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Surname		Other names	
Pearson Edexcel Level 3 GCE		Centre Number	Candidate Number
Physics Advanced Subsidiary Paper 1: Core Physics I			
Tuesday 24 May 2016 – Morning		Paper Reference	
Time: 1 hour 30 minutes		8PH0/01	
You may need a ruler.			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 in Sections A and B.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or how they follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Check your answers if you have time at the end.
- You are advised to show your working in calculations including units where appropriate.

Turn over ►

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SECTION A

Answer ALL questions.

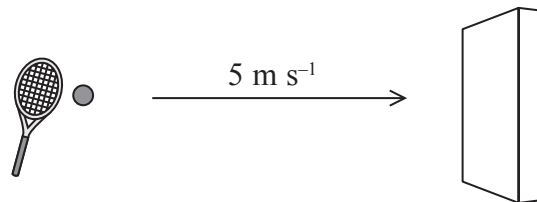
All multiple choice questions must be answered with a cross ☒ in the box for the correct answer from A to D. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The winner of a 400 m race must have the greatest

- ☒ A acceleration.
- ☒ B average speed.
- ☒ C instantaneous speed.
- ☒ D maximum speed.

(Total for Question 1 = 1 mark)

2 A tennis ball of mass 0.06 kg moves towards a wall at a velocity of 5 m s^{-1} as shown.



The tennis ball hits the wall perpendicularly and rebounds at the same speed.

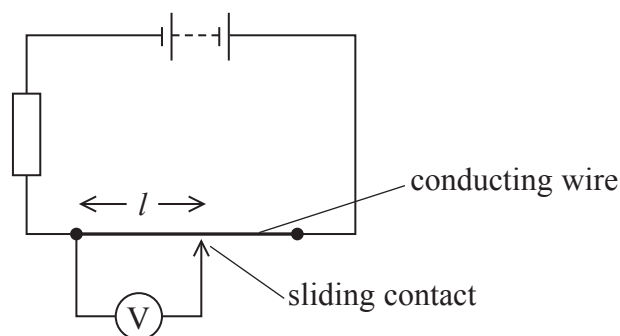
What is the change in momentum of the ball?

- ☒ A 0.60 kg m s^{-1}
- ☒ B 0.30 kg m s^{-1}
- ☒ C $-0.30 \text{ kg m s}^{-1}$
- ☒ D $-0.60 \text{ kg m s}^{-1}$

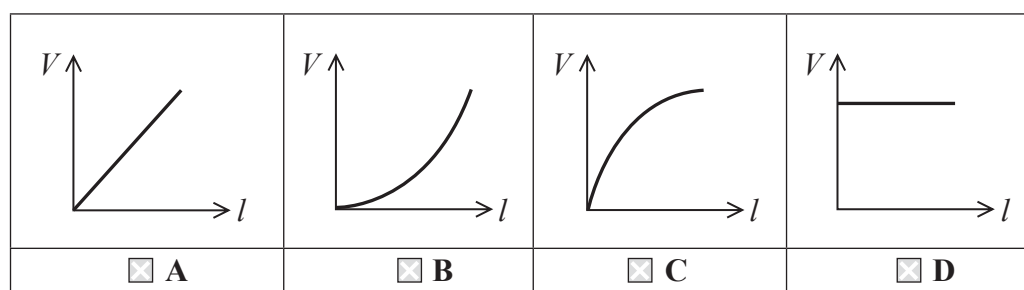
(Total for Question 2 = 1 mark)



- 3 A student set up the circuit below and moved a sliding contact along a uniform conducting wire. The student recorded the potential difference V across each length of wire l under test.



Which graph correctly shows how V varies with l ?



(Total for Question 3 = 1 mark)

- 4 Which of the following correctly defines electromotive force?
- ☒ A Force per unit charge to move a charge across a component.
 - ☒ B Force per unit charge to move a charge around a circuit.
 - ☒ C Work done per unit charge to move a charge across a component.
 - ☒ D Work done per unit charge to move a charge around a circuit.

(Total for Question 4 = 1 mark)

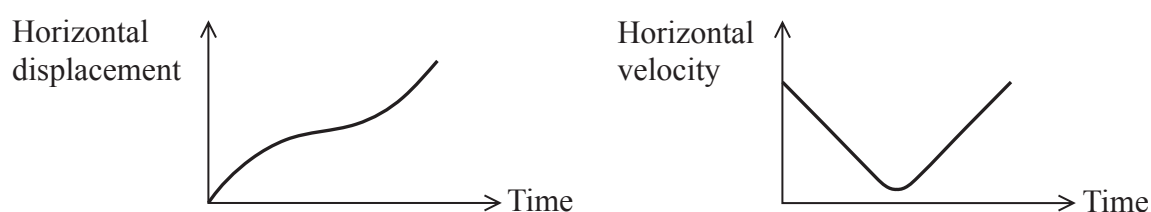


5 Which of the following is the unit for tension expressed in SI base units?

- ☐ A N
- ☐ B N s
- ☐ C kg m s⁻¹
- ☐ D kg m s⁻²

(Total for Question 5 = 1 mark)

6 The graphs shown represent the displacement-time and velocity-time graphs for the horizontal component of the motion of a ball.



Which of the following situations could produce this motion of the ball?

- ☐ A Rolling down one ramp and then rolling up a second ramp.
- ☐ B Rolling down a ramp then along the floor.
- ☐ C Rolling up one ramp and down a second ramp.
- ☐ D Rolling up a ramp and rolling back down the same ramp.

(Total for Question 6 = 1 mark)



- 7 A pilot wishes to fly due east. A wind is blowing in a northerly direction.

The direction of north is as shown.



Which of the following correctly shows the direction the plane should point?



☐ A



☐ B



☐ C

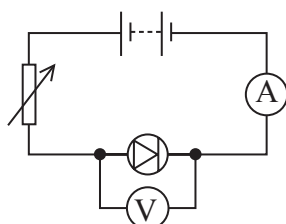


☐ D

(Total for Question 7 = 1 mark)



- 8 A student carried out an experiment to investigate the current-potential difference characteristics of a diode using the circuit below.



He plotted the graph of potential difference V on the y -axis against the corresponding current I on the x -axis.

Which graph would be obtained by the student?

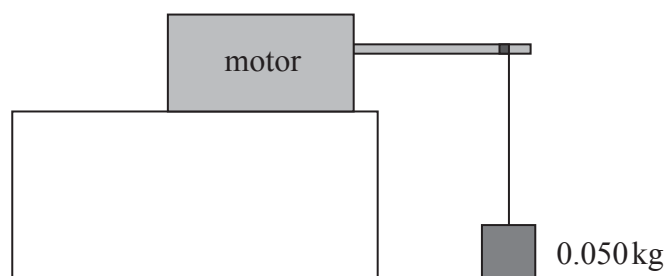
☒ A	
☒ B	
☒ C	
☒ D	

(Total for Question 8 = 1 mark)



- 9 A motor lifts a block of mass 0.050 kg at a constant velocity of 0.40 m s^{-1} .

The current in the motor is 85 mA and the potential difference across it is 3.0 V .



Calculate the efficiency of the motor.

(3)

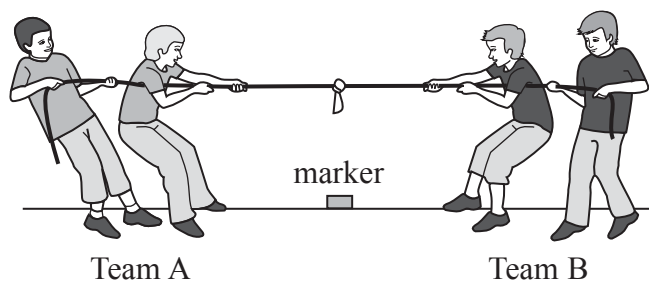
Efficiency of the motor =

(Total for Question 9 = 3 marks)



P 4 9 8 4 5 A 0 7 2 8

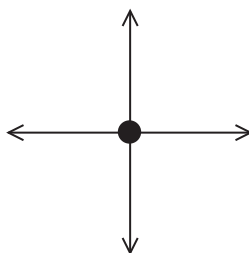
10 In a game of tug-of-war two teams of children pull on opposite ends of a rope. The team that pulls the other team over a marker wins the game.



- (a) Initially Team A and Team B are stationary.

Add labels to the free-body force diagram for the child at the end of the rope for Team A at this instant.

(3)



- * (b) Team B wins by pulling Team A over the marker.

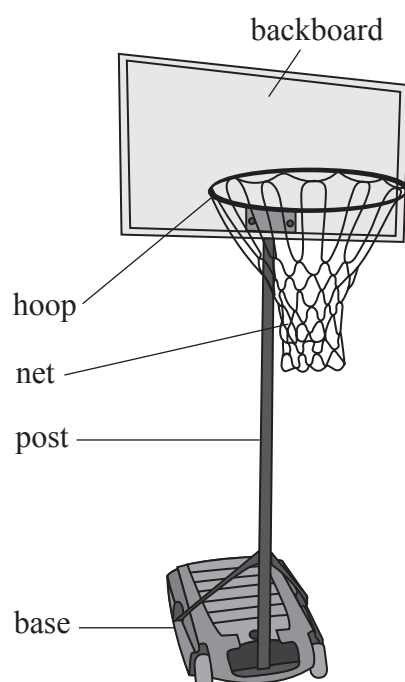
By considering the forces on the children and on the rope explain, in terms of Newton's laws, the process by which Team A loses the game.

(6)

(Total for Question 10 = 9 marks)



- 11 A portable basketball set has a base and a post arrangement. The post arrangement consists of a post, backboard, hoop and net. The base can be filled with water to increase stability.



- (a) The base has a capacity of 85.0 litres.

Show that the maximum weight of the base is about 870 N.

mass of 1.00 litre of water = 1.00 kg

mass of base when empty = 3.50 kg

(2)

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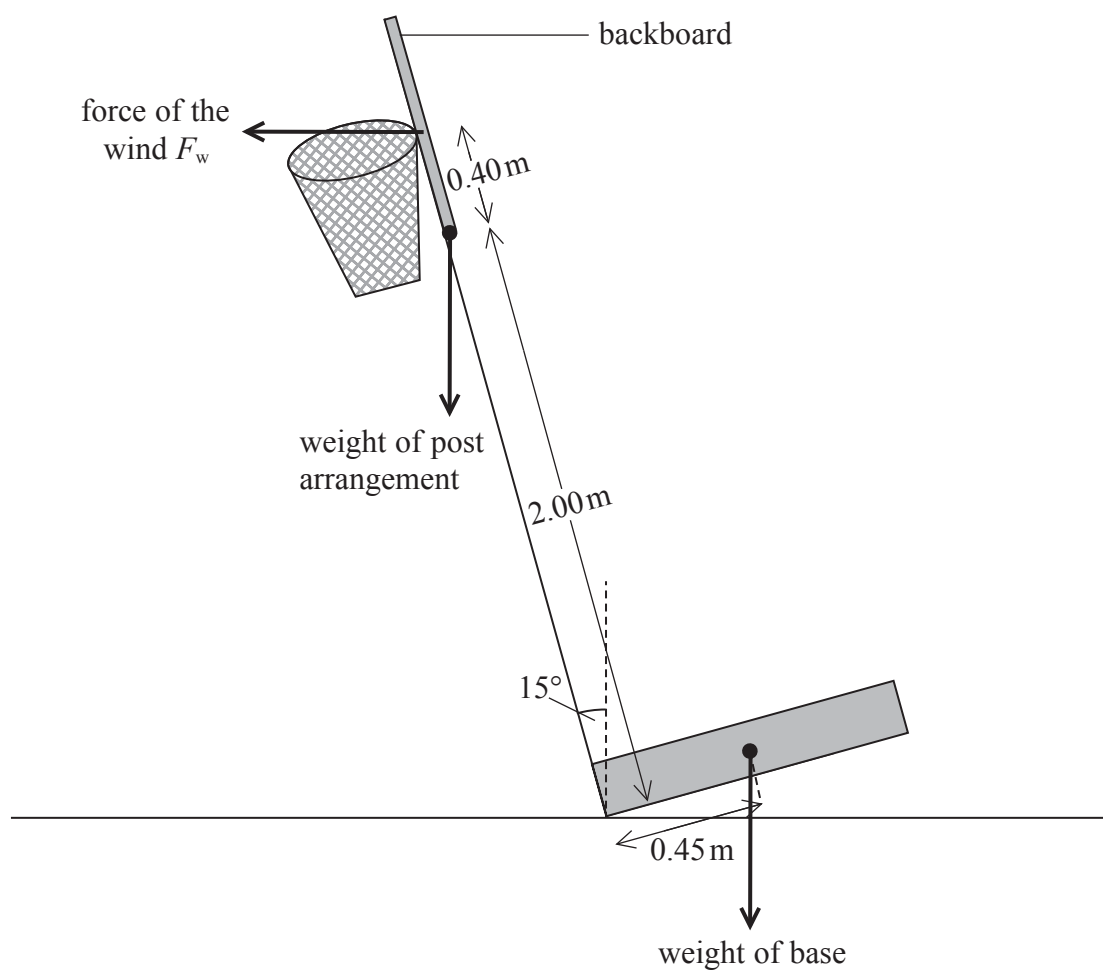
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- (b) Due to the large area of the backboard, the basketball set may topple over when the wind blows.



Calculate the minimum force of the wind F_w that will cause the basketball set to be blown over when it is at the angle shown. Ignore the effect of the wind on the base.

weight of post arrangement = 27.0 N

(5)

Minimum force of the wind $F_w =$



- (c) The base is filled with sand instead of water. The density of sand is greater than the density of water.

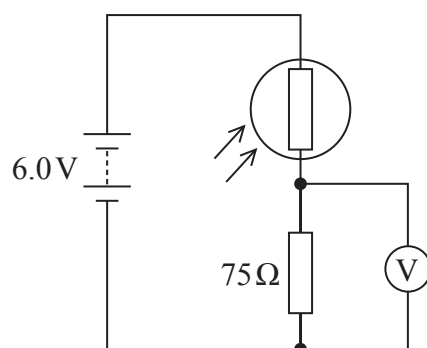
State and justify what would happen to the value of F_w calculated in part (b).

(3)

(Total for Question 11 = 10 marks)



- 12 A student set up a circuit containing a light dependent resistor (LDR) in series with a fixed resistor as shown.



- (a) As the student moved a lamp towards the circuit she observed the potential difference (p.d.) changing across the fixed resistor.

With reference to the electrons in the LDR explain this observation.

(5)

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- (b) When the lamp was at a distance of 10 cm from the LDR, the reading on the voltmeter was 2.4 V.

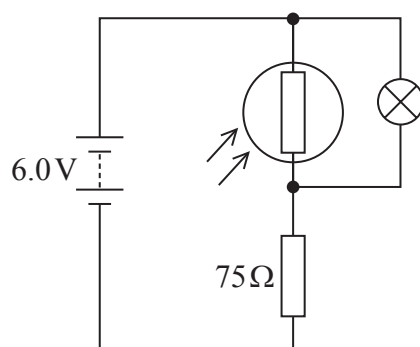
Calculate the resistance of the LDR at this distance.

(3)

Resistance of the LDR =

- (c) The student wants to modify the circuit so that a light bulb lights up when the room goes dark.

She modifies the circuit as shown below. When working normally the resistance of the light bulb is $3\ \Omega$ and the p.d. across it is 3 V.



Explain, without further calculation, whether this circuit would work as intended.

(3)

(Total for Question 12 = 11 marks)



- 13 Road trains are used in Australia to transport freight across large, flat areas of the country. They consist of a minimum of three trailers connected to a cab unit to pull them along.



- (a) The braking distance of a road train travelling at 15 m s^{-1} is 70 m.

Assuming that the same braking force is applied at all speeds, show that the braking distance of a road train when travelling at 25 m s^{-1} is about 190 m.

(3)

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- (b) A car accelerates uniformly at 3.7 m s^{-2} as it passes a stationary road train.

The initial speed of the car is 30 m s^{-1} and it reaches the speed limit of 130 km h^{-1} as it passes the front of the cab.

Calculate the length of the road train.

(3)

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Length of the road train =



(c) One region of Australia decided to trial the removal of the speed limit on some roads.

The following statements were made in an online forum discussing this issue.

Comment

“If a car was going faster, it would have better fuel economy. A lot of modern cars have engines that are more efficient at 200 km h^{-1} than at 100 km h^{-1} .”

Reply

“You confuse efficiency with fuel consumption. You cannot get better fuel economy at higher speeds.”

Justify the statement in the reply.

(3)

(Total for Question 13 = 9 marks)



- 14 A mobile phone is powered by a lithium-ion battery. The information shown is taken from the battery.

3.82 V
6.91 W h

- (a) (i) The watt-hour (W h) is an alternative unit for energy.

Show that the maximum energy that can be stored by the battery is about 25 kJ.

$$1 \text{ W h} = 3600 \text{ J}$$

(1)

- (ii) Calculate the maximum charge that the battery can provide.

(2)

Maximum charge =

- (iii) The mobile phone 'runs out of charge'.

Calculate the minimum time taken, in hours, for the battery to fully recharge.

charging current = 0.90 A

(3)

Minimum time = hours



- (b) The mobile phone in part (a), when purchased, was supplied with a charging plug marked 1 A, 5 V. The mobile phone owner lost the original charging plug and replaced it with a charging plug marked 0.5 A, 5 V.



original charging plug
1A, 5V



replacement charging plug
0.5A, 5V

By evaluating the information given, discuss the suitability of using the replacement charging plug for this mobile phone. Include references to possible benefits, disadvantages and risks associated with using the replacement charging plug.

(4)

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(Total for Question 14 = 10 marks)

TOTAL FOR SECTION A = 60 MARKS



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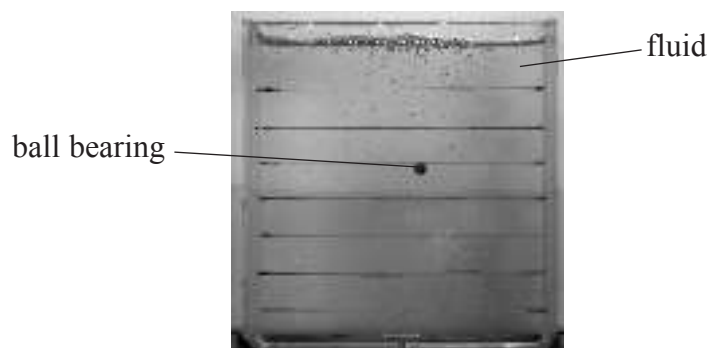
SECTION B

Answer ALL questions.

- 15 A student carried out an experiment to identify a fluid from its viscosity at room temperature.

A ball bearing of diameter d was released at the top of a container containing the fluid. The motion of the ball bearing was recorded using a video camera and hence the terminal velocity v of the ball bearing was determined.

This was repeated for ball bearings of increasing diameter with the fluid at a constant temperature.



- (a) To determine the viscosity η , the student used the equation $v = \frac{d^2 g (\rho_b - \rho_f)}{18\eta}$

where ρ_b = density of the material of the ball bearing

ρ_f = density of the fluid.

Explain why a graph of v on the y -axis and d^2 on the x -axis should be a straight line through the origin.

(3)

- (b) The student obtained the following data.

$d / 10^{-3} \text{ m}$	$d^2 / 10^{-6} \text{ m}^2$	$v / 10^{-3} \text{ m s}^{-1}$
1.0	1.0	2.3
2.0	4.0	11
3.0	9.0	23
4.0	16.0	39
5.0	25.0	64



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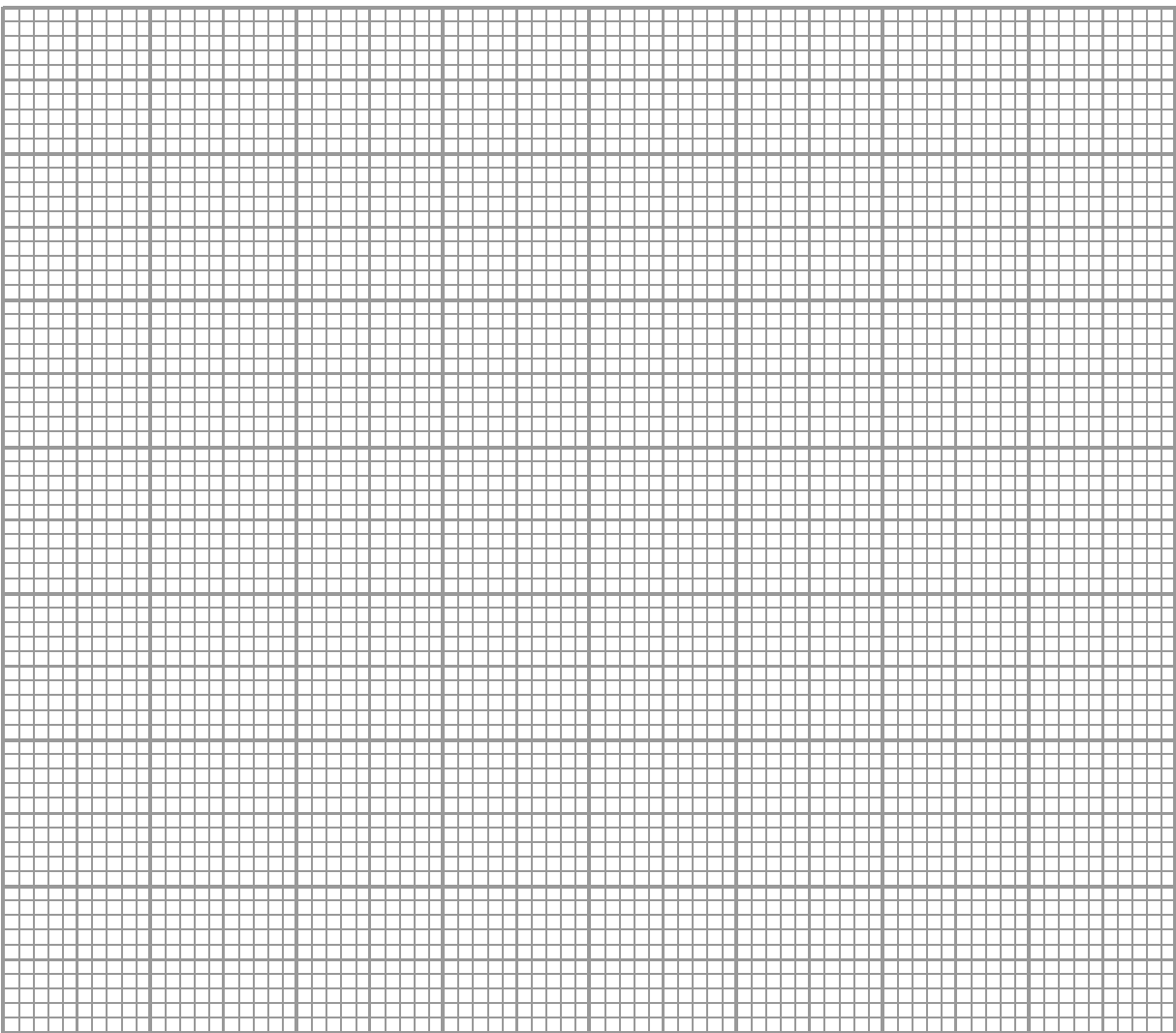
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Plot the graph of v against d^2 .

(4)



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(4)

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- 16** In 2010, Andre Geim and Konstantin Novoselov were awarded the Nobel Prize in Physics for producing, identifying and studying graphene.

Graphene is a form of carbon which exists only as a single atomic layer of graphite. It has a breaking stress of 130 GPa compared to 0.5 GPa for steel. Some scientists claim that graphene is the strongest material ever measured.

- (a) Explain why graphene, despite its greater strength, is unlikely to replace steel in many applications.

(2)

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P 4 9 8 4 5 A 0 2 1 2 8

- (b) Graphite used in pencils consists of many layers of carbon. It can be assumed that a pencil deposits approximately 100 layers of carbon atoms when drawn across a piece of paper.

A student carried out an experiment to determine the resistivity of the graphite in a pencil.

A line of length 0.200m and width 0.50mm was drawn on a piece of paper. An ohmmeter was then used to measure the resistance of the graphite line.



Calculate the resistivity of graphite.

$$\text{resistance} = 1.029 \times 10^6 \, \Omega$$

$$\text{diameter of carbon atom} = 1.4 \times 10^{-10} \, \text{m}$$

(4)

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Resistivity of graphite =



- (c) Photocells traditionally use silicon to generate electricity using visible light. Research demonstrates that unlike silicon, graphene is able to respond at all wavelengths and releases multiple electrons as it absorbs one photon.

Deduce why it would be an advantage to use graphene in photocells to generate electricity.

(3)

(Total for Question 16 = 9 marks)

TOTAL FOR SECTION B = 20 MARKS

TOTAL FOR PAPER = 80 MARKS

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List of data, formulae and relationships

Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to Earth's surface)
Electron charge	$e = -1.60 \times 10^{-19} \text{ C}$	
Electron mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to Earth's surface)
Planck constant	$h = 6.63 \times 10^{-34} \text{ J s}$	
Speed of light in a vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	

Mechanics

Kinematic equations of motion

$$s = \frac{(u + v)t}{2}$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Forces

$$\Sigma F = ma$$

$$g = \frac{F}{m}$$

$$W = mg$$

$$\text{moment of force} = Fx$$

Momentum

$$p = mv$$

Work, energy and power

$$\Delta W = F\Delta s$$

$$E_k = \frac{1}{2}mv^2$$

$$\Delta E_{\text{grav}} = mg\Delta h$$

$$P = \frac{E}{t}$$

$$P = \frac{W}{t}$$

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy output}}$$

$$\text{efficiency} = \frac{\text{useful power output}}{\text{total power output}}$$

Electric circuits

Potential difference

$$V = \frac{W}{Q}$$

Resistance

$$R = \frac{V}{I}$$

Electrical power and energy

$$P = VI$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$W = VIt$$

Resistivity

$$R = \frac{\rho l}{A}$$

Current

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nqvA$$



Materials

Density

$$\rho = \frac{m}{V}$$

Stokes' law

$$F = 6\pi\eta r v$$

Hooke's law

$$F = k\Delta x$$

Pressure

$$p = \frac{F}{A}$$

Young modulus

$$\text{Stress } \sigma = \frac{F}{A}$$

$$\text{Strain } \varepsilon = \frac{\Delta x}{x}$$

$$E = \frac{\sigma}{\varepsilon}$$

Elastic strain energy

$$\Delta E_{\text{el}} = \frac{1}{2} F \Delta x$$

Waves and Particle Nature of Light

Wave speed

$$v = f\lambda$$

Speed of a transverse wave on a string

$$v = \sqrt{\frac{T}{\mu}}$$

Intensity of radiation

$$I = \frac{P}{A}$$

Power of a lens

$$P = \frac{1}{f}$$

$$P = P_1 + P_2 + P_3 + \dots$$

Thin lens equation

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

Magnification for a lens

$$m = \frac{\text{image height}}{\text{object height}} = \frac{v}{u}$$

Diffraction grating

$$n\lambda = d \sin \theta$$

Refractive index

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$n = \frac{c}{v}$$

Critical angle

$$\sin C = \frac{1}{n}$$

Photon model

$$E = hf$$

Einstein's photoelectric equation

$$hf = \phi + \frac{1}{2}mv_{\text{max}}^2$$

de Broglie wavelength

$$\lambda = \frac{h}{p}$$



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