6733/2B

Physics
Group 2 (Home)

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

Question numbers	Leave blank
A	
B	
Total	

Edexcel GCE

Centre Number					
Candidate Number					
Paper reference					
Surname					
Other Names					
Candidate signature					

For the Supervisor's use			
2A	(a)	Length *l*	
		Width *w*	
		Thickness *t*	
	(b)	$\mathcal{E}$ at start	
		$\mathcal{E}$ at end	
		Tick if circuit set up by Supervisor	
Comments			

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test Group 2 (Home)

Thursday 17 May 2001 – Morning

Time: 1 hour 30 minutes

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 this booklet.

Turn over

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Question 2A

Leave blank

(a) (i) Taking care not to damage the card supplied, determine average values for the length l, the width w and the thickness t.

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Explain why it is necessary to take a number of values in order to determine accurate values for the above quantities.

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(6)

(ii) Using the top pan balance, measure the mass of the card and hence find a value for the density of the material of the card.

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The value you have obtained for the average thickness of the card is not necessarily the best average value. Explain how you could obtain a better average value for the thickness. You may assume that additional apparatus is available.

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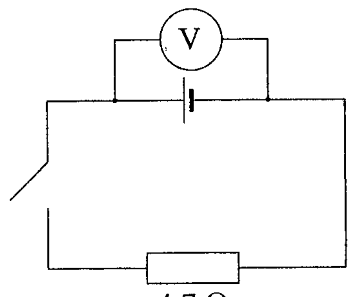
(4)

(b) (i) Set up the circuit as shown below. 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.

Leave blank



(2)

(ii) 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 4.7 Ω resistor.

$\mathcal{E}$ = ...

V = ...

Leave the switch **open** after you have completed your readings.

(2)

(iii) Calculate the current I through the resistor.

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....

Hence calculate the internal resistance r of the cell.

....

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(3)

Leave blank

(c) (i) Place 50 cm^3 of water at room temperature in the polystyrene cup. Record the temperature θ_1 of the water.

θ_1 = ...

The Supervisor has placed 10 washers tied together with string in a beaker of boiling water. Using the string, remove the washers from the beaker and transfer them to the polystyrene cup. Record the highest steady temperature θ_2 reached by the water.

θ_2 = ...

Calculate the specific heat capacity c_s of mild steel given that

$$c_s = \frac{m_w c_w(\theta_2 - \theta_1)}{m_s(\theta_3 - \theta_2)}$$

where m_w = mass of water = 0.050 kg,
c_w = specific heat capacity of water = 4200 J kg^{-1} K^{-1},
m_s = mass of 10 washers, which is given on the card,
θ_3 = initial temperature of washers = 100 °C.

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(5)

(ii) State two sources of error in this experiment.

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(2)

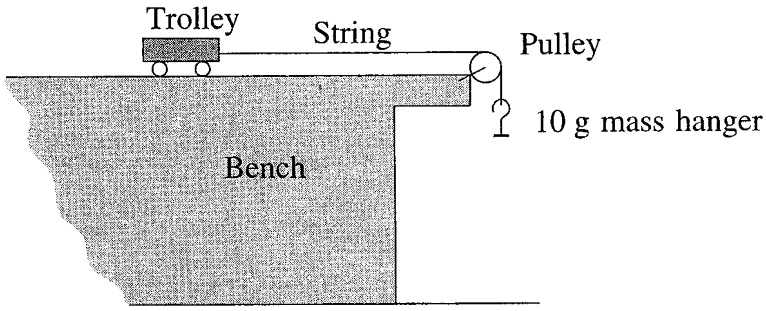
Q2A

(Total 24 marks)

Question 2B

Leave blank

(a) The apparatus shown in the diagram below 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 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 of the trolley given that

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

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Acceleration = ...

(4)

Leave blank

(b) 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) Applying Newton's second law to this system gives

$$(M + m)a = mg - F$$

where M = the mass of the trolley and its load, which is given on the card,
F = the frictional force opposing the motion of the system, and
g = the gravitational field strength.

Use your results from part (a) to calculate a value for F.

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(3)

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(d) Repeat the experiment with a larger value of m in order to calculate a second value for F.

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(4)

(e) Calculate the percentage difference between your two values of F. Comment on the extent to which the value of F may be regarded as constant if it is assumed that experimental errors are in the region of 10%.

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(2)

Leave blank

(f) The equation in part (c) may be investigated by plotting a graph of $(M+m)a$ against m.

(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 if the force F were constant.

(iii) State the values you would expect to obtain for both the gradient and the intercept on the vertical axis.

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(8)

Q2B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8\ \text{m s}^{-1}$	
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 × (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. $$\mathcal{E} = \Sigma IR$$

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

$T \propto$ Average kinetic energy of molecules

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

Conservation of energy

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

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

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

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)
	$\cos\theta \approx 1$