6733/2A
Physics
Group 1

Edexcel GCE

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For Team Leader's use only

Centre Number					
Candidate Number					
Paper reference					
Surname					
Other Names					
Candidate signature					

Supervisor's data and comments		
1A	Diameter of sphere	
	Av. mass of sphere	
1B	Tick if circuit set up by Supervisor (Give details below)	
Comments		

May 2003
Advanced Subsidiary
Physics
Unit Test PHY3 Practical Test
Group 1
Monday 12 May – Morning
Time: 1 hour 30 minutes

Question numbers	Leave blank
A	
B	
Total	

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 this booklet.

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Turn over

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Question 1A

(a) (i) You are provided with 10 glass spheres. Determine an accurate value for the average diameter d of the spheres. Explain with the aid of a diagram how you tried to ensure that d was determined as accurately as possible.

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(5)

(ii) Estimate the percentage uncertainty in your value for d.

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(2)

(iii) Calculate the average volume V of a sphere given that

$$V = \frac{\pi d^3}{6}$$

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(1)

(iv) Use the balance provided to determine the average mass of a sphere. Record all your measurements. Use your data to calculate a value for the density of the glass from which the spheres are made.

Leave blank

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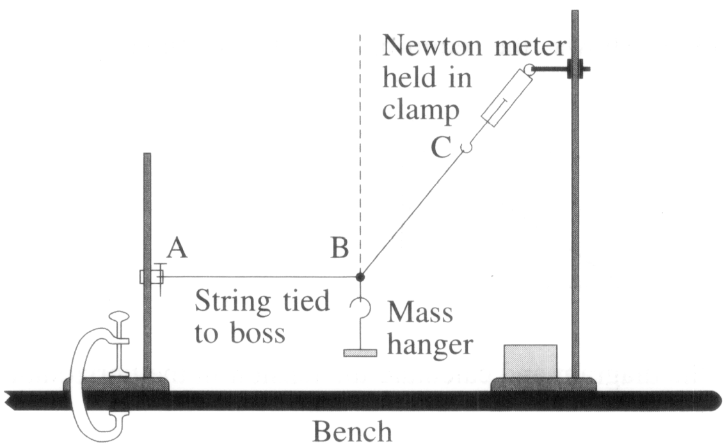
(4)

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



Place 300 g on the mass hanger to give a total mass *M* of 400 g. Adjust the height of the clamp holding the newton meter until the section of string AB is horizontal. Explain carefully how you ensured that the string was horizontal, adding to the above diagram if you wish. Record the reading *R* on the newton meter.

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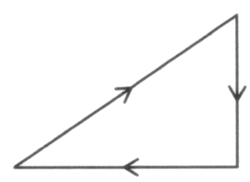
(4)

(ii) Draw a free-body diagram to show the forces acting at the point B, carefully labelling the forces.

Leave blank

(3)

(iii) The diagram below shows the equilibrium of the three forces acting at point B.



Add your data to the diagram and calculate the tension in the horizontal section of the string.

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(5)

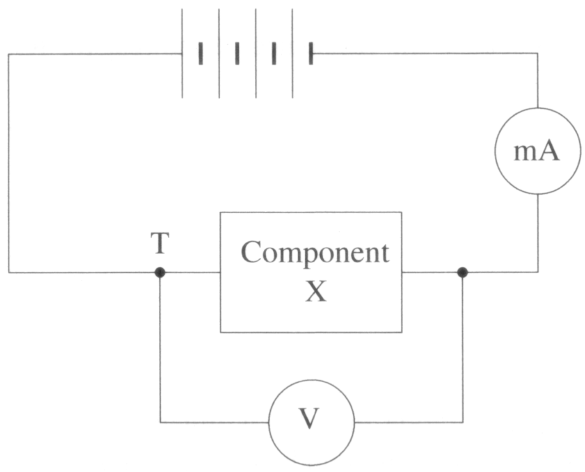
(Total 24 marks)

Q1A

Question 1B

Leave blank

(a) (i) Set up the circuit as shown in the diagram below. Before you connect 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 only lose 2 marks for this.



Connect the 6 V supply to the circuit with the positive terminal of the power supply connected to terminal T of component X. Record the current I_1 in and the voltage V_1 across X.

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(ii) Reverse component X and measure the new values of the current I_2 in and the voltage V_2 across X.

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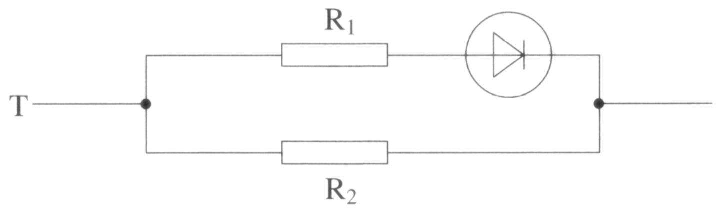
(6)

(b) Component X contains the elements shown in the diagram below.

Leave blank



Use your results from part (a) to deduce the resistance of the resistor R_2.

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(4)

(c) The voltage drop across a conducting diode may be assumed to be 0.70 V. For the situation when both arms of component X are conducting, calculate

(i) the current in the resistor R_2,

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(ii) the current in the series arrangement of the diode and the resistor R_1,

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(iii) the resistance of resistor R_1.

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(6)

(d) (i) Draw a circuit diagram to show how you would use a potential divider to further investigate the current-potential difference relationship for component X.

Leave blank

Describe how you would take the necessary readings.

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(3)

(ii) Sketch a graph of the results you would expect. You may assume that a diode does not start to conduct until the voltage drop across it exceeds 0.70 V.

Leave blank

Explain how the resistance of the resistor R_2 may be found from the graph.

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(5)

Q1B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$	
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)
Elementary (proton) 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 = $F \times$ (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 $$\lambda t_{\frac{1}{2}} = 0.69$$

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	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	

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

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	$= \frac{\text{Useful output}}{\text{Input}}$	
For a heat engine, maximum efficiency	$= \frac{T_1 - T_2}{T_1}$	

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)
	$\cos\theta \approx 1$	