Centre No.						Paper Reference	Surname	Other names
Candidate No.						6 7 3 5 / 2 A	Signature	

Edexcel GCE

Physics

Advanced Level

Unit Test PHY5 Practical Test
Group 1

Tuesday 23 May 2006 – Morning

Time: 1 hour 30 minutes

For Examiner's use only
For Team Leader's use only

Question numbers	Leave blank
A	
B	
C	
Total	

Supervisor's data and comments		
B	Tick if help was given in setting up circuit. (Give details below)	
Comments		

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, other names and signature.

PHY5 consists of questions A, B and C. Each question is allowed 20 minutes plus 5 minutes writing-up time. There is a further 15 minutes for writing-up at the end. The Supervisor will tell you which experiment to attempt first.

Write all your results, calculations and answers in the spaces provided in this question booklet.

In calculations you should show all the steps in your working, giving your answer at each stage.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets.

The total mark for this paper is 48.

The list of data, formulae and relationships is printed at the end of this booklet.

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Question 1A

(a) (i) Measure the length l and the width w of the sheet of paper labelled Part (a).

$l =$ ....

$w =$ ....

The paper has a mass per unit area of 80 g m $^{-2}$. Calculate the mass of the sheet of paper.

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(3)

(ii) Determine the thickness, t, of the sheet of paper.

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Use your measurements to calculate the density of the paper.

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(4)

(b) (i) You are provided with a strip of paper and a clip, suspended from a clamp stand. The pen is to act as a pointer and the pin in the cork is to act as a reference point.

Twist the lower clip by about 45° and release it carefully so that it performs rotational oscillations about a vertical axis.

Determine the period of oscillation T_1.

....

....

Explain how you used the pin in the cork to improve the accuracy of your readings.

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(3)

(ii) Replace the strip with the one from the bench. Take care to ensure that the edge of each clip lines up with the marks on the paper.

Twist the lower clip by about 45° and release it carefully.

Determine the period of oscillation T_2.

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(2)

(iii) Measure the distance l_1 between the lines on the shorter strip of paper.

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Measure the distance l_2 between the lines on the longer strip of paper.

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Calculate the ratio of T_2/T_1.

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Calculate the ratio of l_2/l_1.

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Assuming that the experimental uncertainty in each of T_1 and T_2 is 5% and that the uncertainty in l_1 and l_2 is negligible, discuss whether the suggestion that $T_2/T_1 = l_2/l_1$ is valid.

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(4)

(Total 16 marks)

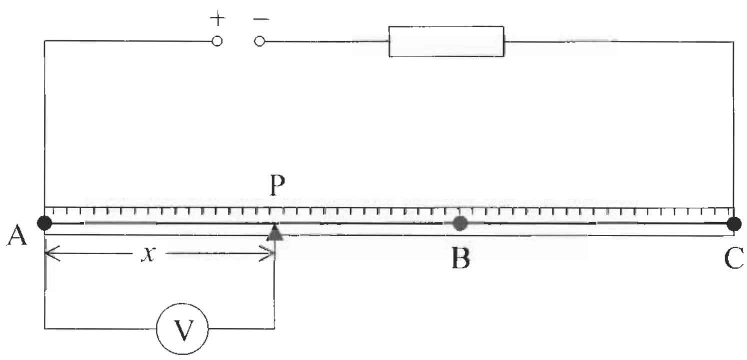
Leave blank

Q1A

Leave blank

Question 1B

(a) Set up the circuit as shown in the diagram. The two resistance wires AB and BC, joined at B, are attached to the metre rule. Plug into the crocodile clips at the 0 cm and 100 cm marks to make the connections labelled A and C as shown in the diagram. A 4 mm plug is to be used to make a contact P with the wire. Before switching on the power supply have your circuit checked by the Supervisor. You will be allowed a short time to correct any faults, but if you are unable to set up the circuit the Supervisor will set it up for you. You will lose only 2 marks for this.



(2)

Use the 4 mm plug to make a contact P at about the 50 cm mark and record the distance AP, labelled x. Record also the reading V on the voltmeter.

x = ...

V = ...

(b) (i) You are to take readings of V for different values of x, the distance between A and P. Use the 4 mm plug to make a contact P at different points along the wire AB. Record your readings for V and x below. Switch off the power supply after you have taken your readings.

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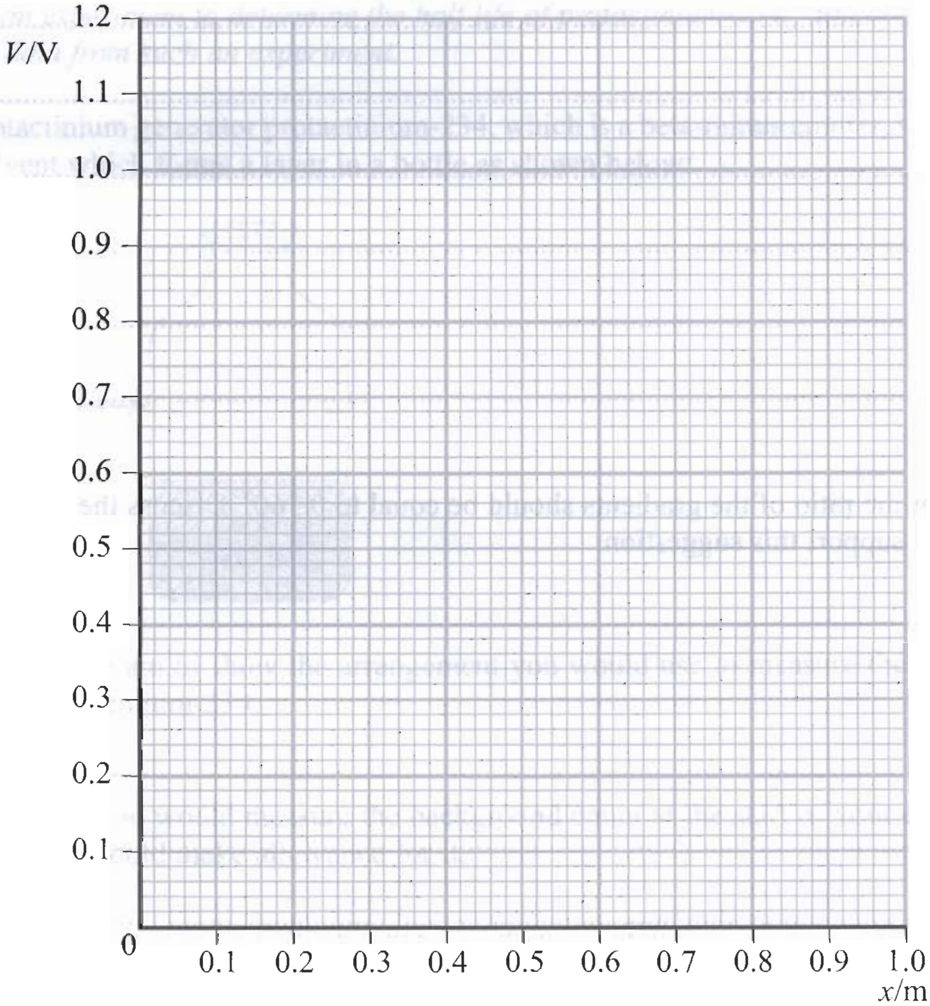
(ii) Plot a graph of your readings on the grid. Label your line X.



(iii) Switch on the power supply and use the 4 mm plug to make a contact P at different points along the wire BC. Record your readings for V and x, where x is the distance between A and P. Switch off the power supply after you have taken your readings.

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(iv) Plot a graph of these readings on the grid above. Label this line Y. Extend the lines X and Y and determine the value of x at their intersection.

x = ...

(7)

Leave blank

Leave blank

(c) Determine the gradients m_X and m_Y of the lines X and Y.

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(3)

(d) It is suggested that the ratio of the gradients should be equal to 0.360. Discuss the extent to which your results support this suggestion.

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(4)

Q1B

(Total 16 marks)

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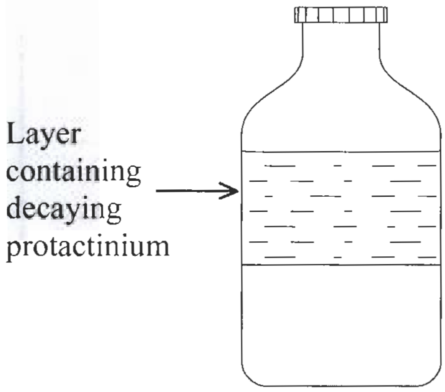
Question 1C

You are to plan an experiment to determine the half life of protactinium-234. You are then to analyse a set of data from such an experiment.

(a) (i) In a protactinium generator protactinium-234, which is a beta-minus emitter, is dissolved in a solvent which forms a layer in a bottle as shown below:



Add to the diagram to show the arrangement you would use to measure the count rate from the protactinium-234.

(3)

(ii) Describe how you would measure the background count at the start of your experiment and how you would make allowance for it.

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(2)

(iii) Describe the readings you would take to determine the half life of the protactinium-234, which is thought to be of the order of one minute.

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(2)

Leave blank

(iv) For radioactive decay, the count rate A after a time t is given by

$$A = A_0 e^{-\lambda t}$$

where A_0 = count rate at $t = 0$
and λ = decay constant

Explain why a graph of $\ln A$ against t should be a straight line.

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(1)

(b) The following data were obtained in such an investigation:

Background count = 27 min^{-1}

t/s	Count rate/min^{-1}		
0	527		
20	447		
40	367		
60	300		
80	262		
100	216		
120	183		

Use the columns provided for your processed data, and then plot a suitable graph on the grid opposite to test whether the decay follows the expected pattern.

Leave blank

(5)

(c) Use your graph to find a value for the decay constant λ.

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Hence determine a value for the half life of the protactinium-234.

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(3)

(Total 16 marks)

Leave blank

Q1C

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to the Earth)
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to the Earth)
Elementary (proton) charge	$e = 1.60 \times 10^{-19} \text{ C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Unified atomic mass unit	$u = 1.66 \times 10^{-27} \text{ kg}$	
Molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$	
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Coulomb law constant	$k = 1/4\pi\varepsilon_0 = 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7} \text{ N A}^{-2}$	

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

$$x = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2ax$$

Forces and moments

Moment of F about O = $F \times$ (Perpendicular distance from F to O)

Sum of clockwise moments about any point in a plane = Sum of anticlockwise moments about that point

Dynamics

Force $F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $F\Delta t = \Delta p$

Mechanical energy

Power $P = Fv$

Radioactive decay and the nuclear atom

Activity $A = \lambda N$ (Decay constant λ)

Half-life $\lambda t_{\frac{1}{2}} = 0.69$

Electrical current and potential difference

Electric current $I = nAQv$

Electric power $P = I^2R$

Electrical circuits

Terminal potential difference $V = \mathcal{E} - Ir$ (E.m.f. $\mathcal{E}$; Internal resistance r)

Circuit e.m.f. $\Sigma\mathcal{E} = \Sigma IR$

Resistors in series $R = R_1 + R_2 + R_3$

Resistors in parallel $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

Heating matter

Change of state: energy transfer $= l\Delta m$ (Specific latent heat or specific enthalpy change l)

Heating and cooling: energy transfer $= mc\Delta T$ (Specific heat capacity c; Temperature change ΔT)

Celsius temperature $\theta/°\text{C} = T/\text{K} - 273$

Kinetic theory of matter

Temperature and energy $T \propto$ Average kinetic energy of molecules

Kinetic theory $p = \frac{1}{3}\rho\langle c^2\rangle$

Conservation of energy

Change of internal energy $\Delta U = \Delta Q + \Delta W$ (Energy transferred thermally ΔQ; Work done on body ΔW)

Efficiency of energy transfer $= \dfrac{\text{Useful output}}{\text{Input}}$

Heat engine maximum efficiency $= \dfrac{T_1 - T_2}{T_1}$

Circular motion and oscillations

Angular speed $\omega = \dfrac{\Delta\theta}{\Delta t} = \dfrac{v}{r}$ (Radius of circular path r)

Centripetal acceleration $a = \dfrac{v^2}{r}$

Period $T = \dfrac{1}{f} = \dfrac{2\pi}{\omega}$ (Frequency f)

Simple harmonic motion:

displacement $x = x_0 \cos 2\pi ft$

maximum speed $= 2\pi f x_0$

acceleration $a = -(2\pi f)^2 x$

For a simple pendulum $T = 2\pi\sqrt{\dfrac{l}{g}}$

For a mass on a spring $T = 2\pi\sqrt{\dfrac{m}{k}}$ (Spring constant k)

Waves

Intensity $I = \frac{P}{4\pi r^2}$ (Distance from point source r; Power of source P)

Superposition of waves

Two slit interference $\lambda = \frac{xs}{D}$ (Wavelength λ; Slit separation s; Fringe width x; Slits to screen distance D)

Quantum phenomena

Photon model $E = hf$ (Planck constant h)

Maximum energy of photoelectrons $= hf - \varphi$ (Work function φ)

Energy levels $hf = E_1 - E_2$

de Broglie wavelength $\lambda = \frac{h}{p}$

Observing the Universe

Doppler shift $\frac{\Delta f}{f} = \frac{\Delta\lambda}{\lambda} \approx \frac{v}{c}$

Hubble law $v = Hd$ (Hubble constant H)

Gravitational fields

Gravitational field strength $g = F/m$

for radial field $g = Gm/r^2$, numerically (Gravitational constant G)

Electric fields

Electrical field strength $E = F/Q$

for radial field $E = kQ/r^2$ (Coulomb law constant k)

for uniform field $E = V/d$

For an electron in a vacuum tube $e\Delta V = \Delta(\frac{1}{2}m_e v^2)$

Capacitance

Energy stored $W = \frac{1}{2}CV^2$

Capacitors in parallel $C = C_1 + C_2 + C_3$

Capacitors in series $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

Time constant for capacitor discharge $= RC$

Magnetic fields

Force on a wire — $F = BIl$

Magnetic flux density (Magnetic field strength)

in a long solenoid — $B = \mu_0 nI$ (Permeability of free space μ_0)

near a long wire — $B = \mu_0 I / 2\pi r$

Magnetic flux — $\Phi = BA$

E.m.f. induced in a coil — $\varepsilon = -\dfrac{N\Delta\Phi}{\Delta t}$ (Number of turns N)

Accelerators

Mass-energy — $\Delta E = c^2 \Delta m$

Force on a moving charge — $F = BQv$

Analogies in physics

Capacitor discharge — $Q = Q_0 e^{-t/RC}$

$$\frac{t_{\frac{1}{2}}}{RC} = \ln 2$$

Radioactive decay — $N = N_0 e^{-\lambda t}$

$$\lambda t_{\frac{1}{2}} = \ln 2$$

Experimental physics

$$\text{Percentage uncertainty} = \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$$

Mathematics

$$\sin(90° - \theta) = \cos\theta$$

$$\ln(x^n) = n \ln x$$

$$\ln(e^{kx}) = kx$$

Equation of a straight line — $y = mx + c$

Surface area — cylinder $= 2\pi rh + 2\pi r^2$

sphere $= 4\pi r^2$

Volume — cylinder $= \pi r^2 h$

sphere $= \frac{4}{3}\pi r^3$

For small angles: $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

$\cos\theta \approx 1$

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Centre No.						Paper Reference	Surname	Other names
Candidate No.						6 7 3 5 / 2 B	Signature	

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Physics

Advanced Level

Unit Test PHY5 Practical Test

Group 2

Wednesday 24 May 2006 – Morning

Time: 1 hour 30 minutes

Question numbers	Leave blank
A	
B	
C	
Total	

Supervisor's data and comments	
B	Tick if help was given in setting up circuit. (Give details below)
Comments	

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, other names and signature.

PHY5 consists of questions A, B and C. Each question is allowed 20 minutes plus 5 minutes writing-up time. There is a further 15 minutes for writing-up at the end. The Supervisor will tell you which experiment to attempt first.

Write all your results, calculations and answers in the spaces provided in this question booklet.

In calculations you should show all the steps in your working, giving your answer at each stage.

Information for Candidates

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The total mark for this paper is 48.

The list of data, formulae and relationships is printed at the end of this booklet.

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Question 2A

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(a) (i) Measure the length l and the width w of the sheet of paper labelled Part (a).

l = ...

w = ...

Use the balance to measure the mass m of the sheet of paper.

m = ...

Use your measurements to determine the mass per unit area of the paper in $g\ m^{-2}$.

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(4)

(ii) Describe how you would determine the thickness of the paper. Include in your description any additional apparatus you would require and precautions you would take to make the reading as accurate as possible.

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(3)

Leave blank

(b) (i) You are provided with a strip of paper and a clip, suspended from a clamp stand. The pen is to act as a pointer and the pin in the cork is to act as a reference point. Twist the lower clip by about 45° and release it carefully so that it performs rotational oscillations about a vertical axis.

Determine the period of oscillation T_1.

....

....

Explain how you used the pin in the cork to improve the accuracy of your readings.

....

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(3)

(ii) Replace the strip with the one from the bench. Take care to ensure that the edge of each clip lines up with the marks on the paper. The pen should be a snug fit in the lower clip.

Twist the lower clip by about 45° and release it carefully.

Determine the period of oscillation T_2.

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(2)

(iii) Calculate the ratio of T_2/T_1.

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Estimate the percentage uncertainty in your value of this ratio.

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(4)

Q2A

(Total 16 marks)

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Question 2B

(a) Measure the diameter d of the short length of wire.

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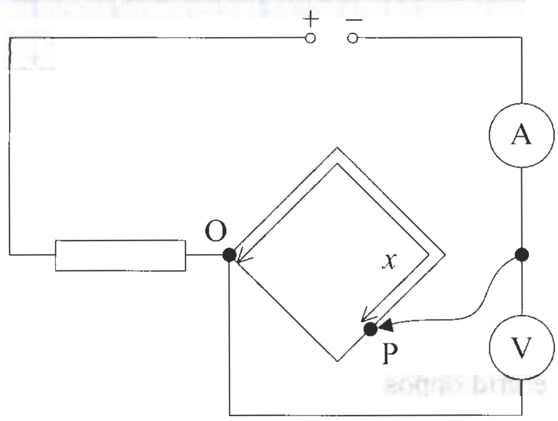
(2)

(b) (i) Set up the circuit as shown in the diagram. A resistance wire is set up as a square. This is the same type of wire as the short length. Plug into the crocodile clip to make contact with the wire at point O as shown in the diagram. This is to be taken as the 0 cm mark. A 4 mm plug is to be used to make a contact P with the wire. Before switching on the power supply have your circuit checked by the Supervisor. You will be allowed a short time to correct any faults, but if you are unable to set up the circuit the Supervisor will set it up for you. You will lose only 2 marks for this.



(2)

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(ii) Make a contact P such that $x = 0.650$ m, where x is the distance of P from O measured clockwise round the square. Record the reading V on the voltmeter and the reading I on the ammeter. Calculate the resistance R between O and P.

V = ... I = ...

R = ...

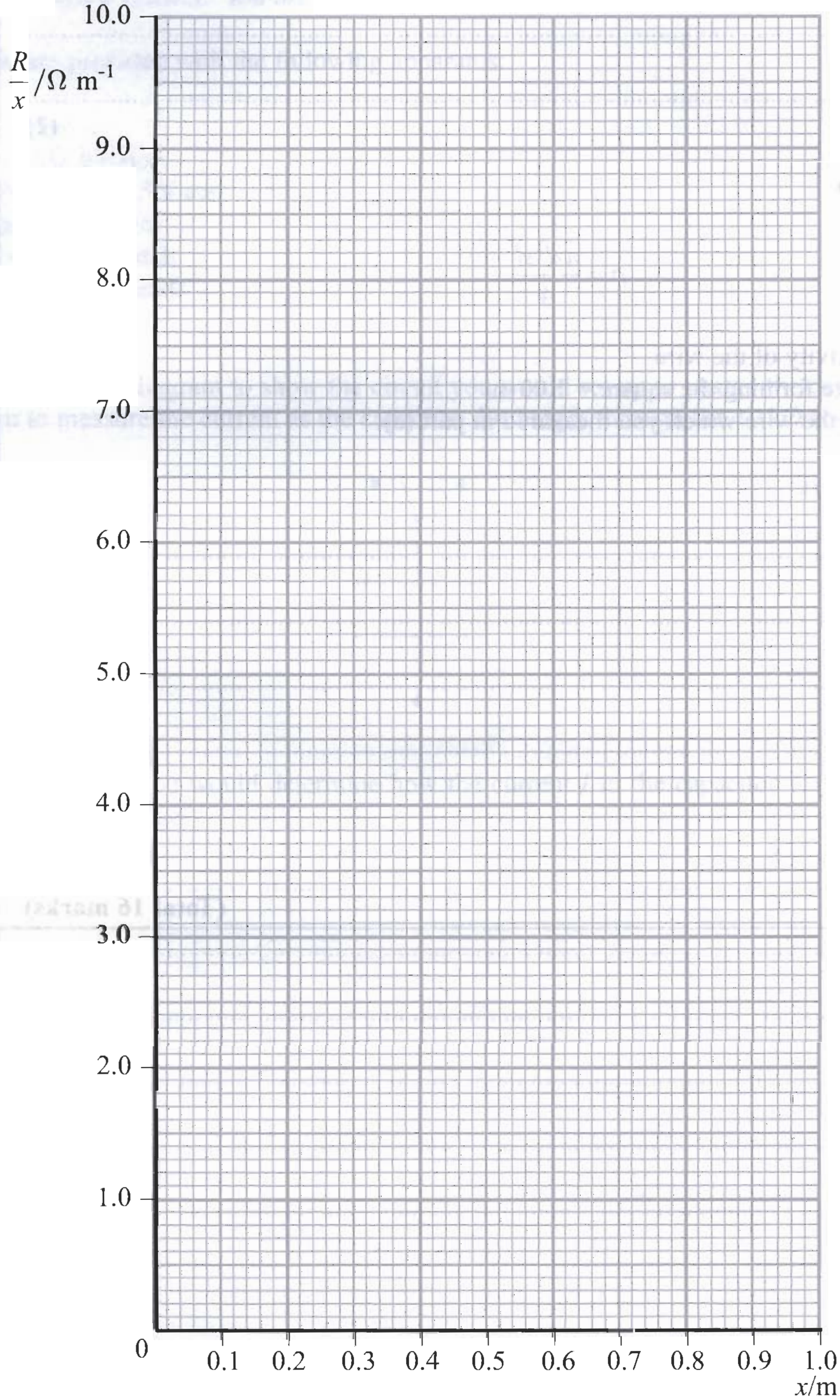
Take readings of V and I for different values of $x \geqslant 0.300$ m. Record your readings below and complete the table for values of R and R/x.

x/m	V/V	I/A	R/Ω	(R/x)/Ω m^{-1}

(6)

(c) Plot a graph of R/x against x on the grid opposite.

(2)



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(d) Determine the magnitude s of the gradient of your graph.

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(2)

(e) It can be shown that

$$\rho = \frac{\pi d^2 s l}{4}$$

where ρ is the resistivity of the wire
l is the length of wire forming the square = 1.00 m
d is the diameter of the wire which you measured in part (a).

Calculate a value for ρ.

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(2)

Q2B

(Total 16 marks)

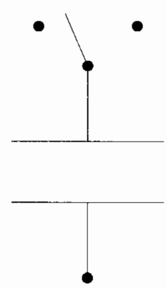
Question 2C

You are to plan an investigation of how the current in a capacitor varies with time when it is discharged through a resistor. You are then to analyse a set of data from such an experiment.

(a) (i) You are provided with the following apparatus:

- capacitor
- 10 kΩ resistor
- (nominal) 1.5 V cell
- microammeter
- two-way switch
- connecting leads
- stopwatch

Complete the diagram to show the circuit you would set up to charge the capacitor and then to measure the current as the capacitor discharges through the 10 kΩ resistor.



(3)

(ii) Describe how you would determine how the current I in the capacitor varied with the time t of discharge.

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(3)

Leave blank

(iii) It is suggested that

$$I = I_0 e^{-at}$$

where I_0 = current at $t = 0$
and a = a constant

Explain why a graph of ln I against t would be a straight line if the relationship were true.

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Estimate the value of I_0 expected in this experiment. Show how you arrived at your answer.

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(2)

(b) The following data were obtained in such an investigation.

t/s	I/μA	
10	121.5	
20	97.5	
30	79.0	
40	63.4	
50	51.4	
60	41.7	
70	33.1	

Use the column provided for your processed data and then plot a suitable graph on the grid opposite to test the suggested relationship.

(5)

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(c) Use your graph to find a value for a.

Leave blank

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Hence calculate a value for the capacitance C of the capacitor, given that

$$a = \frac{1}{CR}$$

where $R = 10\ \text{k}\Omega$.

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(3)

Q2C

(Total 16 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$	
Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to the Earth)
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to the Earth)
Elementary (proton) charge	$e = 1.60 \times 10^{-19} \text{ C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31} \text{ kg}$	
Electronvolt	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
Unified atomic mass unit	$\text{u} = 1.66 \times 10^{-27} \text{ kg}$	
Molar gas constant	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$	
Permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$	
Coulomb law constant	$k = 1/4\pi\varepsilon_0$ $= 8.99 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$	
Permeability of free space	$\mu_0 = 4\pi \times 10^{-7} \text{ N A}^{-2}$	

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

$$x = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2ax$$

Forces and moments

Moment of F about O = $F \times$ (Perpendicular distance from F to O)

Sum of clockwise moments about any point in a plane = Sum of anticlockwise moments about that point

Dynamics

Force $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $\quad F\Delta t = \Delta p$

Mechanical energy

Power $\quad P = Fv$

Radioactive decay and the nuclear atom

Activity $\quad A = \lambda N \quad$ (Decay constant λ)

Half-life $\quad \lambda t_{\frac{1}{2}} = 0.69$

Electrical current and potential difference

Electric current	$I = nAQv$
Electric power	$P = I^2 R$

Electrical circuits

Terminal potential difference	$V = \mathcal{E} - Ir$	(E.m.f. $\mathcal{E}$; Internal resistance r)
Circuit e.m.f.	$\Sigma\mathcal{E} = \Sigma IR$	
Resistors in series	$R = R_1 + R_2 + R_3$	
Resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	

Heating matter

Change of state:	energy transfer $= l\Delta m$	(Specific latent heat or specific enthalpy change l)
Heating and cooling:	energy transfer $= mc\Delta T$	(Specific heat capacity c; Temperature change ΔT)
Celsius temperature	$\theta/°\mathrm{C} = T/\mathrm{K} - 273$	

Kinetic theory of matter

Temperature and energy	$T \propto$ Average kinetic energy of molecules
Kinetic theory	$p = \frac{1}{3}\rho\langle c^2\rangle$

Conservation of energy

Change of internal energy	$\Delta U = \Delta Q + \Delta W$	(Energy transferred thermally ΔQ; Work done on body ΔW)
Efficiency of energy transfer	$= \frac{\text{Useful output}}{\text{Input}}$	
Heat engine — maximum efficiency	$= \frac{T_1 - T_2}{T_1}$	

Circular motion and oscillations

Angular speed	$\omega = \frac{\Delta\theta}{\Delta t} = \frac{v}{r}$	(Radius of circular path r)
Centripetal acceleration	$a = \frac{v^2}{r}$	
Period	$T = \frac{1}{f} = \frac{2\pi}{\omega}$	(Frequency f)

Simple harmonic motion:

displacement $x = x_0 \cos 2\pi ft$

maximum speed $= 2\pi f x_0$

acceleration $a = -(2\pi f)^2 x$

For a simple pendulum	$T = 2\pi\sqrt{\frac{l}{g}}$	
For a mass on a spring	$T = 2\pi\sqrt{\frac{m}{k}}$	(Spring constant k)

Waves

Intensity	$I = \dfrac{P}{4\pi r^2}$	(Distance from point source r; Power of source P)

Superposition of waves

Two slit interference	$\lambda = \dfrac{xs}{D}$	(Wavelength λ; Slit separation s; Fringe width x; Slits to screen distance D)

Quantum phenomena

Photon model	$E = hf$	(Planck constant h)
Maximum energy of photoelectrons	$= hf - \varphi$	(Work function φ)
Energy levels	$hf = E_1 - E_2$	
de Broglie wavelength	$\lambda = \dfrac{h}{p}$	

Observing the Universe

Doppler shift	$\dfrac{\Delta f}{f} = \dfrac{\Delta\lambda}{\lambda} \approx \dfrac{v}{c}$	
Hubble law	$v = Hd$	(Hubble constant H)

Gravitational fields

Gravitational field strength	$g = F/m$	
for radial field	$g = Gm/r^2$, numerically	(Gravitational constant G)

Electric fields

Electrical field strength	$E = F/Q$	
for radial field	$E = kQ/r^2$	(Coulomb law constant k)
for uniform field	$E = V/d$	
For an electron in a vacuum tube	$e\Delta V = \Delta(\frac{1}{2}m_e v^2)$	

Capacitance

Energy stored	$W = \frac{1}{2}CV^2$	
Capacitors in parallel	$C = C_1 + C_2 + C_3$	
Capacitors in series	$\dfrac{1}{C} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}$	
Time constant for capacitor discharge	$= RC$	

Magnetic fields

Force on a wire	$F = BIl$	
Magnetic flux density (Magnetic field strength)		
in a long solenoid	$B = \mu_0 nI$	(Permeability of free space μ_0)
near a long wire	$B = \mu_0 I / 2\pi r$	
Magnetic flux	$\Phi = BA$	
E.m.f. induced in a coil	$\varepsilon = -\dfrac{N\Delta\Phi}{\Delta t}$	(Number of turns N)

Accelerators

Mass-energy	$\Delta E = c^2 \Delta m$
Force on a moving charge	$F = BQv$

Analogies in physics

Capacitor discharge	$Q = Q_0 e^{-t/RC}$
	$\dfrac{t_{\frac{1}{2}}}{RC} = \ln 2$
Radioactive decay	$N = N_0 e^{-\lambda t}$
	$\lambda t_{\frac{1}{2}} = \ln 2$

Experimental physics

$$\text{Percentage uncertainty} = \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$$

Mathematics

$$\sin(90° - \theta) = \cos\theta$$

$$\ln(x^n) = n \ln x$$

$$\ln(e^{kx}) = kx$$

Equation of a straight line	$y = mx + c$	
Surface area	cylinder $= 2\pi rh + 2\pi r^2$	
	sphere $= 4\pi r^2$	
Volume	cylinder $= \pi r^2 h$	
	sphere $= \frac{4}{3}\pi r^3$	
For small angles:	$\sin\theta \approx \tan\theta \approx \theta$	(in radians)
	$\cos\theta \approx 1$	