6733/2A
Physics

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Edexcel GCE

Centre Number					
Candidate Number					
Paper reference					
Surname					
Other Names					
Candidate signature					

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test

Monday 13 January 2003 – Morning

Time: 1 hour 30 minutes

Question numbers	Leave blank
A	
B	
Total	

Supervisor's data and comments		
A	Thickness t of foil	
	Tick if circuit set up by Supervisor (Give details below)	
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 mark for this paper is 48.

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

Turn over

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Question 1A

Leave blank

(a) (i) You have been provided with a sheet of foil. Measure its length l and width w. Explain with the aid of a diagram how you obtained accurate values for l and w.

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(3)

(ii) Determine the thickness t of the sheet by folding it so that a total thickness of $16t$ is recorded. Estimate the percentage uncertainty in your value of t.

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Explain one advantage and one disadvantage of measuring t in this way.

Leave blank

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(6)

(iii) Calculate the volume V of the sheet.

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Measure the mass of the sheet using the balance provided and hence determine the density of the material from which the sheet is made.

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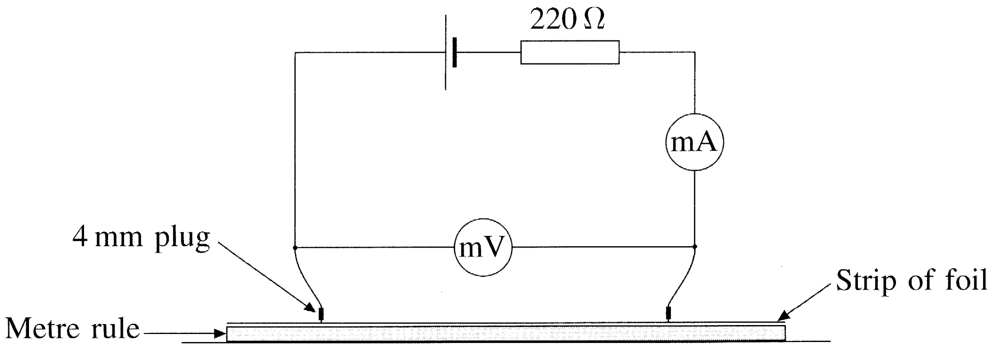
(3)

(b) (i) Set up the circuit as shown in the diagram below to enable you to measure the resistance of an 80.0 cm strip of foil. Before pressing the 4 mm plugs on to the foil, have your circuit checked by the Supervisor. You will be allowed a short time to correct any faults. If you are unable to set up the circuit the Supervisor will set it up for you. You will only lose two marks for this.



(2)

(ii) Taking care not to damage the foil, press the ends of the 4 mm plugs firmly against the strip of foil so that you can measure the voltage V across a length $l = 80.0$ cm. Also measure the current I in this length. Record your measurements in the space below.

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Hence calculate a value for the resistance R of the 80 cm length of foil.

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(4)

(iii) Explain whether your value for R is likely to be greater than, equal to or less than the actual resistance of this length of foil.

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(2)

Leave blank

(iv) Calculate a value for the cross-sectional area A through which the current is passing. You may assume that the width of the strip is 5.0 mm and that its thickness is the same as that determined in part (a).

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Use your results to determine a value for the resistivity ρ of the material from which the foil is made. This is given by

$$\rho = \frac{RA}{l}$$

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(4)

(Total 24 marks)

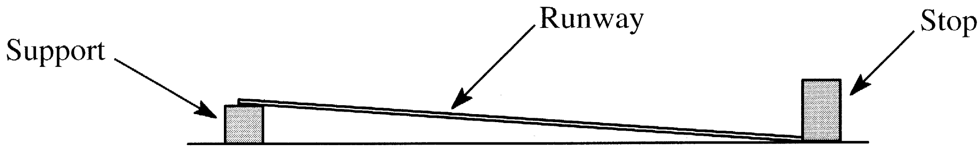
Leave blank

Q1A

Question 1B

Leave blank

(a) Set up the apparatus as shown in the diagram below with support A placed under one end of the runway and the stop secured at the other end.



Determine the mean time t for the ball to travel a distance s of 1.00 m from rest down the runway.

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Hence calculate the speed v of the ball after moving 1.00 m, which is given by

$$v = \frac{2s}{t}$$

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(3)

(b) Determine the vertical height h through which the ball falls as it travels this distance of 1.00 m down the runway. Draw a diagram to show how this height was determined.

h = ...

Using the mass of the ball, which is given on the card, calculate the potential energy E_P lost by the ball as it falls through the height h.

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Using your results from part (a) calculate the linear kinetic energy E_K gained by the ball as it moves down the runway.

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Because the ball has both linear and rotational kinetic energy in this experiment, it is expected that $E_P = kE_K$, where k is a constant. Use your energy values to calculate a value for k.

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(6)

(c) Repeat parts (a) and (b) of the experiment using support B in order to obtain a second value for k.

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(5)

(d) Determine the percentage difference between your two values of k. If the total experimental uncertainty in the energies is of the order of 20%, comment on the validity of assuming that k is constant.

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(2)

Leave blank

(e) You are to plan an experiment to further investigate the equation $E_P = kE_K$. Your plan should include

(i) a description of how E_P can be changed,

(ii) a description of the experiment to be performed,

(iii) a sketch graph showing the expected results,

(iv) an indication of how the constant k may be found from the graph.

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(8)

(Total 24 marks)

Leave blank

Q1B

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8\ \mathrm{m\,s^{-1}}$	
Acceleration of free fall	$g = 9.81\ \mathrm{m\ s^{-2}}$	(close to the Earth)
Gravitational field strength	$g = 9.81\ \mathrm{N\ kg^{-1}}$	(close to the Earth)
Electronic charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Unified atomic mass unit	$\mathrm{u} = 1.66 \times 10^{-27}\ \mathrm{kg}$	
Molar gas constant	$R = 8.31\ \mathrm{J\ K^{-1}\ mol^{-1}}$	

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 × (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 $$\lambda t_{\frac{1}{2}} = 0.69$$

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	$\theta/^{\circ}\mathrm{C} = T/\mathrm{K} - 273$	

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

	$\sin(90^{\circ} - \theta) = \cos\theta$	
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)
	$\cos\theta \approx 1$	