Centre No.						Paper Reference	Surname	Other names
Candidate No.						6 7 3 3 / 2 A	Signature	

Edexcel
GCE

Physics
Advanced Subsidiary
Unit Test PHY3 Practical Test Group 1

Wednesday 14 May 2008 – Afternoon

Time: 1 hour 30 minutes

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

Question numbers	Leave blank
1A	
1B	
Total	

Supervisor's Data and Comments			
1A	a(i)	Tick if circuit set up for candidate (Give details below)	
	a(ii)	Tick if the candidate needed assistance connecting the voltmeter	
1B		Weight of the suspended rule	
Comments			

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, other names and signature.

PHY3 consists of questions 1A and 1B. 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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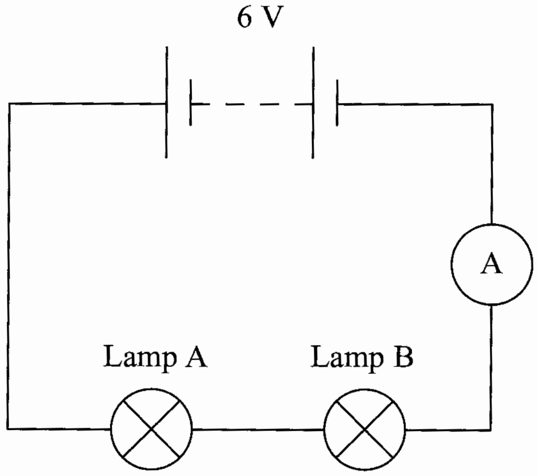
Question 1A

(a) (i) Set up the circuit as shown in the diagram below. Note at this stage the voltmeter with which you have been provided is not used.

Before you connect your circuit 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) Connect the power supply and measure the current I in the circuit.

$I =$ ....

(1)

(iii) Observe lamps A and B. State and explain your observations.

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(2)

(iv) Use the voltmeter to measure the potential difference V_A across lamp A and then the potential difference V_B across lamp B. If you do not know how to connect the voltmeter into the circuit, ask the Supervisor for assistance. You will only lose one mark for this.

$V_A =$ ....

$V_B =$ ....

Disconnect the power supply.

N 3 1 2 0 2 A 0 2 1 2

Leave blank

The normal operating voltage of both lamps is 6 V. Explain the relevance of your values of V_A and V_B to your observations in (iii).

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(6)

(b) (i) You have been provided with an inclined runway. Determine the time t taken for the sphere to travel a distance x of 0.800 m down the runway.

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(2)

(ii) The final speed v of the sphere at the end of the distance x is given by $v = \frac{2x}{t}$. Calculate v.

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(1)

(iii) Use the top pan balance to measure the mass m of the sphere. Hence find the linear kinetic energy of the sphere after travelling 0.800 m down the runway.

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(2)

(iv) In the space below draw a diagram of the inclined runway. Show carefully on your diagram the vertical height h through which the sphere moved when it travelled a distance of 0.800 m down the runway.

Determine the height h. State any techniques you used to obtain an accurate value for h.

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Hence find the gravitational potential energy lost by the sphere as it moved down the runway.

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(5)

Leave blank

(v) Calculate the value of $\frac{\text{Kinetic energy gained by the sphere}}{\text{Gravitational potential energy lost}}$.

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Calculate the percentage difference between your value of this ratio and the theoretical value which is 0.71.

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(3)

Q1A

(Total 24 marks)

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Question 1B

(a) Many modern road bridges have a single pillar from which the bridge is suspended. You are to investigate a model of this arrangement using the extension of a spring to measure the force.

An identical spring to the one used in the experimental arrangement must first be calibrated. Measure the unstretched length l of the coiled part of the vertically suspended spring.

l = ...

Add the 100 g mass hanger to the spring and determine the extension x of the spring. Add further 100 g masses and determine the corresponding extensions.

The force F extending the spring is given by:

$$F = mg$$

where m = total mass suspended from the spring and g = gravitational field strength.

Use the table below for your results. The force F has been calculated for you. You may use the additional column to assist in the recording of your results.

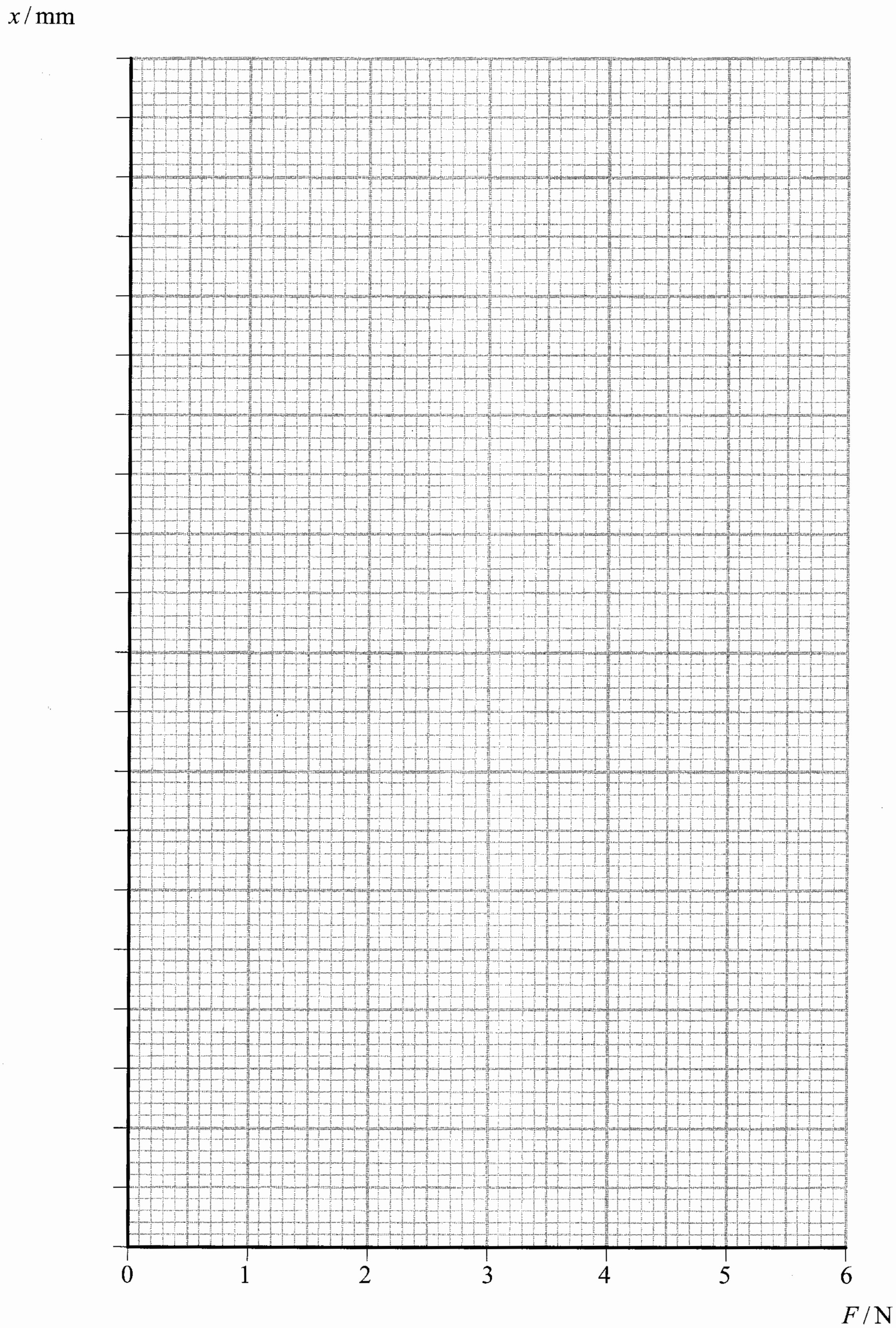
m/kg	F/N		x/mm
0.00	0.00		
0.10	0.98		
0.20	1.96		
0.30	2.94		
0.40	3.92		
0.50	4.91		

(4)

(b) Using the grid on page 7 plot a graph of x against F.

(2)

Leave blank



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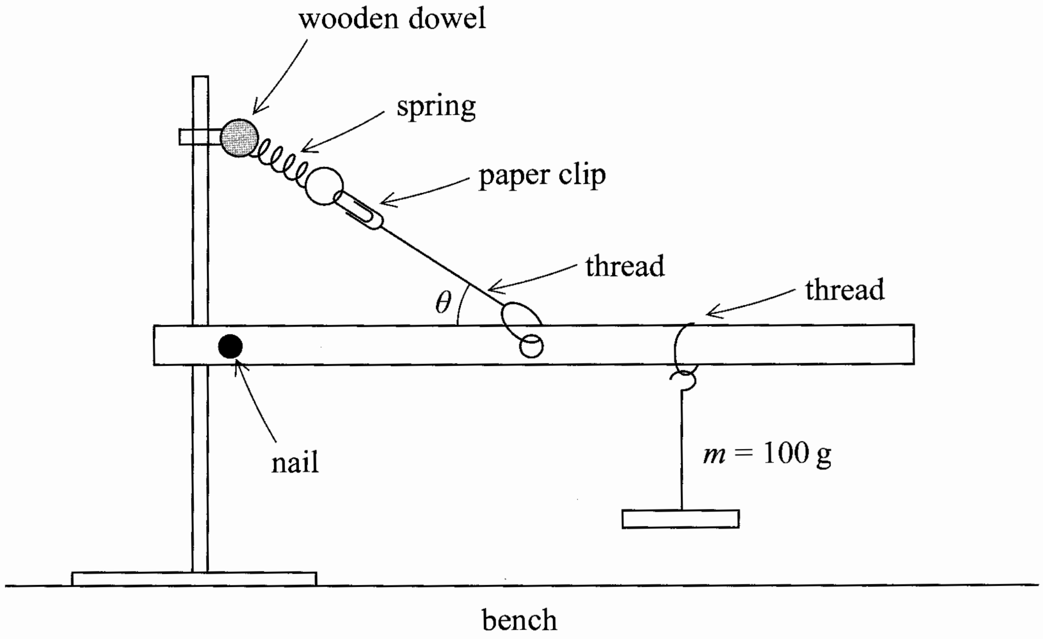
(c) The apparatus shown in the diagram below has already been set up for you. Move the mass $M = 100$ g so that it is suspended from the 90.0 cm mark on the rule.



Adjust the height of the boss holding the wooden dowel until the metre rule is horizontal. Explain how you ensured that the metre rule was horizontal. You may add to the above diagram if you wish.

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(2)

(d) Measure the height h_1 of the centre of the nail above the bench and the height h_2 of the centre of the dowel above the bench. Hence calculate the angle θ between the metre rule and the thread.

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(2)

Leave blank

(e) Measure the stretched length s of the coiled part of the spring. Using your value of l from part (a) determine the extension e of the spring.

$s =$ ....

$e =$ ....

Using the calibration graph from part (b) determine the tension T in the spring.

$T =$ ....

(3)

(f) When the rule is horizontal and in equilibrium, the following equation applies:

$$T \sin \theta = g \left(\frac{q}{p} \right) M + W \qquad \text{where}$$

p = distance from the centre of the nail to the centre of mass of the rule, which may be assumed to be at the 50.0 cm mark,
q = distance from the centre of the nail to the position on the rule from which mass M is suspended,
W = weight of the metre rule.

Determine p and q and use the information from parts (d) and (e) to calculate W.

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(3)

Leave blank

(g) A student wishes to investigate how $T \sin \theta$ depends on the mass suspended from the rule at the 90.0 cm mark. You are to plan this investigation. Your plan should include:

(i) an indication of the values in the equation which are constant,

(ii) a description of how the experiment would be performed,

(iii) a sketch of the graph to be plotted,

(iv) an indication of the expected results.

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(8)

Q1B

(Total 24 marks)

TOTAL FOR PAPER: 48 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	
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	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
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 $$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$$

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 $\theta/°\mathrm{C} = T/\mathrm{K} - 273$

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)

$\cos\theta \approx 1$