6733/2A
Physics

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

Edexcel GCE

Centre Number	
Candidate Number	
Paper reference	
Surname	
Other names	
Candidate signature	

Question numbers	Leave blank
A	
B	
Total	

Physics

Advanced Subsidiary

Unit Test PHY3 Practical Test

Wednesday 12 January 2005 – Morning

Time: 1 hour 30 minutes

For the Supervisor's use			
1A	(b)	Tick if help given 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 this booklet.

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Question A

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(a) (i) Measure the mass m_b of the 250 cm^3 (250 ml) beaker. You have access to a top pan balance. Pour the salt into the beaker and measure the total mass m_t of the beaker and salt. Hence determine the mass m of salt.

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Fill the measuring cylinder with water to within a few cm^3 of 100 cm^3. Record this volume.

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Pour this water into the beaker. Repeat the process. Record your second volume.

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State the total volume transferred to the beaker.

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Stir the water thoroughly so that a salt solution is formed.

Assuming that 1.00 cm^3 (1.00 ml) of water has a mass of 1.00 g and that there is no change in liquid volume as the salt dissolves, calculate the theoretical value for the density of the salt solution.

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(3)

Leave blank

(ii) Use the apparatus provided and the top pan balance to find the density of the salt solution experimentally. To gain full credit you must show all your working.

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(5)

(iii) Estimate the percentage uncertainty in your value for the volume of the solution.

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Assuming that the uncertainty in your mass values is negligible, discuss whether your two values for the theoretical and experimental density of the solution indicate that there is a change in the volume when the salt is dissolved in water. Your answer should be based on a quantitative argument.

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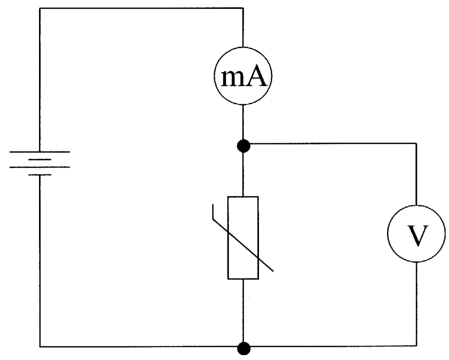
(4)

Leave blank

(b) (i) Set up the circuit as shown in the diagram below. Before connecting to the power supply 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) Using the space below, record the potential difference V across the thermistor and the current I in the thermistor.

$V =$ ....

$I =$ ....

Hence calculate a value for the resistance R of the thermistor.

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(3)

(iii) You are to observe how the current changes with time as you warm the thermistor and then sketch a graph of this.

Leave blank

Hold the thermistor between your thumb and forefinger and observe what happens to the current in the thermistor. Continue holding the thermistor until the current reaches a steady value. Record the final steady values for the current I_f in the thermistor and the potential difference V_f across it.

V_f ....

I_f ....

Hence calculate a second value R_f for the resistance of the thermistor.

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In the space below **sketch** a graph of the current in the thermistor against the time for which the thermistor is held.

(7)

QA

(Total 24 marks)

Leave blank

Question B

(a) (i) The apparatus has been set up ready for you to use and should not be moved.

Approximately half fill the beaker with the hot water provided. Quickly pour this water into the plastic cup up to the marked line, which is calibrated to give 100 cm^3 of water in the cup.

Observe the temperature of the water in the cup and start the stopwatch when the temperature reaches 80.0 °C. Record the temperature θ at regular intervals of time t for five minutes.

Tabulate your readings in the space below.

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(5)

(ii) Plot a graph of θ against t on the grid below.

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(4)

(iii) Determine the gradient $\Delta\theta/\Delta t$ of your graph when $\theta = 70.0$ °C.

Leave blank

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Hence calculate the rate at which the water is losing energy when $\theta = 70.0$ °C, given that the density of water is $1.0\ \text{g cm}^{-3}$ ($1000\ \text{kg m}^{-3}$) and its specific heat capacity is $4.2\ \text{J g}^{-1}\text{K}^{-1}$ ($4200\ \text{J kg}^{-1}\text{K}^{-1}$).

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(4)

(b) (i) It is suggested that an insulated cup could be made by using two cups with an air gap between them.

Draw a labelled diagram to show how you could do this with the apparatus provided.

(2)

(ii) Outline the steps you would take in repeating the experiment with the double cup in order to test its insulating properties compared with the single cup.

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(3)

(iii) In the space below, sketch the results you would expect to get. You should sketch the curves for the single cup and the double cup on the same set of axes. Label your curves.

(3)

(iv) It is suggested that the double cup should insulate at least twice as well as the single cup. Explain how you would test this from the curves that you have sketched in part (iii).

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(3)

(Total 24 marks)

Leave blank

QB

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)
Elementary (proton) charge	$e = 1.60 \times 10^{-19}\ \text{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
Electronvolt	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$	
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 $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $\quad F\Delta t = \Delta p$

Mechanical energy

Power $\quad P = Fv$

Radioactive decay and the nuclear atom

Activity $\quad A = \lambda N \quad$ (Decay constant λ)

Half-life $\quad \lambda t_{\frac{1}{2}} = 0.69$

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)
	$\cos\theta \approx 1$	