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 PHY3 Practical Test

Thursday 12 January 2006 – Morning

Time: 1 hour 30 minutes

Supervisor's Data and Comments		
A	Thickness of coin *t*	
	Tick if help given in: Circuit 1 (Give details below)	
	Tick if help given in: Circuit 2 (Give details below)	
	Tick if help given to change multimeter range (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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Turn over

Question A

(a) (i) Measure the thickness of the single coin.

....

Measure the thickness of the stack of coins.

....

Hence determine the number *n* of coins in the stack.

....

....

(4)

(ii) You are provided with a metre rule and knife-edge. Use the principle of moments to determine the ratio of the mass of the stack of coins to the mass of the single coin and hence a second value for *n*. Draw a diagram of the arrangement you used, showing carefully the distances you measured. Show all your measurements and calculations in the space below.

....

....

....

....

(6)

(iii) State **one** source of experimental error in **each** of these methods of determining *n*.

Error in method (i): ....

....

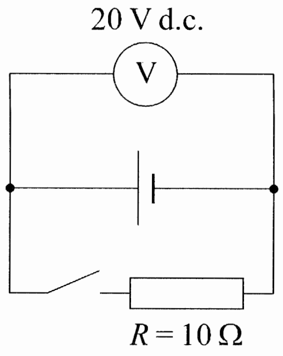
Error in method (ii): ....

....

(2)

Leave blank

(b) (i) Set up the circuit shown below, with the switch open and the multimeter set on the 20 V d.c. range.



If you are unable to set up the circuit ask the Supervisor. You will lose no more than 2 marks for this.

(2)

Record the e.m.f. ε of the cell.

ε = ...

Close the switch and record the potential difference V across the cell.

V = ...

Calculate a value for the internal resistance r of the cell given that

$$r = \left(\frac{\varepsilon}{V} - 1\right)R$$

where $R = 10\ \Omega$.

....

....

....

(2)

(ii) Disconnect the multimeter and set it to the 200 Ω range. If you are unable to do this ask the Supervisor. You will lose only 1 mark.

Use the meter to measure the resistance R_0 of the **lamp** when it is at room temperature.

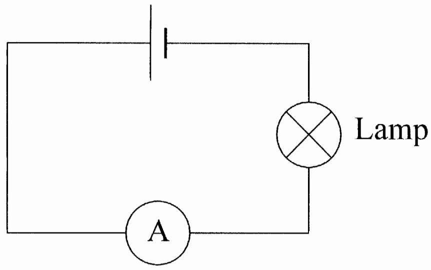
R_0 = ...

(2)

Leave blank

Leave blank

(iii) Set the multimeter to the 2 A d.c. range and then set up the circuit below.



If you are unable to do this ask the Supervisor. You will lose only 1 mark.

Record the current I in the lamp.

$I =$ ....

Use the p.d. V that you found in part (i) to calculate a value for the resistance R_T of the lamp when it is glowing.

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In view of the value you have obtained for R_T, discuss whether it is reasonable to use this value of V for the calculation.

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(4)

(iv) Calculate the ratio $\frac{R_T}{R_0}$ and use the graph opposite to estimate the temperature T of the glowing filament.

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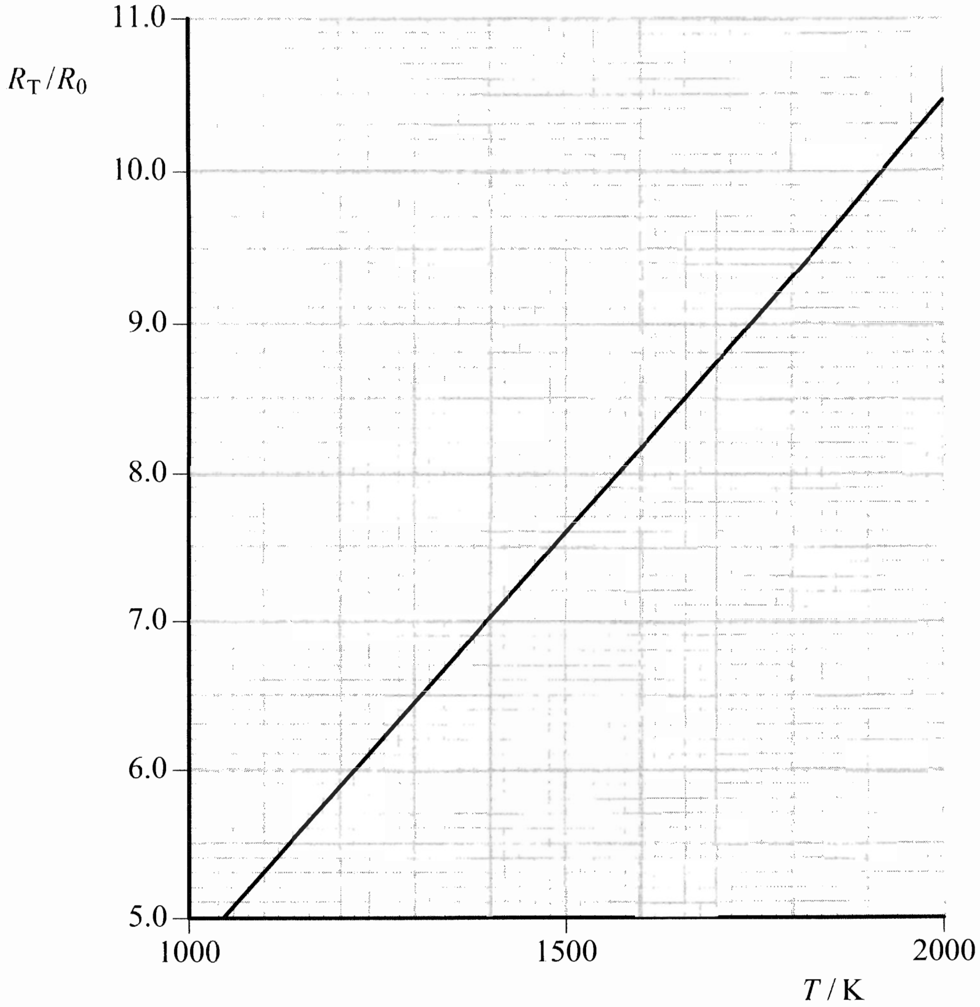
....

(2)



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QA

(Total 24 marks)

Question B

Leave blank

(a) (i) Place the 250 ml beaker on a heat proof mat. Pour water from the supply of boiling water up to the 75 ml mark on the 250 ml beaker and place the thermometer in the water. When the temperature starts to fall start the stopwatch and record, in the table below, the temperature θ_1 as a function of the time t for a period of 5 minutes. Add units to the headings of the columns of the table.

(ii) Repeat the above experiment using the 100 ml beaker rather than the 250 ml beaker. Fill the 100 ml beaker to the 75 ml mark from the supply of boiling water. Record your readings of θ_2 in the table below, adding the appropriate units.

Time t/	Temperature θ_1 of the water in the 250 ml beaker/	Temperature θ_2 of the water in the 100 ml beaker/

(6)

(b) Plot a graph of θ_1 against t on the grid opposite. Label this graph A.
On the same axes plot a graph of θ_2 against t on the grid opposite. Label this graph B.

(4)

(c) Determine the gradient of graph A at a **temperature** which is common to both graphs.

....

....

....

....

(4)

Leave blank

(d) A student suggests that the rate of fall of temperature at a given temperature is directly proportional to the area of the surface of the water, provided there is no loss of heat from the sides and base of the beaker. Plan an experiment to investigate this suggestion. Your plan should include:

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

(ii) sketches of any graphs you would plot,

(iii) an explanation of how the results would be analysed.

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(10)

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

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QB

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	$1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$	
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 = $F \times$ (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 $F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

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 $P = I^2 R$

Electrical circuits

Terminal potential difference $V = \varepsilon - Ir$ (E.m.f. ε; Internal resistance r)

Circuit e.m.f. $\Sigma\varepsilon = \Sigma IR$

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

Temperature and energy $T \propto$ 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

$\sin(90° - \theta) = \cos\theta$

$\ln(x^n) = n \ln x$

$\ln(e^{kx}) = kx$

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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