6733/2A

Physics

Group 1

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

Edexcel GCE

Centre Number					
Candidate Number					
Paper reference					
Surname					
Other Names					
Candidate signature					

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test Group 1

Friday 11 January 2002 – Morning

Time: 1 hour 30 minutes

Question numbers	Leave blank
A	
B	
Total	

For the Supervisor's use				
A	(a)	Length		
		Diameter		
B	Tick if circuit set up		(a)	
	Tick if card given		(b)	
	Diameter			
Comments				

Instructions to Candidates

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

The paper reference is shown in the top left-hand corner. If more than one paper reference is shown, you should write the one for which you have been entered.

PHY3 consists of questions A and B. Each question is allowed 35 minutes plus 5 minutes writing up time. There is a further 10 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 marks for this paper is 48.

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

Turn over

Edexcel
Success through qualifications

Question A

Leave blank

(a) (i) Taking care not to damage the wire, determine values for the length l and the average diameter d.

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Explain why it is necessary to take several values of d.

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(4)

(ii) Calculate the volume V of the wire given that

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

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Using the top pan balance, measure the mass of the wire and hence find a value for the density of the material of the wire.

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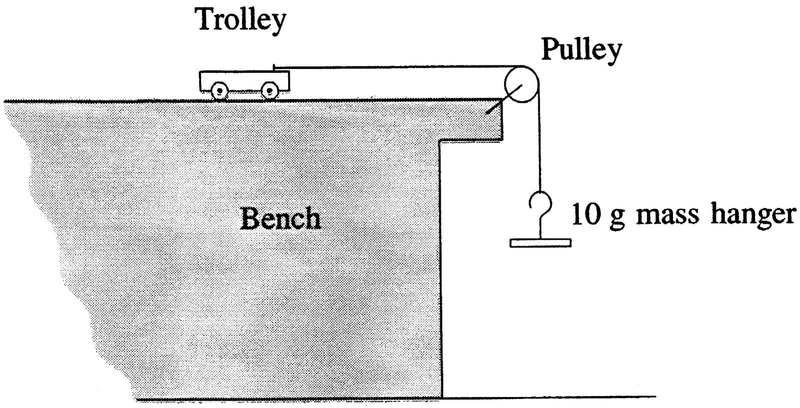
(3)

Leave blank

(b) (i) The apparatus shown in the diagram has been set up for you.



Add masses to the mass hanger until it is clear that the trolley accelerates across the table. Record the total mass m used to accelerate the trolley in the space below.

$m =$ ....

Determine the average time t taken for the trolley to travel a distance $x = 0.500$ m from rest when accelerated by this mass.

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Calculate the acceleration a of the trolley given that

$$a = \frac{2x}{t^2}$$

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(6)

Leave blank

(ii) Explain, with the aid of a diagram, how you ensured that the trolley travelled a distance of 0.500 m in the measured time.

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(3)

(c) (i) Shake the beaker, which contains 48 coins (or discs), and throw the coins (or discs) into the tray. Remove all the coins which land with the head uppermost (or discs with the cross uppermost) and record the number N of coins (or discs) remaining in the tray. Place these coins (or discs) back in the beaker and repeat this process for three more throws. Tabulate N and the number x of throws in the space below.

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Using the grid opposite plot a graph of N against x. Draw the line of best fit through your points.

(5)

Leave blank

(ii) Discuss the extent to which your curve is a representation of a radioactive decay.

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(3)

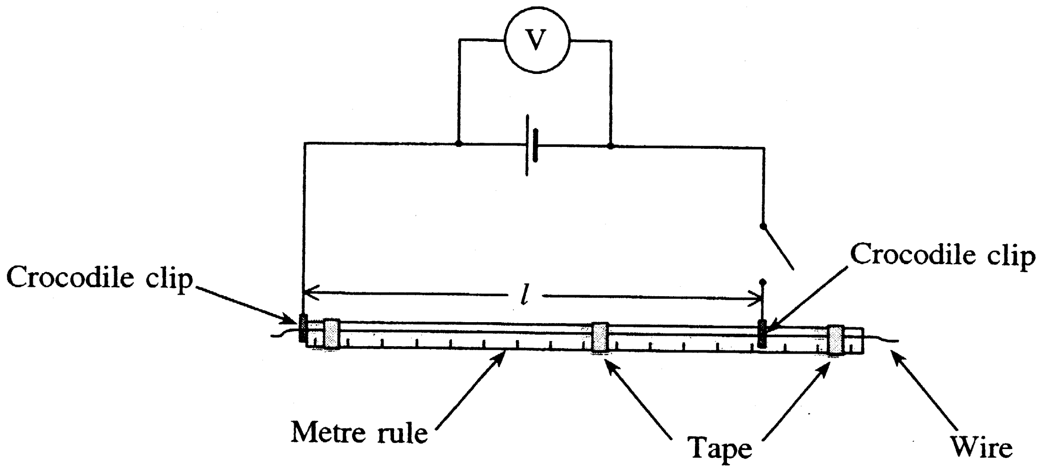
QA

(Total 24 marks)

Leave blank

Question B

(a) Set up the circuit as shown in the diagram. The length of wire has already been attached to the metre rule. You should attach the crocodile clips to the wire so that the length l is 0.800 m. Before you close the switch 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 only lose 2 marks for this.



(2)

(b) You may assume that the voltmeter is an ideal voltmeter which takes no current. Use your circuit to determine the e.m.f. $\mathcal{E}$ of the cell and the potential difference V across the length $l = 0.800$ m.

$\mathcal{E}$ = ...

V = ...

If you are unable to do this ask the Supervisor for the card which will give you brief instructions. You will only lose 2 marks for this.

Leave the switch **open** when you have taken your readings.

(2)

(c) An equation which applies to this arrangement is

$$\frac{\mathcal{E}}{V} = 1 + \frac{k}{l}$$

Use your results from part (b) to determine a value for k.

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(2)

Leave blank

(d) (i) Repeat part (b) using a length l of 0.400 m. Record your new values of $\mathcal{E}$ and V, and calculate a second value for k.

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(3)

(ii) Explain, using your knowledge of electrical circuits, any changes which occur in the values of $\mathcal{E}$ and V.

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(5)

Leave blank

(e) (i) Calculate the percentage difference between your two values of k. Comment on the extent to which the value of k may be regarded as constant if experimental errors amount to approximately 5%.

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(ii) The constant k is given by

$$k = \frac{\pi d^2 r}{4\rho}$$

where r = internal resistance of the cell,
d = diameter of the wire (given on card),
ρ = resistivity of the material of the wire = $4.9 \times 10^{-7}\ \Omega\,\text{m}$.

Using the average of your values for k calculate a value for the internal resistance of the cell.

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(4)

(f) Assuming that both $\mathcal{E}$ and k remain constant, the equation in part (c) may be investigated by plotting a graph of $1/V$ against $1/l$.

(i) Explain carefully how you would carry out the experiment to plot this graph.

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(ii) Sketch the graph you would expect to obtain.

Leave blank

(iii) Explain how both ε and k could be obtained from the results.

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(6)

QB

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
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)
Electronic 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	$R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$	

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 $$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$$

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	$\lambda t_{1/2} = 0.69$	

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.	$= \Sigma IR$	
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 $\theta/°\text{C} = T/\text{K} - 273$

Kinetic theory of matter

$T \propto$ 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 $= \dfrac{\text{Useful output}}{\text{Input}}$

For a heat engine, maximum efficiency $= \dfrac{T_1 - T_2}{T_1}$

Experimental physics

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

Mathematics

$\sin(90° - \theta) = \cos\theta$

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)

$\cos\theta \approx 1$