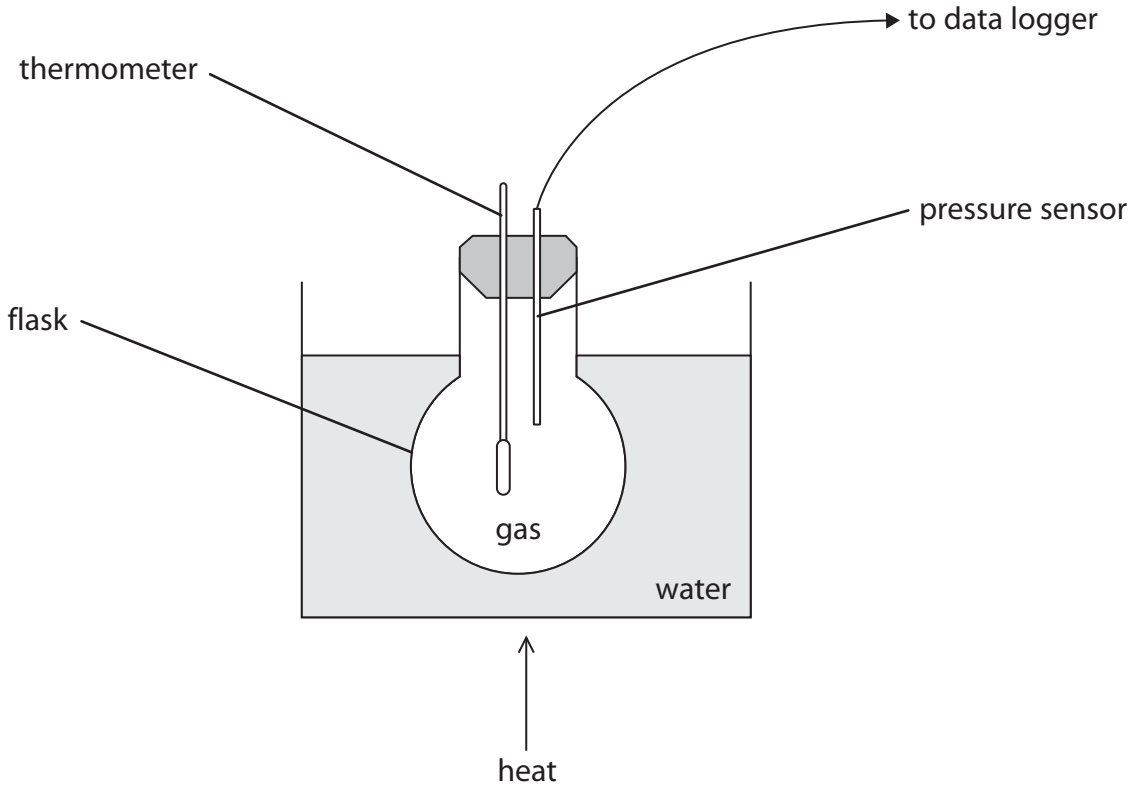
(Total for Question 3 = 5 marks)

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4 The diagram shows apparatus used to investigate how the pressure of a gas varies with temperature.



(a) The volume of the gas is kept constant by the flask.

The volume of the gas is a control variable.

State why it is important to keep a control variable constant throughout the investigation.

(1)

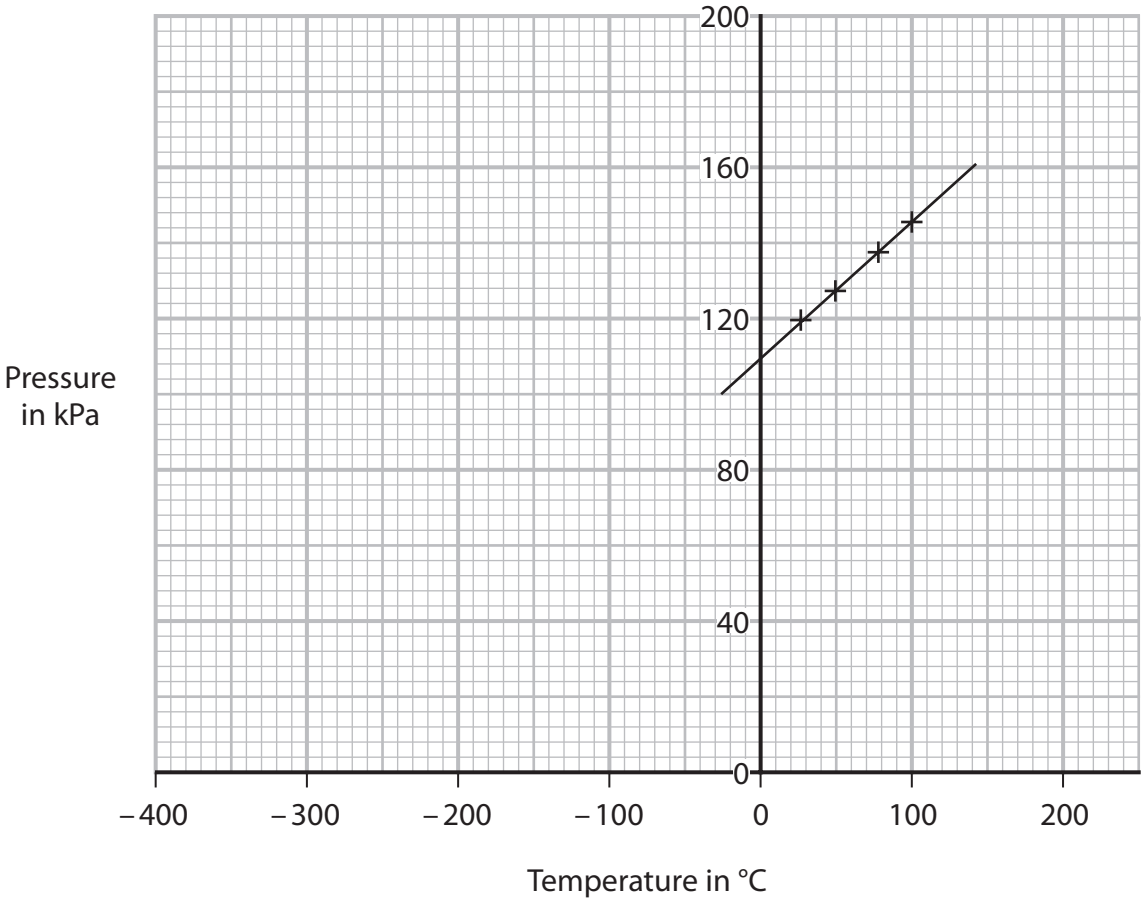
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(b) The pressure of the gas changes as its temperature increases.

The graph shows the results.



(i) Explain how these results show that there is a linear, but not proportional, relationship between the pressure of the gas and its temperature in °C.

(2)

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(ii) Use the graph to determine the value for absolute zero.

(2)

temperature = ... °C

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(iii) Explain how the pressure of the gas changes as its temperature increases.

Include ideas about particles in your answer.

(3)

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(c) The pressure of the gas is 112 kPa when its temperature is 35 °C.

The gas is heated to 340 °C using some different apparatus.

(i) Calculate the pressure of the gas when its temperature is 340 °C.

Assume the gas has a constant volume.

(4)

pressure = ... kPa

(ii) The volume of the gas is constant in the investigation.

Give the name of the other quantity that must be constant for the calculation to be correct.

(1)

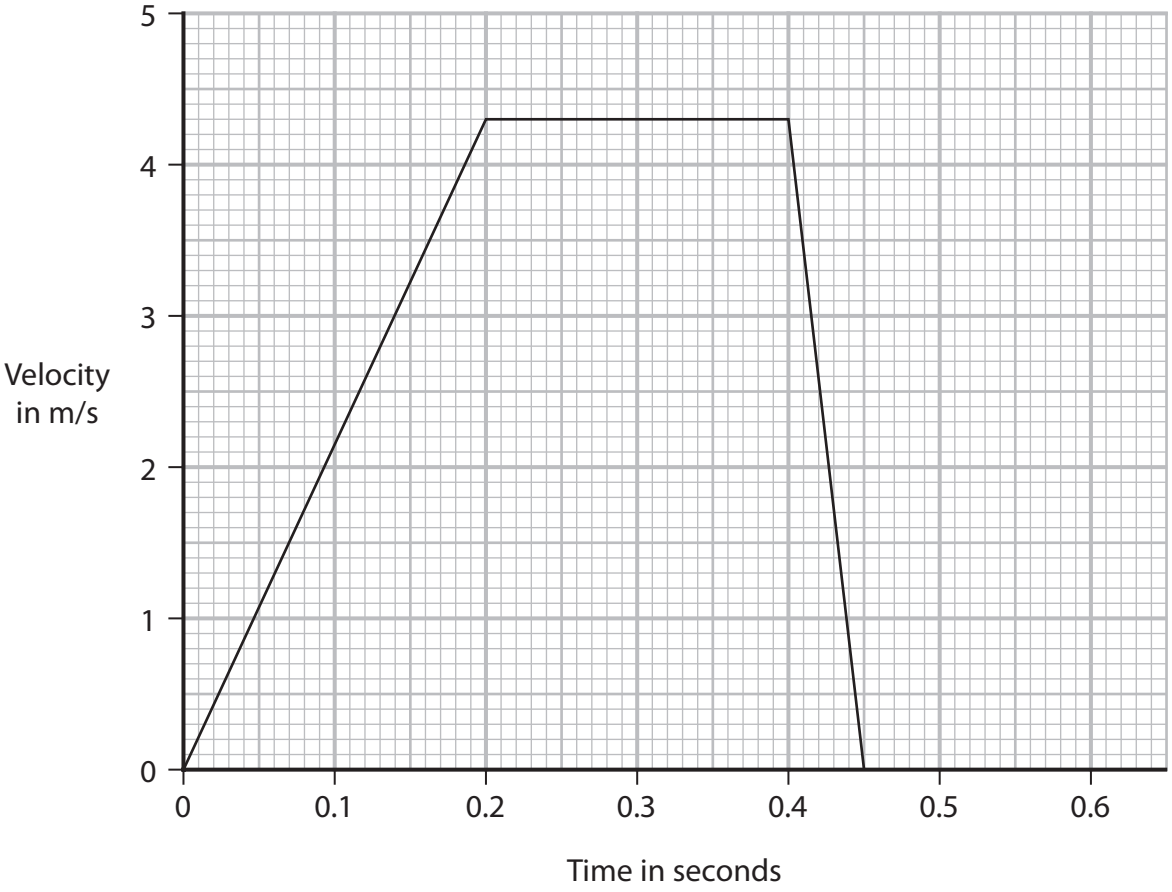
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(Total for Question 4 = 13 marks)

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5 A student does an investigation to show how the velocity of a toy car changes when the car rolls down a ramp onto a table and hits a wooden block.

The graph shows how the velocity of the toy car changes with time.



(a) Calculate the distance travelled by the car during the first 0.4 seconds.

(4)

distance = ... m

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(b) (i) Calculate the acceleration of the car between 0.40 s and 0.45 s.

(3)

acceleration = ... m/s^2

(ii) State the formula linking resultant force, mass and acceleration.

(1)

(iii) The car has a mass of 0.13 kg.

Calculate the resultant force on the car as it slows down.

(2)

resultant force = ... N

(c) A piece of soft material is fixed to the front of the toy car.

Explain how this will affect the gradient of the velocity-time graph after the car hits the block.

(3)

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(Total for Question 5 = 13 marks)

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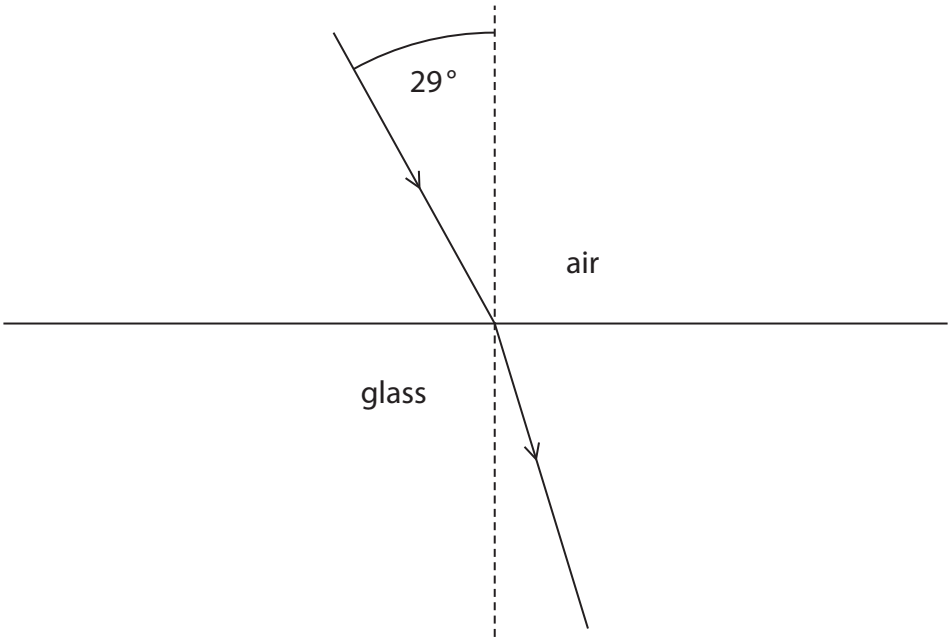
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6 The diagram shows a ray of light travelling from air into glass.



(a) Use a protractor to determine the angle of refraction.

(1)

angle of refraction = ... degrees

(b) State the formula linking refractive index, angle of incidence and angle of refraction.

(1)

(c) Calculate the refractive index of this glass.

(3)

refractive index = ...

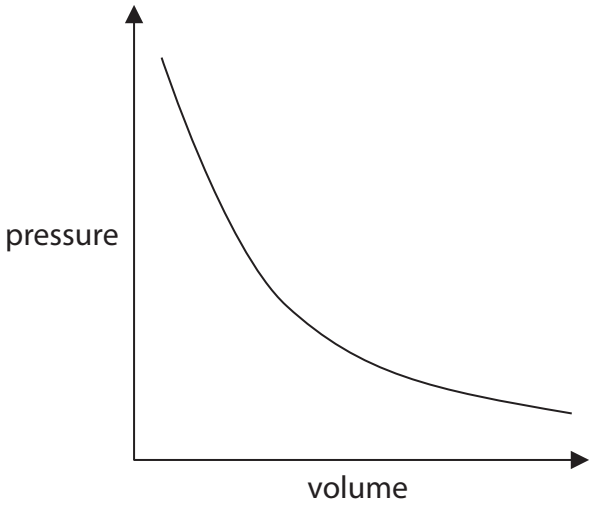
(Total for Question 6 = 5 marks)

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7 A glass contains fizzy water.

Bubbles of carbon dioxide form at the bottom of the glass and rise to the surface.

(a) The graph shows the relationship between the volume of a bubble and the pressure of the gas in the bubble.



(i) Describe the relationship shown by the graph.

(2)

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(ii) State the formula linking pressure difference, height, gravitational field strength and density.

(1)

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(iii) The depth of the fizzy water in the glass is 22 cm.

The density of the fizzy water is 1080 kg/m^3.

Calculate the pressure difference at the bottom of the glass due to the fizzy water.

(2)

pressure difference = ... Pa

(iv) Calculate the pressure of the gas in the bubble when the bubble is at the bottom of the glass.

[atmospheric pressure = 101 000 Pa]

(1)

pressure = ... Pa

(v) When a bubble is at the top of the glass, the pressure of the gas in the bubble is equal to 101 000 Pa and the bubble has a volume of 0.084 cm^3.

Calculate the volume of the gas in the bubble when the bubble is at the bottom of the glass.

Assume the temperature of the gas remains constant.

(3)

volume = ... cm^3

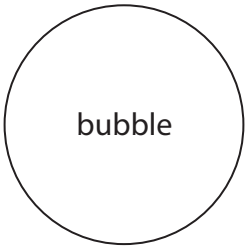
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(b) A force called upthrust acts vertically upwards on the bubble.

When the bubble is released, it accelerates vertically upwards.

Draw two labelled arrows on the diagram to show the forces on the bubble as it is released.

(3)



(Total for Question 7 = 12 marks)

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8 (a) The diagram shows a bar magnet.

Draw four magnetic field lines around the bar magnet.

(3)

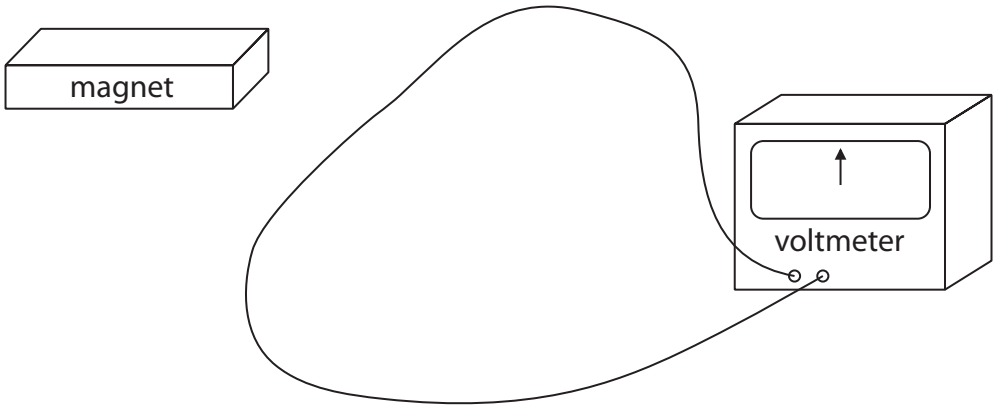


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(b) The diagram shows a loop of wire connected to the terminals of a voltmeter.



Explain why the voltmeter reading changes from zero when the magnet is moved near the loop of wire.

(2)

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(Total for Question 8 = 5 marks)

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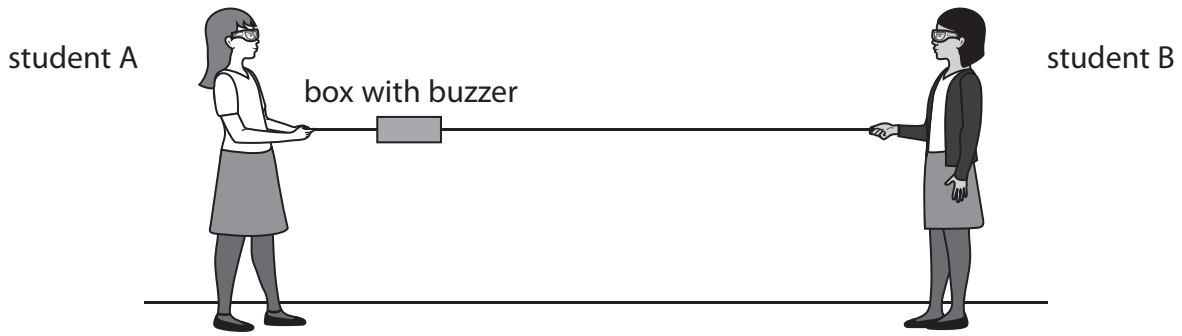
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9 The diagram shows two students holding a piece of string with a box attached.

The box has a buzzer inside and can move along the string.



The buzzer in the box emits a loud sound of constant frequency.

The box moves **away** from student A at a constant speed.

Explain why the sound heard by student A has a different frequency to the sound emitted by the buzzer.

(5)

(Total for Question 9 = 5 marks)

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10 (a) Uranium-235 captures a neutron and undergoes nuclear fission in a chain reaction.

The equation shows a possible nuclear fission reaction.

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{97}_{40}Zr + {}^{135}_{52}Te + x\,{}^{1}_{0}n$$

Calculate x, the number of neutrons released by this fission reaction.

(2)

x = ...

(b) Describe what is meant by a **chain reaction**.

(3)

.....

.....

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.....

(c) Iodine-129 is an isotope found in radioactive waste from nuclear power stations.

Iodine-129 has a half-life of approximately 15 million years.

A sample of iodine-129 has an activity of 72 kBq.

Show that the time required for the sample to have an activity less than 5 kBq is approximately 60 million years.

(3)

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(d) Some radioactive waste from nuclear power stations has a very long half-life.

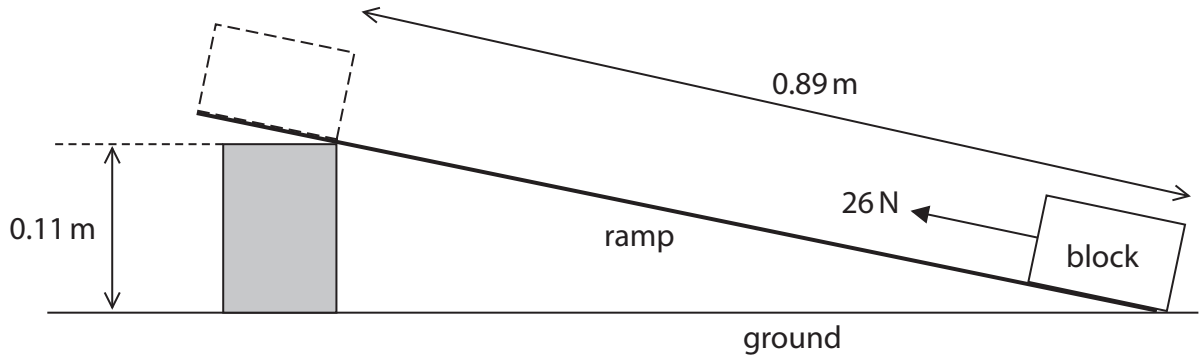
Discuss precautions that must be taken when disposing of this radioactive waste.

(5)

(Total for Question 10 = 13 marks)

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11 A student uses this apparatus to investigate the force needed to pull a block along a ramp.



(a) (i) State the formula linking work done, force and distance moved in the direction of the force.

(1)

(ii) The student pulls the block 0.89 m along the ramp with a force of 26 N.

Show that the work done on the block by the 26 N force is about 23 J.

(2)

(iii) The block has a mass of 1.3 kg and moves vertically upwards 0.11 m.

Calculate the increase in the gravitational potential energy (GPE) store of the block between the bottom and the top of the ramp.

(3)

increase in GPE = ... J

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(iv) Explain why the work done to move the block along the ramp is greater than the increase in the GPE store of the block.

(2)

(b) The student suggests it is better to use a less steep ramp to raise the block through the same vertical height.

Discuss an advantage and a disadvantage of using a less steep ramp.

(4)

(Total for Question 11 = 12 marks)

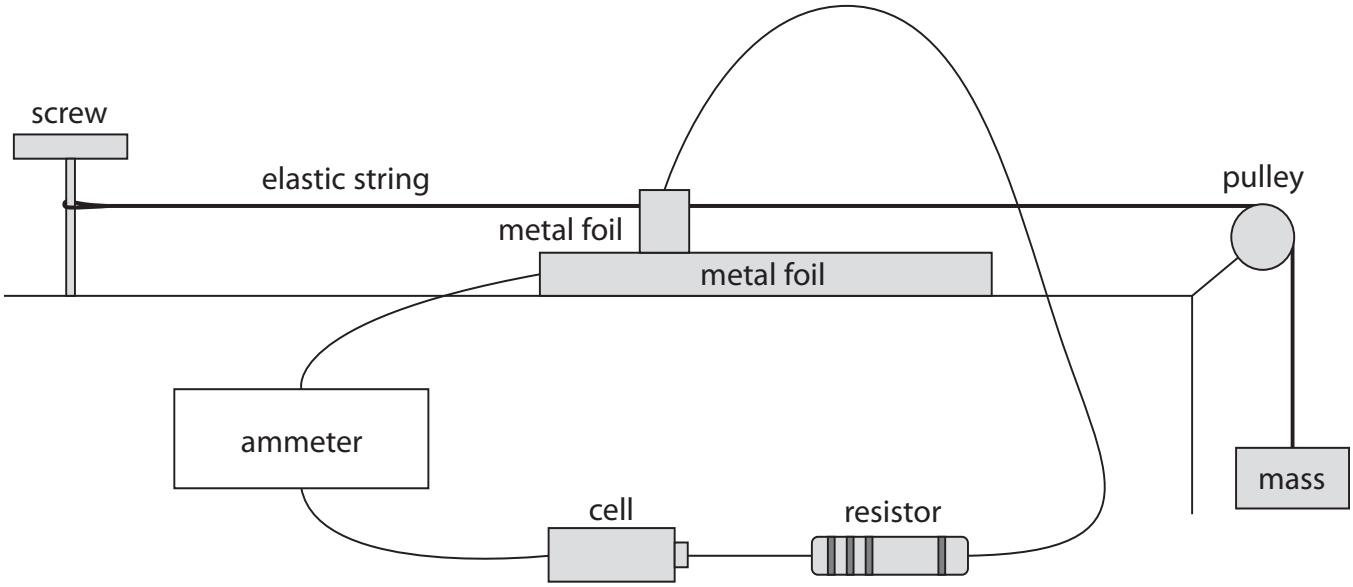
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12 The diagram shows some apparatus used to find the mass of an object.

The two pieces of metal foil act as a variable resistor.

When more mass is added, the elastic string stretches and the small piece of metal foil moves to the right.



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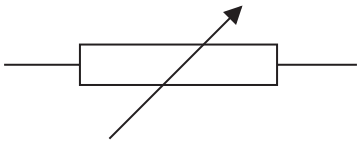
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(a) (i) Draw the circuit diagram for this electrical circuit.

The variable resistor has been drawn for you.

(4)



(ii) Draw a voltmeter on the diagram to measure the voltage of the variable resistor.

(2)

(b) Explain how the voltage across the variable resistor changes if more mass is added to the end of the elastic string.

(4)

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(c) The student extends the investigation by keeping the mass constant and replacing the cell with a variable power supply.

The student measures the current in the circuit for different voltages.

These are the results.

Voltage in V	Current in mA
0.0	0.0
2.0	4.0
4.0	7.0
6.0	11.0
8.0	14.0

(i) State the independent variable in the student's investigation.

(1)

(ii) Plot the student's results on the grid.

(3)

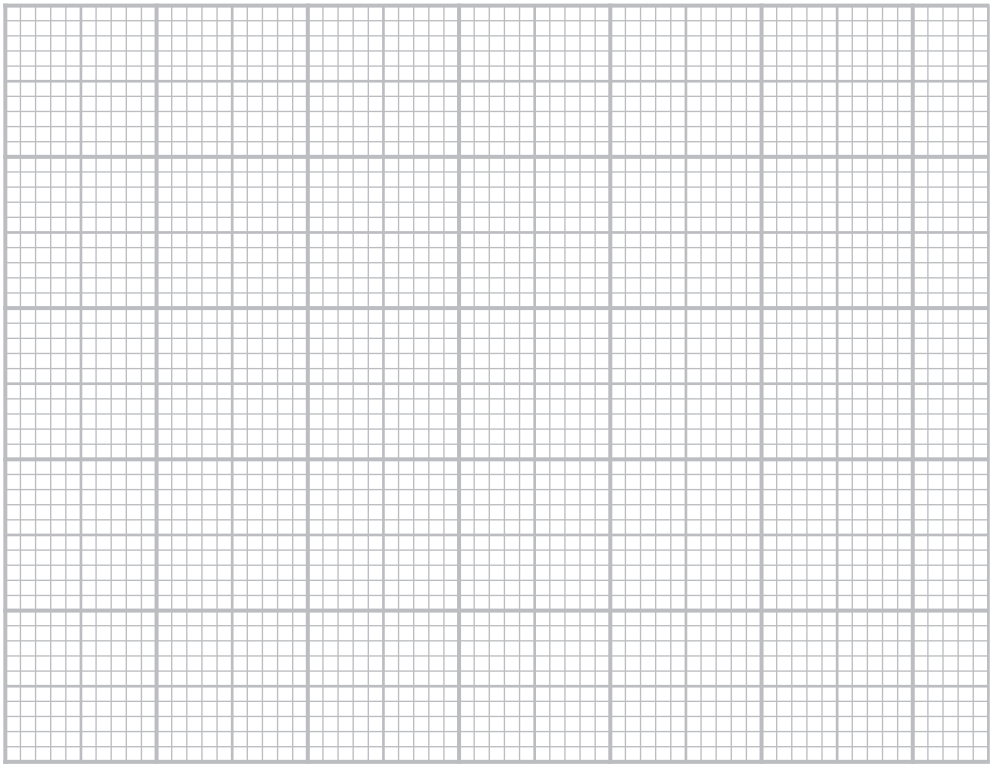
(iii) Draw a line of best fit.

(1)

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(Total for Question 12 = 15 marks)

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