6733/2A

Physics
Group 1

Edexcel
GCE

Centre Number	
Candidate Number	
Paper reference	
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 1

Monday 13 May 2002 – Morning

Time: 1 hour 30 minutes

For the Supervisor's use			
1A	(a)	Turns *N*	
		Length *l*	
		Mass *M*	
1B	Whether help given		
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.

Turn over

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Edexcel
Success through qualifications

Question 1A

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

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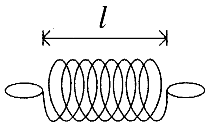
Measure as precisely as possible the length l of the coiled part of the spring when the coils are just touching.



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Use your values of N and l to determine a value for the diameter d of the wire from which the spring is constructed.

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(4)

(ii) Use the apparatus provided to find the extension x of the spring when different masses m are suspended vertically from the spring.

Plot a graph of x against m. Hence determine the mass M of the wooden block.

Show all your results below and use the grid opposite to plot your graph.

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(8)

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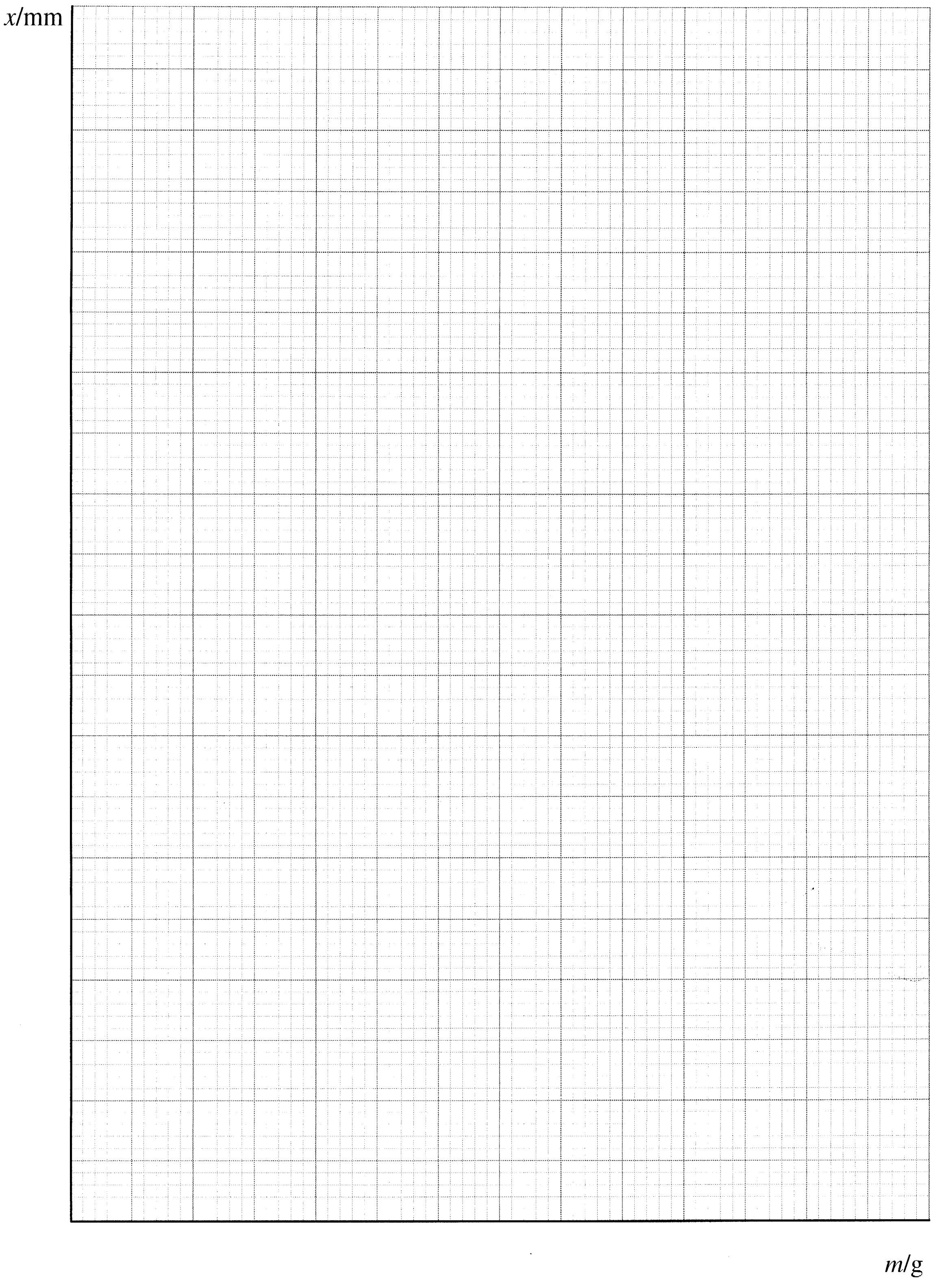

(b) (i) Use the electronic balance provided to find the mass of the candle and card. Use this mass and the data on the card to calculate the mass m of the candle.

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Pour 100 ml (cm^3) of water into the Pyrex beaker and place the candle under the beaker. (**Do not adjust the height of the beaker.**)

Use the candle to heat the water for 5.0 minutes and find the rise in temperature $\Delta\theta$ that this produces. Show your readings below and state any precautions that you took to ensure accuracy.

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Calculate a value for the power P of the candle assuming that

$$P = \frac{k\Delta\theta}{\Delta t}$$

where $k = 500\ \mathrm{J\,K^{-1}}$ and Δt = time for which water was heated.

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(6)

(ii) Use the balance to find the new mass of the candle and card. Hence find the mass Δm of wax that was burnt whilst heating the water.

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Use this value of Δm and your value of m from part (i) to estimate for how long the candle would burn.

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The manufacturer claims that the candle "gives as much light as a small lamp and will last all night". To what extent does your experiment support this?

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(6)

(Total 24 marks)

Q1A

Question 1B

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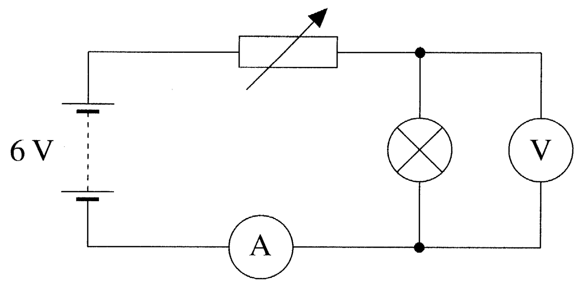
(a) (i) Set up circuit A as shown below.



Have your circuit checked by the Supervisor before switching on the power supply. 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 up to 3 marks for this.

Make measurements to determine the maximum and minimum values of current that this circuit can pass through the lamp.

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(5)

(ii) Measure the p.d. V across the lamp when the current I is at its minimum value. Hence find the resistance R of the lamp.

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Repeat the above to find the resistance of the lamp when the current is at its maximum value.

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Discuss whether the lamp obeys Ohm's law.

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(5)

(b) (i) It is suggested that $R = k\sqrt{I}$ where k is a constant.

Assuming that the total percentage uncertainty of the meters is 10%, discuss the extent to which your results confirm this relationship.

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(4)

(ii) Draw a circuit diagram to show how you would use the variable resistor as a potential divider to further investigate this relationship for values of I in the range 0–60 mA.

Describe how you would take the necessary readings.

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Sketch the graph you would plot and state how you would use it to find a value for k.

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(10)

Q1B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^{8}\ \mathrm{m\,s^{-1}}$	
Acceleration of free fall	$g = 9.81\ \mathrm{m\ s^{-2}}$	(close to the Earth)
Gravitational field strength	$g = 9.81\ \mathrm{N\ kg^{-1}}$	(close to the Earth)
Electronic charge	$e = -1.60 \times 10^{-19}\ \mathrm{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
Unified atomic mass unit	$\mathrm{u} = 1.66 \times 10^{-27}\ \mathrm{kg}$	
Molar gas constant	$R = 8.31\ \mathrm{J\ K^{-1}\ mol^{-1}}$	

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.	$\Sigma\mathcal{E} = \Sigma IR$	
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	$\theta/^\circ\text{C} = T/\text{K} - 273$	

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

	$\sin(90^\circ - \theta) = \cos\theta$	
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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