6733/2A
Physics
Group 1
(Home)

Edexcel GCE

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

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 Group 1 (Home)

Tuesday 15 May 2001 – Morning

Time: 1 hour 30 minutes

For the Supervisor's use		
1A	(a)	Turns *N*
		Diameter *D*
		Length *l*
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 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 1A

Leave blank

(a) (i) Count the number of turns N of the spring.

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Remove the spring from the nails. Measure the diameter D of the coiled part of the unstretched spring. Draw a sketch to explain how you did this.

....

With the coils touching, measure the length l of the **coiled** part of the spring.

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(6)

(ii) Calculate an approximate value for L, the length of wire forming the spring, given that $L = (N + 4)\pi D$.

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$L =$ ....

Calculate a value for the diameter $d = l/N$ of the wire from which the spring is made.

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$d =$ ....

Hence calculate the volume of wire $V = \pi d^2 L/4$.

....

....

$V =$ ....

(3)

Leave blank

(iii) Use the balance provided to find the mass m of the spring.

....

Use your values of m and V to find a value for the density of the material of the spring.

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....

(3)

(b) (i) Stretch the spring between the two nails. Use the meter and leads provided to find the resistance R of the **coiled** part of the spring. State any precautions that you took in making your measurement.

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(3)

(ii) Use your values of N, D and d from part (a) to determine a value for the resistivity ρ of the material of the wire given that

$$\rho = \frac{Rd^2}{4ND}$$

....

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....

....

(3)

(c) The energy stored in a stretched spring is $\frac{1}{2}Fx$ where x is the extension produced when a force F is applied to the spring.

Use the apparatus provided to determine a value for the energy stored in the spring when it is stretched between the two nails.

Describe with the aid of a diagram how you did this and show all your measurements and calculations in the space below.

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(6)

(Total 24 marks)

Leave blank

Q1A

Question 1B

Leave blank

(a) (i) Pour hot water into the glass beaker up to the 200 ml (cm^3) mark.

Record the temperature θ of this water at regular intervals until the temperature falls below 70 °C. Your starting temperature should be above 80 °C.

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(4)

(ii) Plot a graph of temperature θ against time t on the grid opposite.

(4)

(iii) Use your graph to determine the rate at which the temperature is falling, $\Delta\theta/\Delta t$, when $\theta = 75$ °C.

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Assuming that it takes 900 J of energy to raise the temperature of the beaker and water by 1 K (1 °C), estimate the power P of the heater that would be required to maintain the temperature of the water at a steady 75 °C.

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(4)

Leave blank

(b) (i) A student performs a similar experiment using a datalogger to capture the data and a computer to determine $\Delta\theta/\Delta t$. She finds that the required power is 30 W.

Draw a schematic (block) diagram to show the experimental arrangement and suggest a suitable sampling rate for the datalogger.

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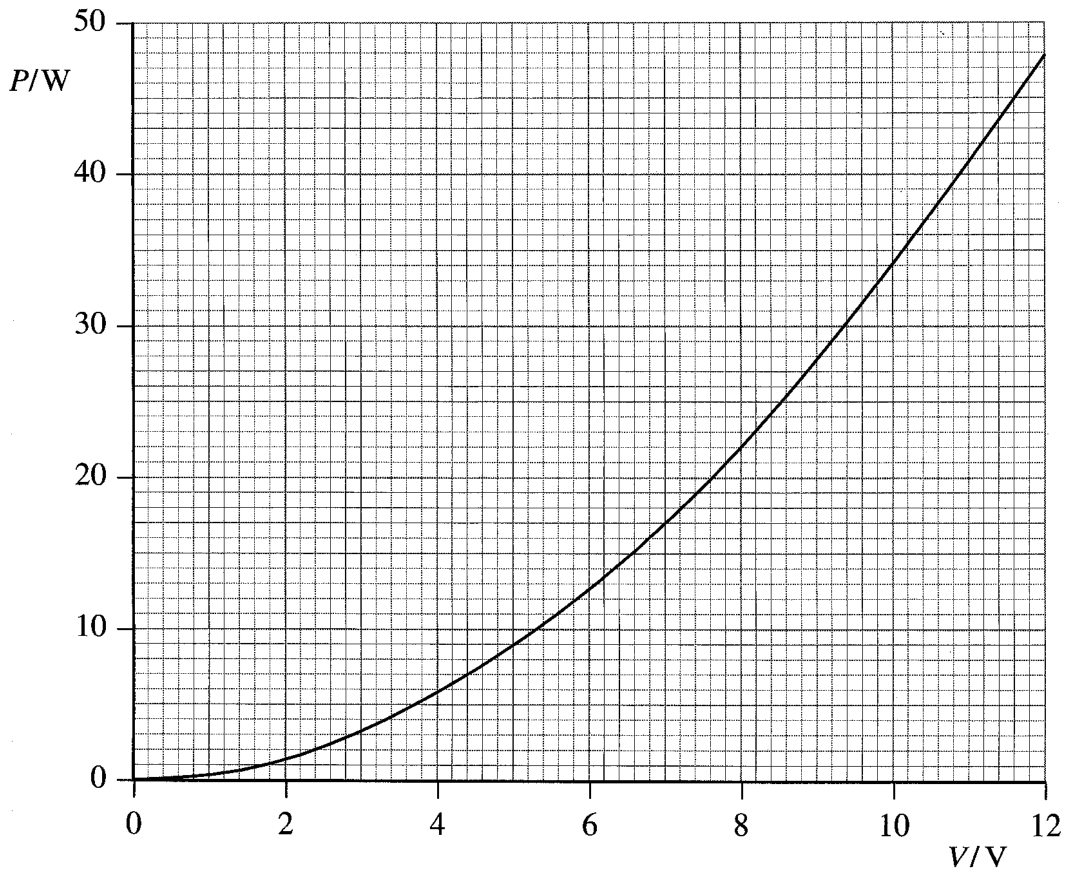
(4)

(ii) In a catalogue she finds a heater rated at 12 V, 48 W. Its power P varies with the applied potential difference V according to the following curve.



What potential difference would be required to provide a power of 30 W?

....

Leave blank

Describe, with the aid of a diagram, the circuit she could use to set the potential difference across the heater at the required value. You may assume that normal laboratory equipment is available.

Leave blank

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(4)

(iii) After immersing the heater in 200 ml of water and setting the power to 30 W she wants to monitor the temperature of the water in this arrangement overnight and analyse the results next morning.

Explain how she could do this.

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Suggest two reasons why she might find that the temperature had not remained at 75 °C.

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(4)

Q1B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^{8}$ 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)
Electronic 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	
Unified atomic mass unit	u $= 1.66 \times 10^{-27}$ kg	
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 × (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.	$= \Sigma IR$	
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	$p = \frac{1}{3}\rho\langle c^2\rangle$	

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)
	$\cos\theta \approx 1$	