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 **4PH1/1P 4SD0/1P**

Physics

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

You must have:
Ruler, calculator, protractor

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 the 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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Pearson

FORMULAE

You may find the following formulae useful.

energy transferred = current × voltage × time

$$E = I \times V \times t$$

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

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

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

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

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

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

pressure × volume = constant

$$p_1 \times V_1 = p_2 \times V_2$$

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

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

Answer ALL questions.

1 The passage describes the evolution of a star with a mass that is much larger than the mass of the Sun.

Use words or phrases from the box to complete the passage.

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

(6)

chemical	contract	expand	gravitational
kinetic	main sequence	neutron star	nuclear
protostar	supernova	vibrate	white dwarf

Hydrogen atoms in a nebula move towards each other due to the force of gravity.

As the atoms move towards each other, their ..... energy store increases, which increases the temperature. If the temperature becomes high enough, nuclear fusion of hydrogen will start and the star enters the ..... stage of its evolution.

When hydrogen fusion stops in the core of the star, the core of the star will start to ..... . This increases the temperature in a layer surrounding the core. Hydrogen fusion restarts in a layer surrounding the core.

This causes the star to ..... and its surface temperature decreases. The star is now a red super giant. Eventually nuclear fusion stops in the core of the star and the star explodes as a ..... .

The core of the star collapses to form either a ..... or a black hole.

(Total for Question 1 = 6 marks)

2 (a) A speed camera is positioned at the side of a road.

The camera measures the speed of a vehicle on the road to determine whether the vehicle is travelling too fast.

The camera takes two photographs of the vehicle 0.25 s apart.

The photographs are used to measure the distance travelled by the vehicle during this time.

(i) State the formula linking average speed, distance moved and time taken.

(1)

(ii) In the time between the two photographs, the car travels a distance of 6.5 m.

Calculate the average speed of the car.

(2)

average speed = ... m/s

(iii) The speed limit of the road is 80 kilometres per hour.

Determine whether the car is exceeding the speed limit.

(2)

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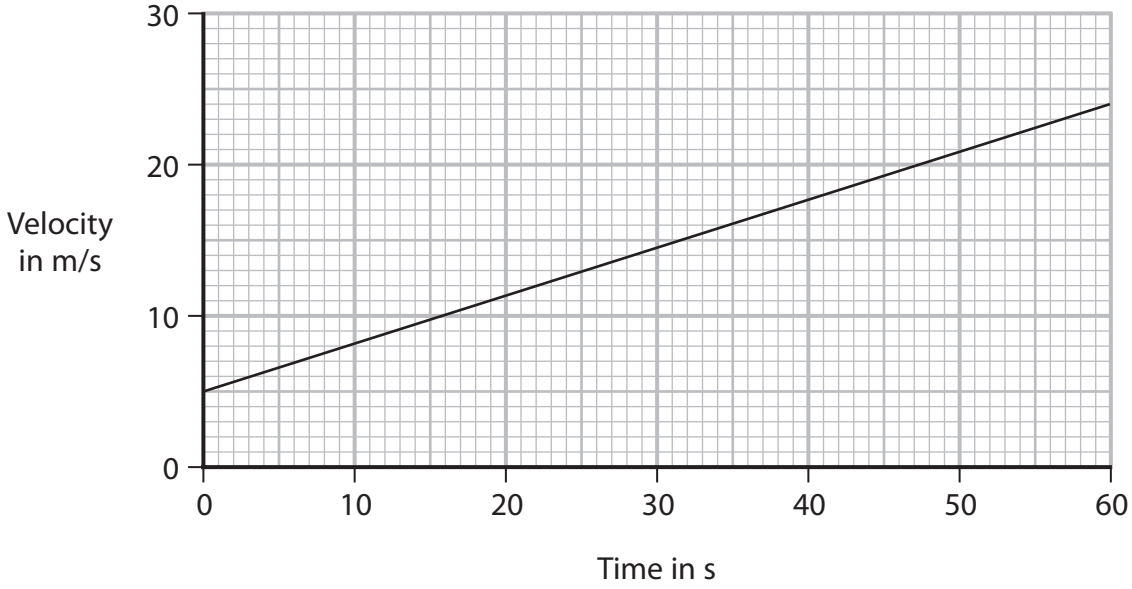
(b) The velocity-time graph shows how the velocity of a lorry changes with time.



(i) Explain how the graph shows that the lorry has a constant acceleration.

(2)

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(ii) State the formula linking acceleration, change in velocity and time taken.

(1)

(iii) Calculate the acceleration of the lorry.

(3)

acceleration = ... m/s^2

(Total for Question 2 = 11 marks)

3 The photograph shows a mains-operated, decorative lamp, X.

Lamp X has seven identical bulbs that are connected in series.

(a) Give a disadvantage of connecting the bulbs in series.

(1)

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(b) Suggest an advantage of connecting the bulbs in series.

(1)

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(c) Each bulb has a working resistance of 390 Ω.

The voltage across each bulb is 33 V.

(i) State the formula linking voltage, current and resistance.

(1)

(ii) Calculate the current in each bulb.

(3)

current = ... A

(iii) Calculate the energy transferred to lamp X when it is used for 2.5 hours.

(4)

energy transferred = ... J

(d) Another decorative lamp, Y, uses five of the same 390 Ω bulbs connected in series.

Both lamps are mains operated.

Explain how the brightness of a single bulb in lamp Y compares to the brightness of a single bulb in lamp X.

(3)

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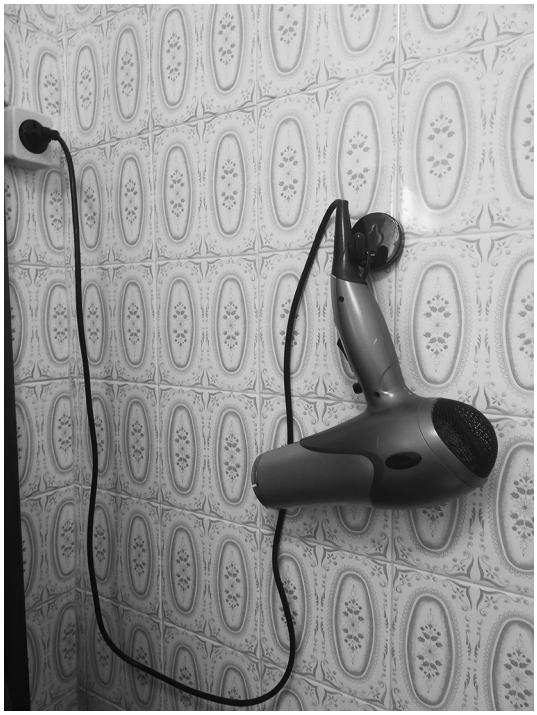
(Total for Question 3 = 13 marks)

4 The photograph shows a hair dryer plugged into the mains supply.

The hair dryer contains a fuse.



© Cristina Bernardo/Shutterstock

(a) State which wire in the hair dryer should be in series with the fuse.

(1)

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(b) The fuse is an electrical safety feature used in mains-operated domestic appliances.

State two other electrical safety features that can be used in mains-operated domestic appliances.

(2)

1 .....

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2 .....

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(c) The hair dryer has a current of 9.6 A.

The mains supply voltage is 230 V.

(i) State the formula linking power, current and voltage.

(1)

(ii) Calculate the power of the hair dryer.

Give the unit.

(3)

power = ... unit .....

(iii) The hair dryer contains a coil of wire which is used to heat air passing through the hair dryer.

Explain why the coil of wire heats up when there is a current in it.

(3)

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(d) Explain how a fuse protects a domestic appliance.

(3)

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(Total for Question 4 = 13 marks)

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5 A teacher uses a radioactive source containing atoms of the isotope radium-226.

(a) Give a safety precaution that would reduce the teacher's exposure to radiation when working with the radioactive source.

(1)

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(b) Radium-226 can be represented using the symbol

$$^{226}_{88}Ra$$

How many neutrons are in the nucleus of an atom of radium-226?

(1)

- ☒ **A** 88
- ☒ **B** 138
- ☒ **C** 226
- ☒ **D** 314

(c) The teacher investigates the type of radiation emitted from the radioactive source.

(i) Give the name of a piece of apparatus that detects ionising radiation.

(1)

.....

(ii) The teacher finds that the radiation emitted from the radioactive source is not detected when the detector is more than 5 cm away from the source.

State the type of radiation emitted by the radioactive source.

(1)

.....

(d) The number of radium-226 atoms in the source decreases over time, with a half-life of 1600 years.

(i) State what is meant by the term **half-life**.

(2)

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(ii) The radioactive source contains 2.66×10^{21} atoms of radium-226.

Approximately how many atoms of radium-226 will remain in the source after 800 years?

(1)

☒ **A** 0.67×10^{21}

☒ **B** 1.33×10^{21}

☒ **C** 1.88×10^{21}

☒ **D** 2.66×10^{21}

(Total for Question 5 = 7 marks)

6 When a rubber ball is dropped it hits the floor and bounces.

Design an investigation to determine how the temperature of the rubber ball affects the maximum height the ball reaches after it bounces.

In your answer, refer to

- how to change the temperature of the ball
- the variables that need to be controlled
- how to obtain high-quality data

You may draw a labelled diagram to support your answer.

(6)

(Total for Question 6 = 6 marks)

7 Very strong magnets can be made using the element neodymium.

(a) Diagram 1 shows parts of two neodymium magnets, X and Y, when they are held close together.

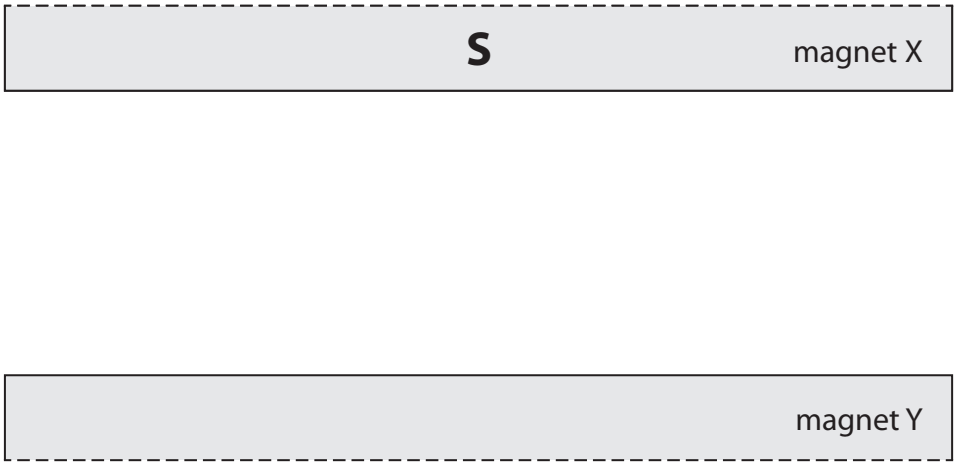

Diagram 1

A uniform magnetic field is produced in the space between the magnets.

Diagram 1 shows the south pole of magnet X.

Complete diagram 1 by drawing the uniform magnetic field and labelling the pole on magnet Y.

(3)

(b) Diagram 2 shows another neodymium magnet being used to lift an iron ball from a table.

The iron ball is shown at the instant it leaves the surface of the table.

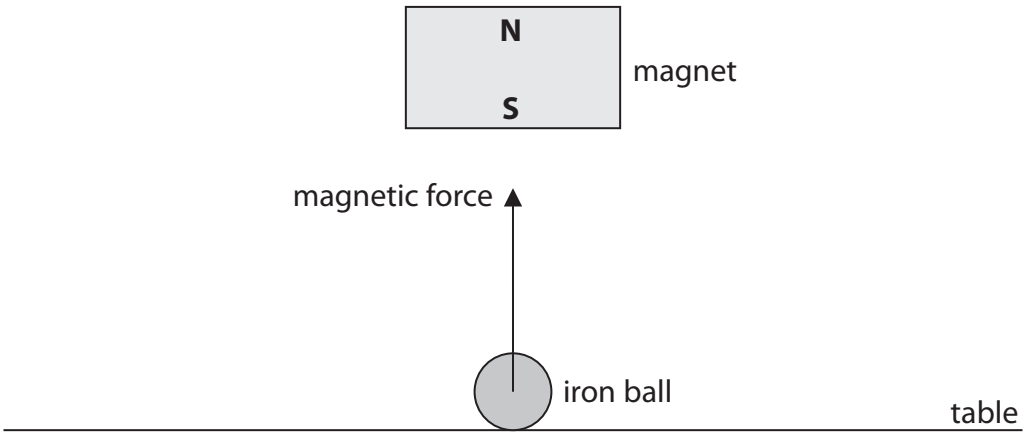

Diagram 2

(i) Explain why the iron ball experiences an upward magnetic force.

(2)

(ii) The iron ball experiences an upward resultant force at the instant shown in diagram 2.

Draw a labelled arrow on diagram 2 to show the weight of the iron ball.

(1)

(iii) State the formula linking weight, mass and gravitational field strength.

(1)

(iv) At the instant shown in diagram 2, the resultant force acting on the iron ball is 124 mN and the magnetic force is 165 mN.

Calculate the mass of the iron ball.

(4)

mass of iron ball = ... kg

(v) Explain why the resultant force acting on the iron ball increases as the iron ball moves towards the magnet.

(2)

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(Total for Question 7 = 13 marks)

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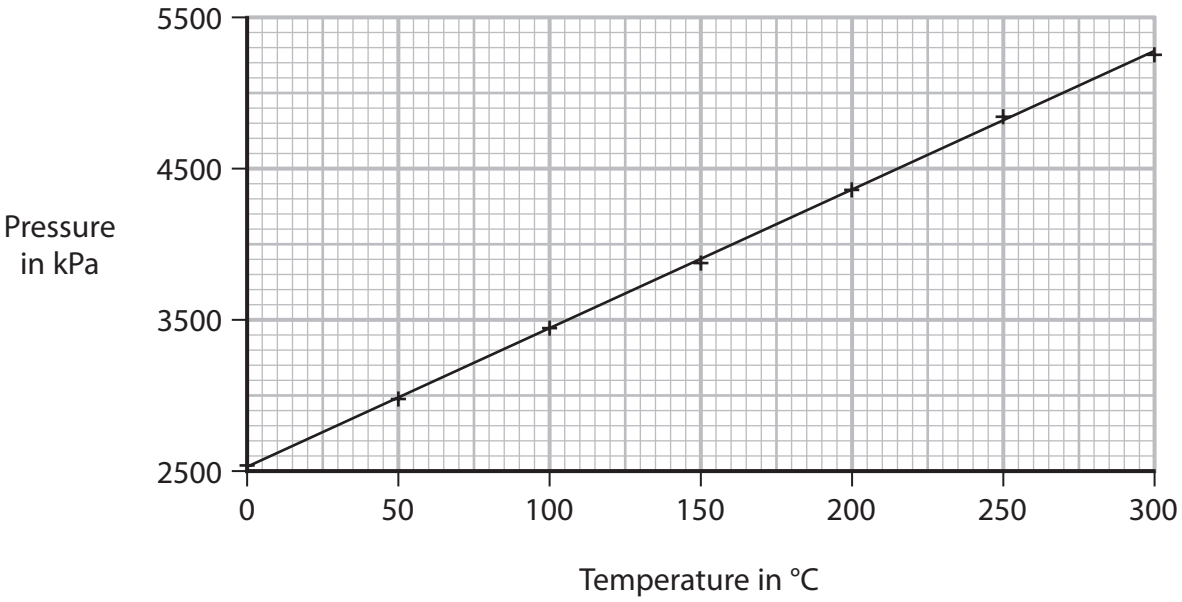
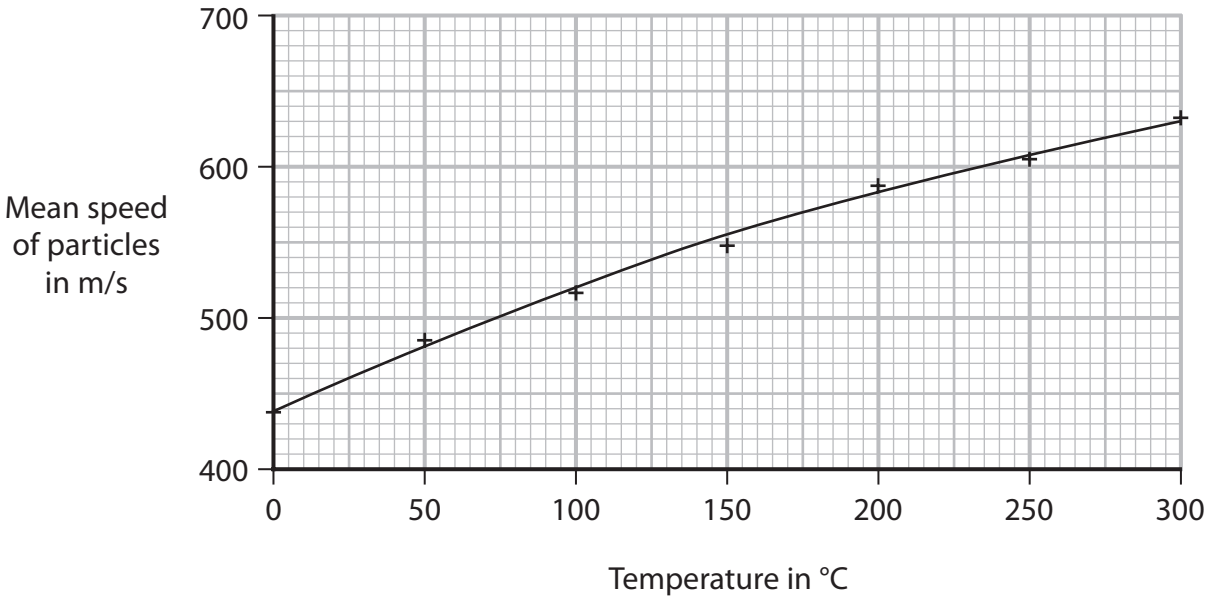
8 A student uses a computer simulation to investigate the motion of particles in a gas.

He records the pressure of the gas and the mean speed of the particles in the gas at different temperatures.

The graphs show his results.



Graph 1



Graph 2

(a) Give a reason why the student does not start the *y*-axis scale from zero on either of his graphs.

(1)

(b) Describe the relationships shown by the graphs.

(3)

(c) Explain why the value of temperature chosen in the simulation should not decrease below – 273 °C.

(2)

(d) The student then calculates the kinetic energy of a single gas particle at each temperature.

(i) Using the curve of best fit on graph 2, determine the mean speed of a gas particle when the gas temperature is 100 °C.

(1)

mean speed = ... m/s

(ii) The mass of a single gas particle is 5.3×10^{-26} kg.

Calculate the average kinetic energy of a gas particle when the temperature of the gas is 100 °C.

(3)

kinetic energy = ... J

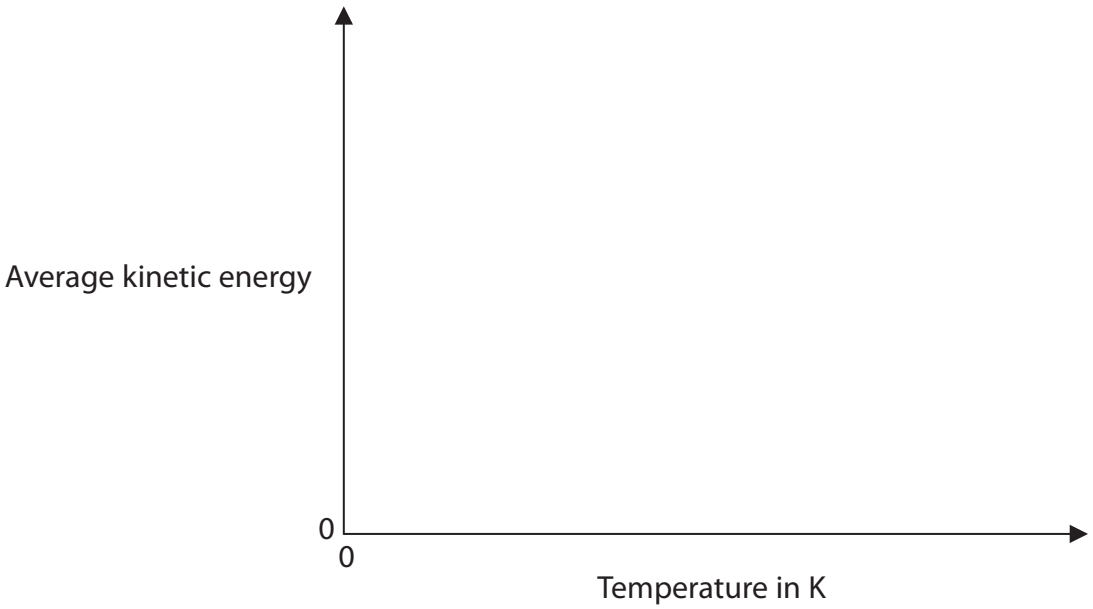
(iii) Calculate the temperature of the gas in kelvin when its temperature is 100 °C.

(1)

temperature = ... K

(iv) On the axes, sketch a graph of the average kinetic energy of the gas particles against temperature in kelvin.

(2)



(Total for Question 8 = 13 marks)

9 A student does an investigation to determine the refractive index of a block made from flint glass.

(a) She directs a ray of red light at the block, as shown in diagram 1.

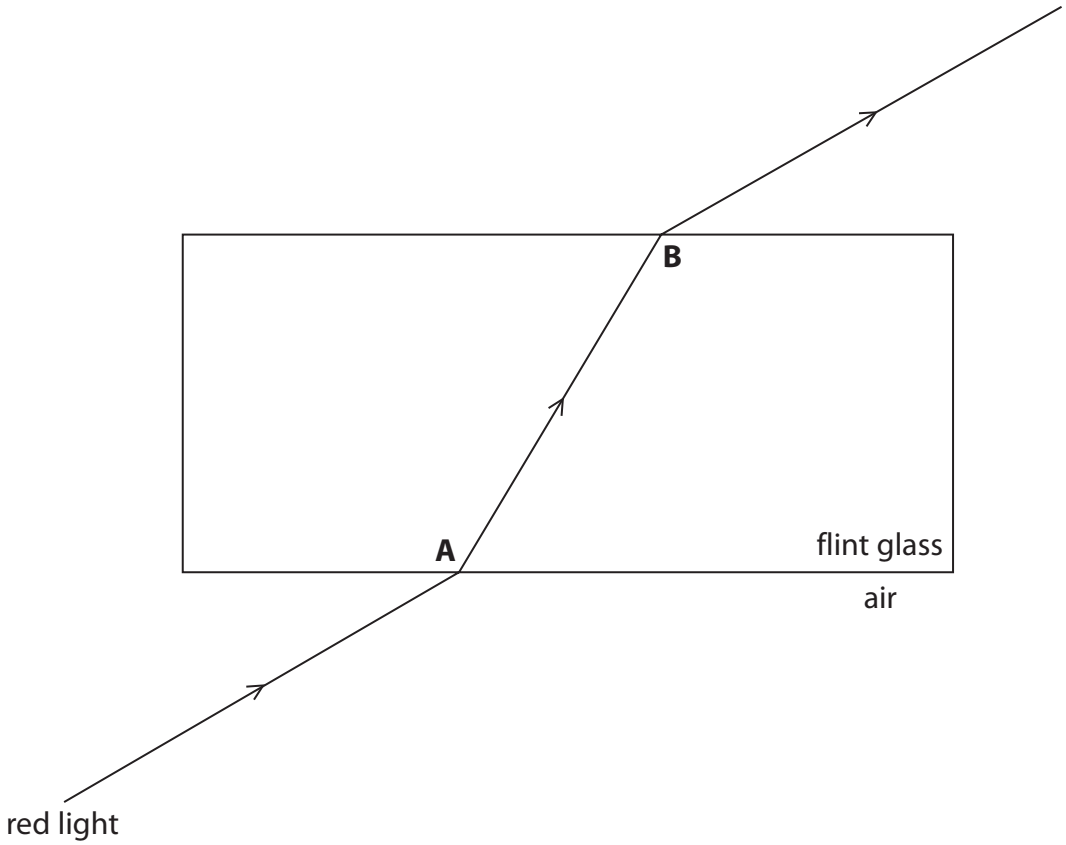


Diagram 1

(i) Some of the light is reflected from the surface of the block at point A.

On diagram 1, draw this reflected ray of light.

(1)

(ii) Use a protractor to determine the angle of incidence and the angle of refraction of the red light at point A on diagram 1.

(2)

angle of incidence = ... degrees

angle of refraction = ... degrees

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

(1)

(iv) Calculate the refractive index of the glass for red light.

(2)

refractive index = ...

(v) Describe how the student could improve her investigation to obtain a more reliable value of the refractive index.

(3)

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(b) The student replaces the red light with a blue light.

Diagram 2 shows a ray of blue light directed at point A, at the same angle of incidence as the previous ray of red light.

The dashed lines on diagram 2 show the previous path of the ray of red light.

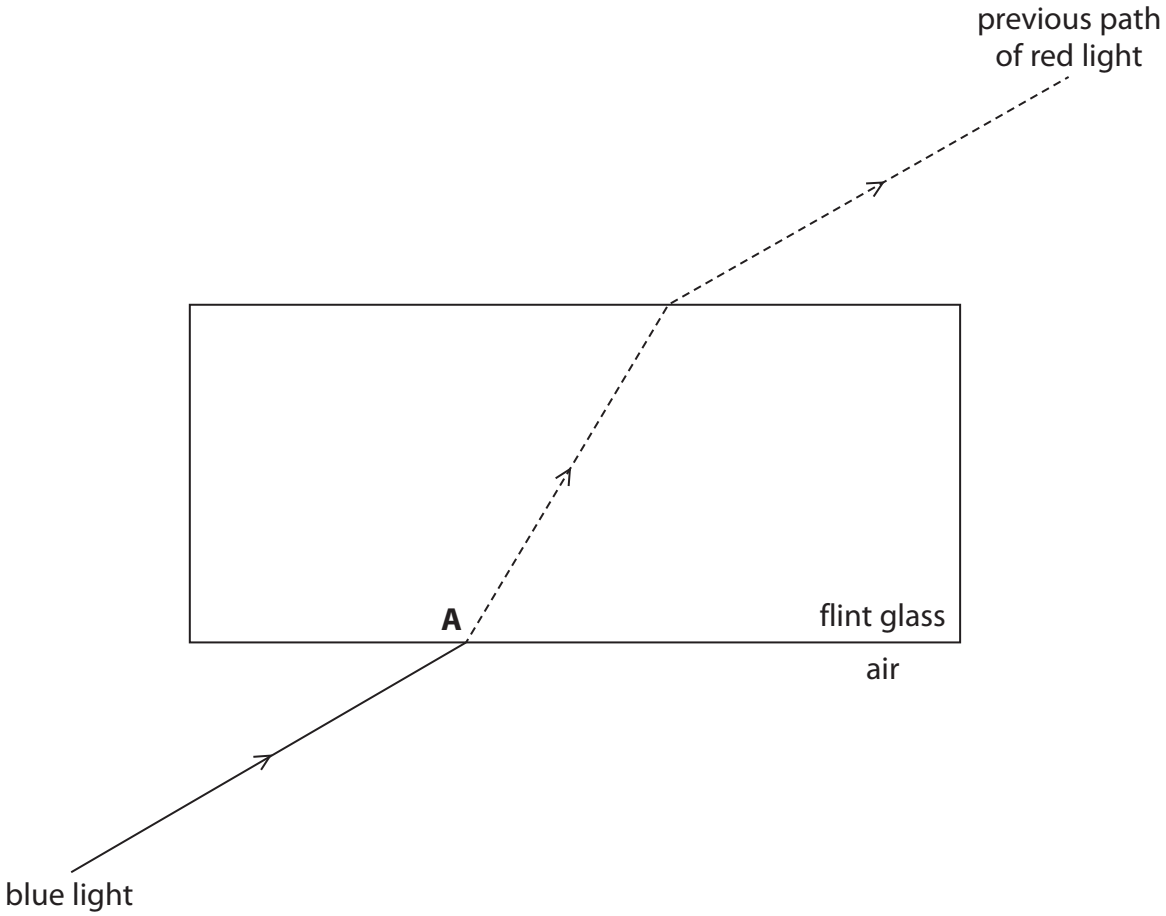

Diagram 2

The refractive index of flint glass for blue light is higher than the refractive index of flint glass for red light.

Complete diagram 2 by drawing the path of blue light from point A until it passes into air.

(3)

(Total for Question 9 = 12 marks)

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10 The photograph shows a large hurdle on an athletics track.

(a) The bar of the hurdle is made of wood and is painted black and white.

The temperature of the hurdle increases when the Sun shines on it.

Explain which part of the bar reaches the highest temperature.

(2)

(b) The air near the bar receives energy by heating.

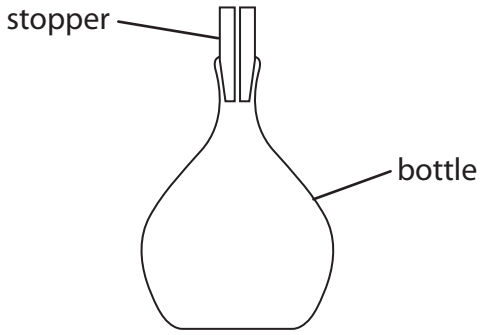
Explain how a convection current is formed in the air near the bar.

(4)

(Total for Question 10 = 6 marks)

11 A student uses a bottle and a stopper to find the density of an unknown liquid.

The stopper fits tightly into the bottle and has a small diameter hole through it.



(a) This is the student's method.

- use a balance to find the mass of the bottle and stopper
- completely fill the bottle with water
- insert the stopper and dry the outside of the bottle
- use the balance to find the mass of the full bottle and stopper

These are the student's results.

mass of empty bottle and stopper = 63.4 g

mass of full bottle and stopper = 112.9 g

Use the student's results to determine the volume of the water in the bottle.

Give your answer to three significant figures.

[density of water = 0.998 g/cm^3]

(4)

volume = ... cm^3

(b) The student empties the bottle and then dries it.

He refills the bottle with the unknown liquid.

He measures the mass of the full bottle and stopper as 143.8 g.

Calculate the density of the unknown liquid.

(3)

density of unknown liquid = ... g/cm^3

(c) Another student uses a measuring cylinder to find the volume of the unknown liquid.

Discuss the advantages and disadvantages of using each method to find the volume of the unknown liquid.

(3)

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(Total for Question 11 = 10 marks)

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