Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4503/02

PHYSICS

PHYSICS 3
HIGHER TIER

A.M. THURSDAY, 23 May 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**14**	
2.	**13**	
3.	**5**	
4.	**7**	
5.	**6**	
6.	**7**	
7.	**8**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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 in this booklet.

INFORMATION FOR CANDIDATES

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

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2. In calculations you should show all your working.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answer to questions **2***(b)*(i) and **7***(b)*.

Equations

V_1 = voltage on the primary coil V_2 = voltage on the secondary coil N_1 = number of turns on the primary coil N_2 = number of turns on the secondary coil	$\frac{V_1}{V_2} = \frac{N_1}{N_2}$
power = voltage × current	$P = VI$
$\text{speed} = \frac{\text{distance}}{\text{time}}$	
u = initial velocity v = final velocity t = time a = acceleration x = displacement	$v = u + at$ $v^2 = u^2 + 2ax$ $x = ut + \frac{1}{2}at^2$ $x = \frac{1}{2}(u + v)t$
momentum = mass × velocity	$p = mv$
$\text{kinetic energy} = \frac{\text{mass} \times \text{speed}^2}{2}$	$KE = \frac{1}{2}mv^2$
$\text{pressure} = \frac{\text{force}}{\text{area}}$	$p = \frac{F}{A}$
	$T / \text{K} = \theta / ^\circ\text{C} + 273$
p = pressure V = volume T = kelvin temperature	$\frac{pV}{T} = \text{constant}$
$\text{density} = \frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{v}$
	$E = mc^2$

SI multipliers

Prefix	Multiplier
p	10^{-12}
n	10^{-9}
μ	10^{-6}
m	10^{-3}

Prefix	Multiplier
k	10^{3}
M	10^{6}
G	10^{9}
T	10^{12}

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Turn over.

Examiner only

Answer **all** *questions.*

1. *(a)* Complete the sentence below. [2]

The law of conservation of momentum states that in a collision or explosion .....

.....

.....

(b) (i) Two cars of equal mass, 800 kg, collide. Before the collision, car **B** is at rest while car **A** has a constant velocity of 15 m/s. In the questions that follow, ignore the effects of friction.

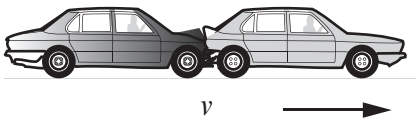
Before collision

Use an equation from page 2 to calculate the momentum of car **A** before the collision. [2]

Momentum = ... kg m/s

(ii) After the collision, the two cars are stuck together.

After collision



Use the equation:

$$\text{velocity} = \frac{\text{momentum}}{\text{mass}}$$

to calculate the velocity v of the cars after the collision. [3]

Velocity = ... m/s

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(iii) During the collision, car **A** exerts a force of 16000 N to the right on car **B**. What force does car **B** exert on car **A** during the collision? [2]

.....

(c) Use an equation from page 2 to calculate the loss of kinetic energy in the original collision. [2]

Loss of kinetic energy = ... J

(d) Suppose both cars had been travelling towards each other at the same speed.

(i) What would their velocity be after a head-on collision if they stuck together on impact? [1]

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(ii) Explain your answer. [2]

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14

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Turn over.

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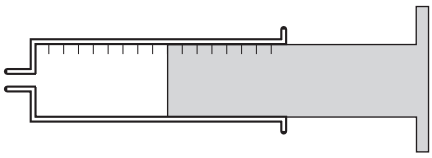
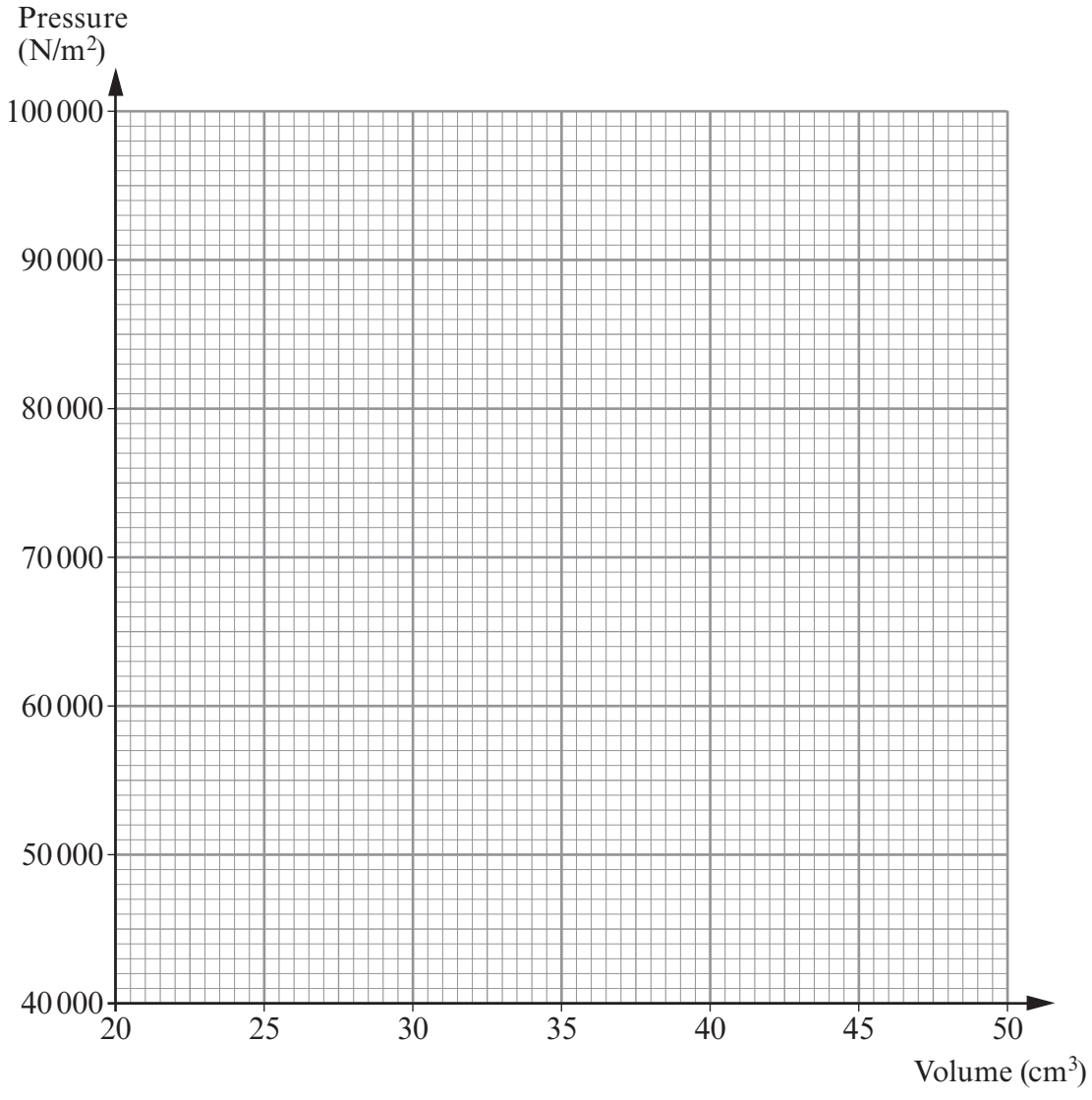
2. A fixed mass of gas is kept at constant temperature in a syringe as shown below.



The gas in the syringe is expanded (made larger) by slowly pulling the plunger out. The table shows the pressure exerted by the gas at different volumes.

Volume (cm^3)	20	25	35	40	50
Pressure (N/m^2)	100 000	80 000	57 000	50 000	40 000

(a) (i) Use the information in the table to **plot a graph** on the grid below. [3]



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(ii) Describe the relationship between the volume and pressure of the gas. [2]

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(iii) Use your graph to write down the pressure of the gas when its volume is 30 cm^3. [1]

..... N/m^2

(b) (i) The gas is at constant temperature. Explain in terms of molecular motion and collisions why the pressure changes in the way it does when the volume is increased. (You may want to refer to the diagram on the previous page in your answer.) [6 QWC]

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(ii) State how the motion of a gas molecule would be affected if the temperature of the gas is increased. [1]

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13

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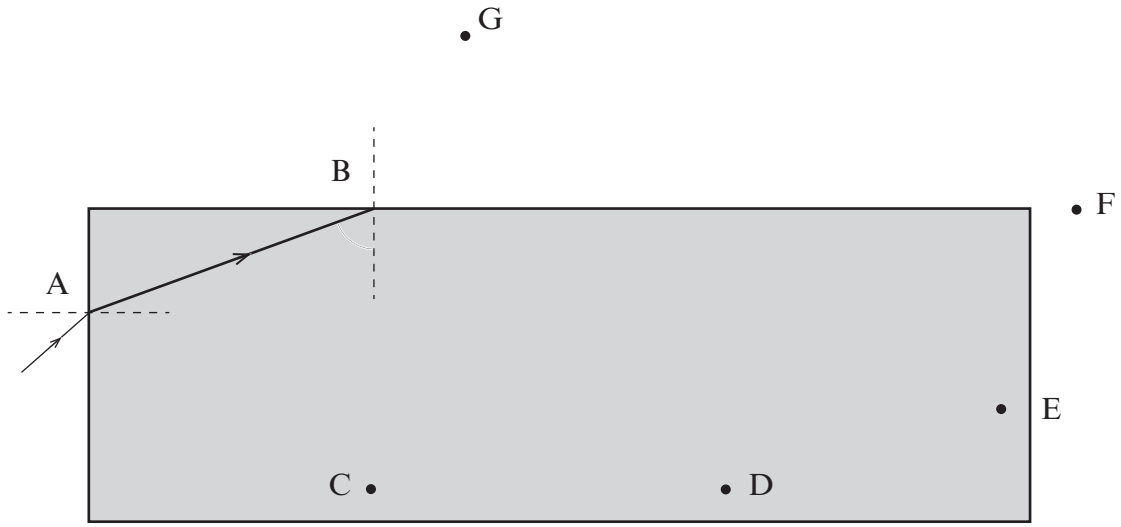
3. The diagram shows a ray of light passing from air, and then into a glass block. The critical angle for glass is 42°.



(a) The ray of light enters the glass block at A in the diagram. Write the name for this change of direction **and** state why the ray follows the path shown. [2]

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(b) (i) At point B the ray strikes the glass surface at an angle of 70°. After striking the surface, it goes on to **one of** the points C, D, E, F or G. **Draw the correct ray on the diagram**. [1]

(ii) Give **two** reasons why the ray changes direction in the way you have chosen at B. [2]

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5

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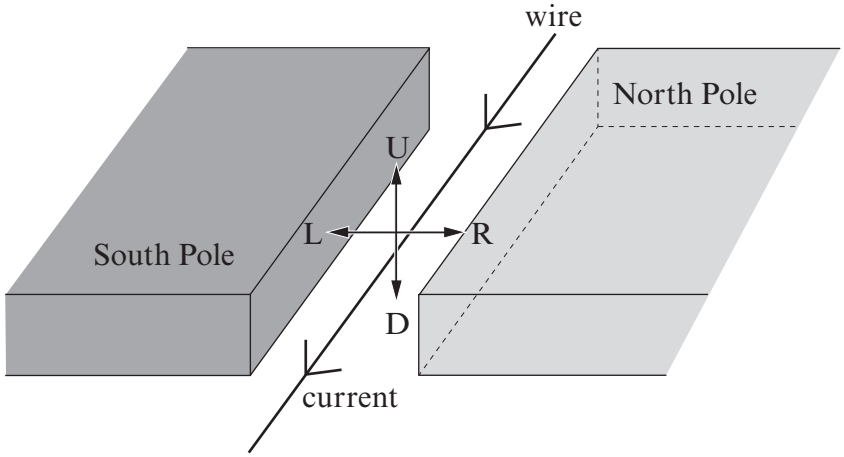
4. The diagram shows a wire being moved in a magnetic field between two permanent magnets.



(a) By using one of the letters on the diagram, state the direction in which the wire needs to move so that the current is induced in it in the direction shown. [1]

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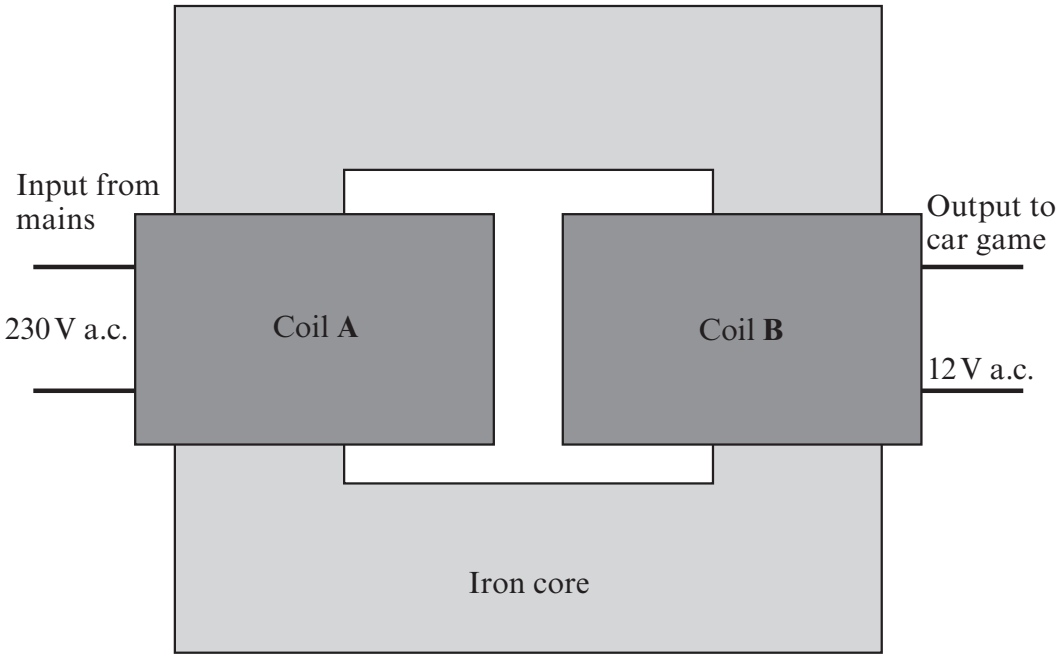
(b) A model racing car game uses a transformer. It changes a 230 V input to a 12 V output by using two coils **A** and **B**.



(i) Which coil, **A** or **B** should have the bigger number of turns? Give a reason for your answer. [1]

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(ii) State why the input voltage has to be alternating for the transformer to work. [1]

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(iii) One function of the iron core is to increase the strength of the magnetic field inside the primary coil. State **one** other function that it has. [1]

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(iv) Briefly state why an output voltage is produced by the transformer. [1]

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(v) Coil **A** has 18 400 turns. Use an equation from page 2 to calculate the number of turns in coil **B**. [2]

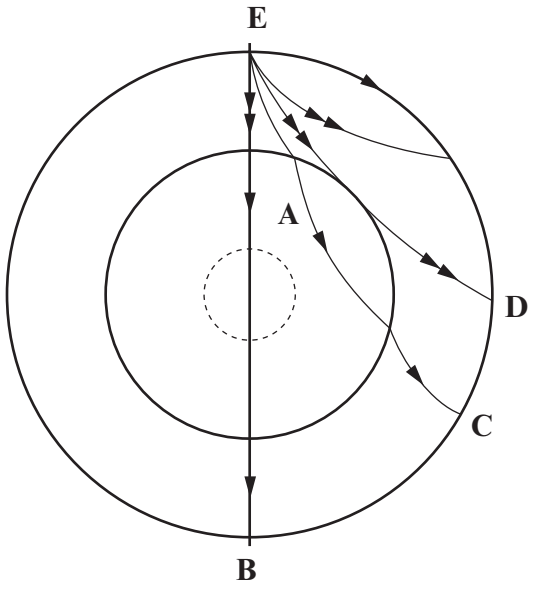
Number of turns = ...

7

Turn over.

Examiner only

5. The diagram shows how seismic waves from an earthquake at point **E** travel through the Earth. These waves travel through the Earth and are detected by scientists elsewhere.



(a) State which seismic waves (if any) are detected:

(i) between points **B** and **C** [1]

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(ii) between points **C** and **D**. [1]

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(b) Explain how the Earth's structure affects the path of the seismic wave that passes from **E** to **A** on the diagram. [4]

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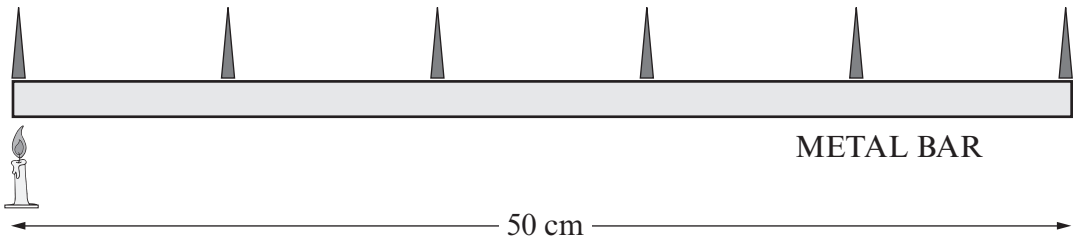
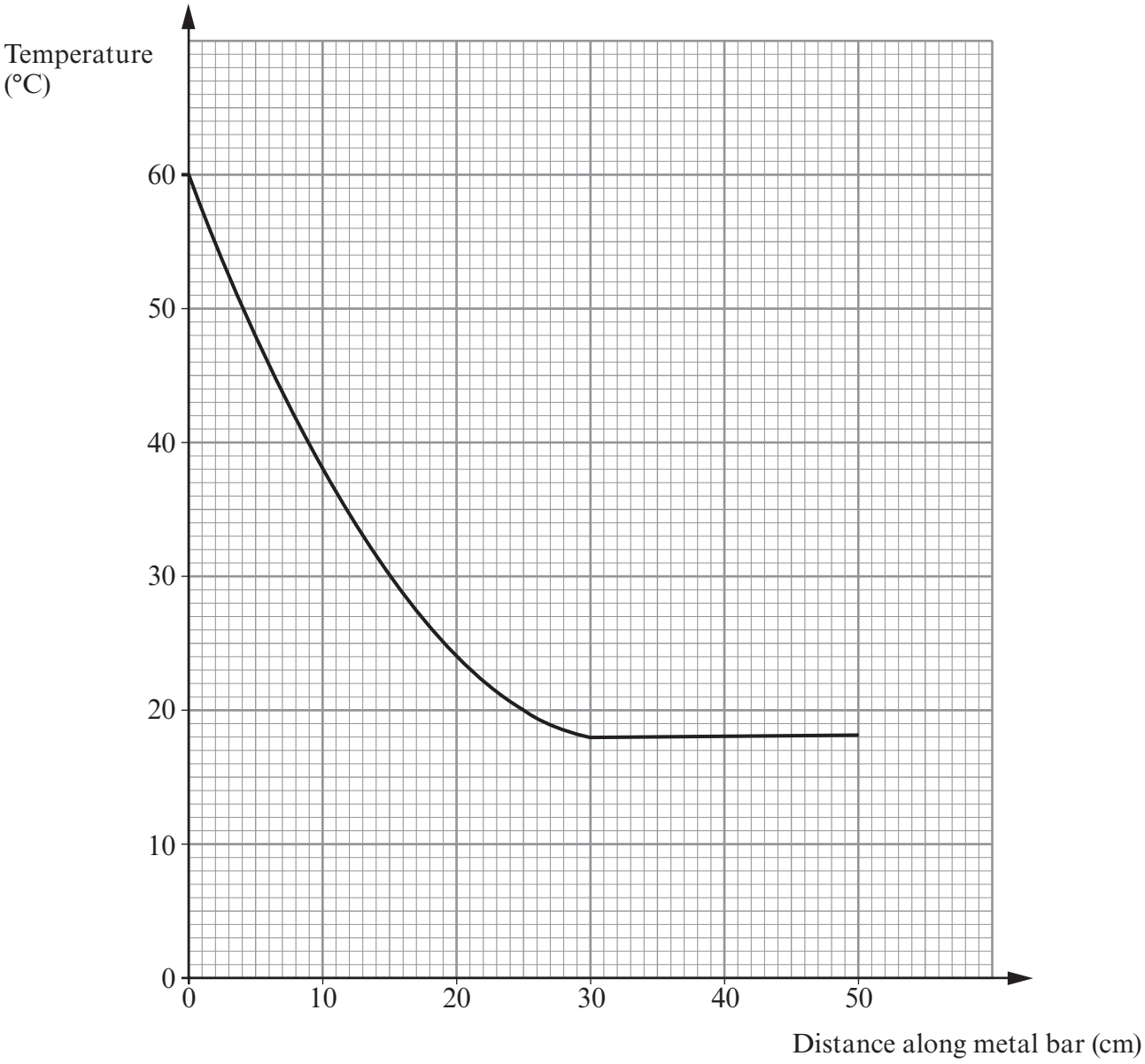
Examiner only

6. The diagram shows a metal bar which is heated by a candle at one end and has temperature probes attached to it along its length.

Six temperature probes connected to a computer



The graph shows how the temperature falls with distance along the metal bar from the heated end.



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(a) (i) Use the graph to calculate the mean temperature drop per cm for the first 20 cm along the metal bar. [2]

..... °C/cm

(ii) The mean temperature drop per cm for the first 10 cm along the bar is 2.2 °C/cm. State how the temperature drop per cm **at the heated end** of the metal bar could be found from the graph. [1]

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(b) **Draw** on the graph a line to show how the temperature change along the bar would look for a metal bar which conducts less well. [2]

(c) Explain, in terms of particles, why metals are better conductors of heat than non-metals. [2]

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7

TURN OVER FOR QUESTION 7

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7. *(a)* The Sun is in the main sequence stage of its life. It derives its energy from the conversion of hydrogen to helium. The forces acting within it are balanced.
Each second, the energy released from the Sun is about 4×10^{26} J.

Use an equation from page 2 to calculate the mass of the Sun that is converted into energy each second. [speed of light = 3×10^8 m/s] [2]

Mass = ... kg

(b) Explain how the Sun will produce elements heavier than helium after it leaves the main sequence stage of its life. [6 QWC]

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END OF PAPER