6733/2B
Physics
Group 2

Edexcel GCE

Centre Number					
Candidate Number					

Paper reference
6733/2B

Surname

Other names

Candidate signature

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

Question numbers	Leave blank
A	
B	
Total	

Physics
Advanced Subsidiary
Unit Test PHY3 Practical Test Group 2
May 2005
Wednesday 18 May – Morning
Time: 1 hour 30 minutes

Supervisor's Data and Comments		
2A	Tick if circuit set up by Supervisor. (Give details below)	
	Diameter *d* of marble	
	Mass *m* of marble	
Comments		

Instructions to Candidates

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

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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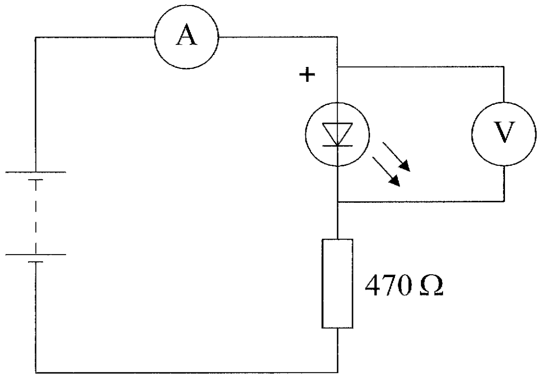
Question 2A

(a) (i) Set up the circuit shown in the diagram below. Use the red LED (light emitting diode). Before you connect your circuit to the power supply, have it 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 lose no more than two marks for this.



(2)

(ii) Connect the circuit to the power supply. Record the potential difference V_r across the red LED and the corresponding current I_r.

V_r = ...

I_r = ...

Hence calculate the resistance R_r of the red LED in this circuit.

....

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(3)

(iii) Replace the red LED with the green LED. Ensure that the positive end of the LED is connected as in the previous circuit. Record the potential difference V_g across the green LED and the corresponding current I_g.

V_g = ...

I_g = ...

Hence calculate the resistance R_g of the green LED in this circuit.

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(3)

(iv) Repeat your measurements and calculations with the 220 Ω resistor connected into the circuit in place of the 470 Ω resistor.

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1 Red LED with 220 Ω resistor

V_r' = ...

I_r' = ...

....

....

....

R_r' = ...

2 Green LED with 220 Ω resistor

V_g' = ...

I_g' = ...

....

....

....

R_g' = ...

(5)

(v) Write three conclusions based on your experimental observations.

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(3)

(b) (i) Determine an accurate value for the diameter d of the marble. Explain, with the aid of a diagram, how you tried to ensure that an accurate value for the diameter was found.

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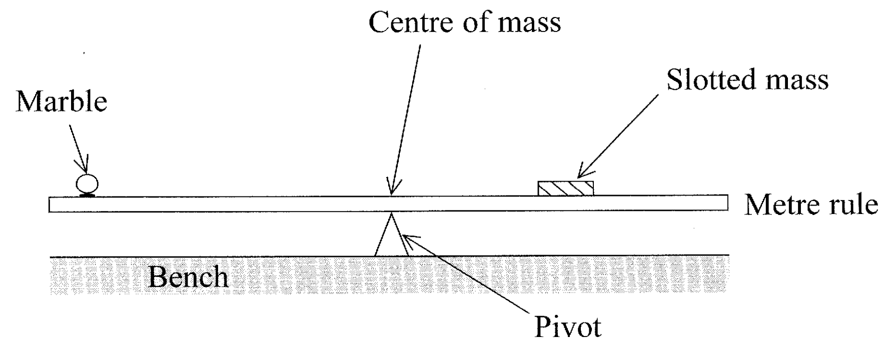
(3)

(ii) The metre rule has a small piece of Blu-tack attached to it at the 5 cm mark. Balance the rule on the knife edge to determine the position of the centre of mass of the rule and Blu-tack combination.

Scale reading at centre of mass = ...

(iii) Secure the marble to the metre rule at the position of the Blu-tack. Set up the arrangement shown in the diagram below.



Determine the mass m of the marble using the principle of moments. Using the above diagram, show carefully the measurements which you took in order to determine the mass m. Record all your measurements and calculations in the space below. The slotted mass has a mass of 10 g

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(5)

(Total 24 marks)

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Q2A

Question 2B

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(a) Without using calipers, determine a value for the average diameter d of the table tennis ball. Draw a diagram to show how you did this and record your measurements in the space below.

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The moment of inertia I is a rotational property of the table tennis ball. Calculate a value for I given that

$$I = \frac{md^2}{6}$$

where m = mass of table tennis ball which is given on the card.

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(5)

(b) Use the apparatus provided to find the time t it takes for the ball to roll from rest through a distance of 1.00 m down the slope set up for you. **DO NOT ADJUST THE ANGLE OF THE SLOPE.**

Draw a diagram to explain how you did this and record your measurements in the space below.

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Measure the height h through which the ball has fallen whilst travelling 1.00 m down the slope. Show how you did this on your diagram and record your measurements below.

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Calculate a value for sin α, where α is the angle the slope makes with the bench.

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(7)

(c) The speed v of the ball after travelling a distance s is given by

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

Calculate the speed of the ball after it has travelled a distance of 1.00 m and hence determine the linear kinetic energy E_k that it gains.

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Calculate the potential energy E_p that it loses when falling through the height h.

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(3)

(d) These energies differ because some of the potential energy is converted into rotational kinetic energy.

When this is taken into account

$$t^2 = \frac{10s}{3g \sin \alpha}$$

where g = gravitational field strength.

Use your value for sin α from part (b) to calculate a theoretical value for t when s = 1.00 m.

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Calculate the percentage difference between this theoretical value for t and the experimental value you found in part (b). Comment on the extent to which your answer supports the equation.

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(3)

Leave blank

(e) You are to plan an experiment to further investigate the equation in part (d). Your plan should include

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

(ii) a sketch graph showing the expected results,

(iii) how you would use the graph to test the equation.

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(6)

Q2B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8$ m s^{-1}	
Acceleration of free fall	$g = 9.81$ m s^{-2}	(close to the Earth)
Gravitational field strength	$g = 9.81$ N kg^{-1}	(close to the Earth)
Elementary (proton) charge	$e = 1.60 \times 10^{-19}$ C	
Electronic mass	$m_e = 9.11 \times 10^{-31}$ kg	
Electronvolt	1 eV $= 1.60 \times 10^{-19}$ J	
Molar gas constant	$R = 8.31$ 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	$\theta/°\text{C} = T/\text{K} - 273$	

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	$= \frac{\text{Useful output}}{\text{Input}}$	
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

	$\sin(90° - \theta) = \cos\theta$	
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)
	$\cos\theta \approx 1$	

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