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

Tuesday 13 January 2009 – Afternoon

Time: 1 hour 30 minutes

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

Question numbers	Leave blank
1A	
1B	
Total	

For the Supervisor's use		
A	a) Tick if circuit set up for candidate (Give details below)	
A	b) Height of bench	
B	Weight of metre 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 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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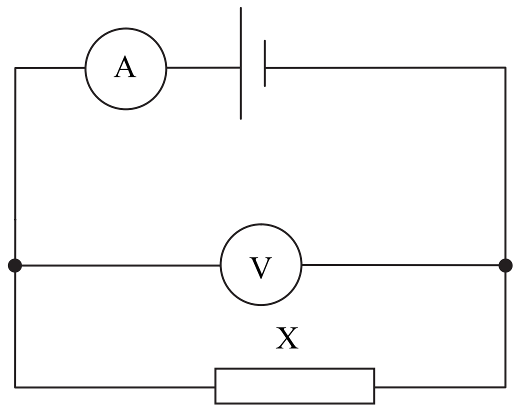
Question A

(a) (i) Set up the circuit as shown in the diagram below with the resistor labelled X in the circuit.

Before you connect 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. Measure the current I_X in the resistor X and the potential difference V_X across X.

I_X = ...

V_X = ...

(2)

(iii) Replace resistor X by resistor Y. Measure the current I_Y in the resistor Y and the potential difference V_Y across Y.

I_Y = ...

V_Y = ...

(2)

Leave blank

(iv) Connect resistor X so that it is in parallel with resistor Y. Measure the current I_C in the combination of resistors and the potential difference V_C across the combination.

I_C = ...

V_C = ...

(2)

Disconnect the power supply.

(v) Using your results from parts (ii), (iii) and (iv), calculate the resistance R_X of X, the resistance R_Y of Y and the resistance R_C of the parallel combination.

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(3)

(vi) Use your experimental values of R_X and R_Y to calculate the expected resistance R_T, of the parallel combination.

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Determine the percentage difference between R_C and R_T.

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Suggest possible reasons for any difference between R_C and R_T.

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(4)

Leave blank

(b) (i) Record the mass M of the block of wood and the small hook. This value is written on the block's top surface.

$M =$ ....

Place the 100 g mass on the block of wood. Record the total mass M_T of the block and the 100 g mass.

$M_T =$ ....

Position the block on the bench so that the mass hanger is just below the pulley. Add 10 g slotted masses to the 10 g mass hanger until it is clear that the block accelerates across the bench when given a gentle tap in the direction of travel.

Record the total mass m of the hanger and the slotted masses needed to cause this acceleration.

$m =$ ....

(1)

(ii) Determine the maximum distance x over which the block is accelerated.

Explain, with the aid of a diagram, how you did this.

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(3)

(iii) With the aid of the two small pieces of masking tape, mark the distance x on the bench. Determine the time t taken for the block of wood to travel this distance from rest.

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(2)

(iv) Calculate the acceleration a of the block given that $a = \dfrac{2x}{t^2}$.

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The frictional force F opposing the motion of the block is given by

$$F = mg - (M_T + m)a$$

Calculate F.

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(3)

Q1A

(Total 24 marks)

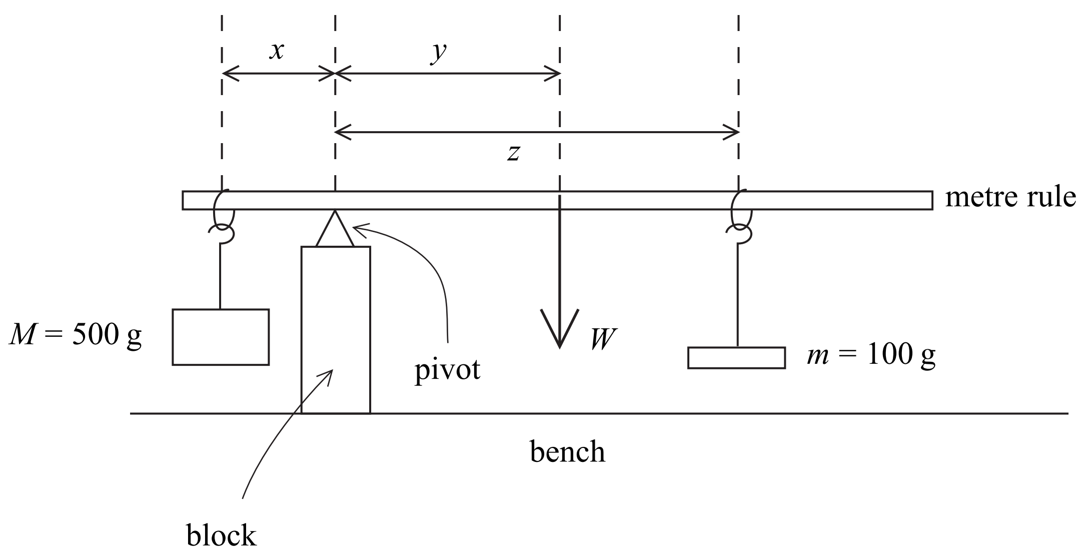
Leave blank

Question B

(a) Determine the position of the centre of mass of the metre rule.

Position of centre of mass = ...
(1)

(b) You are to investigate a model of a crane in which the weight of a mass that is being lifted on one side of a pivot is counterbalanced by a large weight placed on the opposite side of the pivot.



Place the pivot on the block of wood. Place the rule on the pivot at the 20.0 cm mark on the rule. Place one of the loops of thread at the 5.0 cm mark on the rule and suspend a mass $M = 500$ g from this point. Using the other loop of thread suspend a mass $m = 100$ g on the opposite side of the pivot. Move the position of the 100 g mass until the system is in equilibrium with the rule approximately horizontal. Determine the distances x, y and z shown on the diagram.

x = ...

y = ...

z = ...
(3)

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(c) By considering the uncertainty in the measurements taken on the metre rule determine the percentage uncertainty in your measurement of x. Which of the quantities x, y or z is likely to have the lowest percentage uncertainty? Explain your answer.

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(3)

(d) Applying the principle of moments to this situation, the following equation is obtained.

$$Mgx = Wy + mgz \qquad \text{[Equation 1]}$$

where W = the weight of the metre rule.

Using your results from part (b), determine W.

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(4)

Leave blank

(e) Without altering the position of the 100 g mass hanger, add a further 100 g to the hanger to give a new value of *m* of 200 g. Keeping the 200 g mass and the 500 g mass in the same positions, move the position of the rule on the pivot until the system is again in equilibrium with the metre rule approximately horizontal.

Record the new position of the pivot.

New position of pivot = ...

Determine new values for *x*, *y* and *z*. Hence determine a second value for *W*.

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(3)

(f) Calculate the percentage difference between the two values of *W*. Using your result from part (c), comment on the extent to which this percentage difference may be due to experimental uncertainty.

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(3)

Leave blank

(g) Equation 1 in part (d) may be re-written in the form:

$$\frac{y}{x} = -\frac{g}{W}\frac{mz}{x} + \frac{Mg}{W} \qquad \text{[Equation 2]}$$

In this equation *x*, *y*, *z* and *m* are all variables. *M*, *g* and *W* are constants. Equation 2 may be compared to that of a straight line. You are to plan an experiment to investigate this model, where **only** the movement of the pivot is used to restore balance when the value of *m* is changed. Your plan should include:

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

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

(iii) an indication of the expected results.

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(7)

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)
Elementary (proton) 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	
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 = $F \times$ (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 $P = I^2R$

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)

$\cos\theta \approx 1$

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