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

Friday 12 January 2007 – Afternoon

Time: 1 hour 30 minutes

For Examiner's use only

For Team Leader's use only

Question numbers	Leave blank
A	
B	
Total	

Supervisor's data and comments			
A	(a)	Tick if help given (Give details below)	
	(b)	Density	
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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N 2 4 3 1 5 A 0 1 1 2

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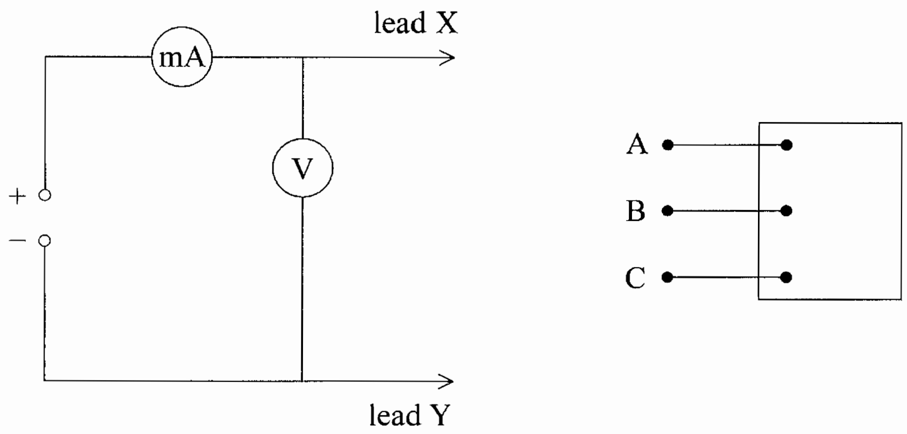
Question A

(a) (i) You have been provided with a hidden circuit that has three terminals. Set up the test circuit as shown in the diagram below. Before you connect your test 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 lose only two marks for this. You will not lose marks if the Supervisor only corrects a meter polarity error.



test circuit — hidden circuit

(2)

(ii) Connect the power supply to the test circuit. Connect lead X of the test circuit to terminal A of the hidden circuit and lead Y of the test circuit to terminal B of the hidden circuit. Record the current I in the circuit and the potential difference V across the hidden circuit in the table below. Include units for I and V in the table.

(iii) Repeat the above procedure for all possible connections of the test circuit to the hidden circuit. All possible connections are listed in the table below, where you should record all your results.

X connected to	Y connected to	I /	V /
A	B		
A	C		
B	A		
B	C		
C	A		
C	B		

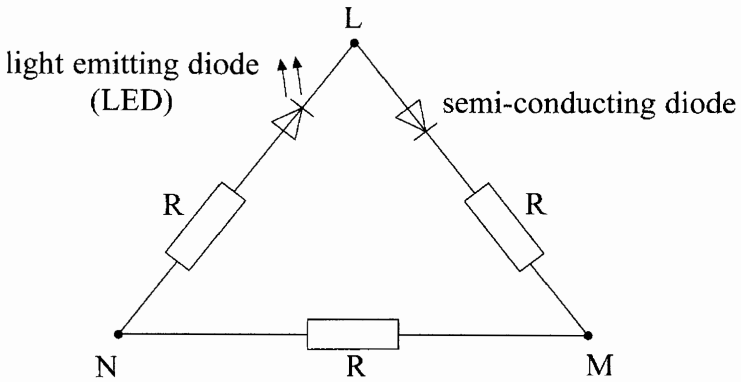
(7)

N 2 4 3 1 5 A 0 2 1 2

No further readings are required for part (a). You may wish to take your readings for part (b) and return later to (a)(iv).

(iv) The arrangement of the components in the hidden circuit is shown in the diagram below.

All the resistors shown in the circuit have the same value and for any given current, the light emitting diode (LED) will have a higher resistance than the semiconducting diode.



By considering each pair of terminals in the hidden circuit shown above, choose the connection that would have the least resistance.

Positive terminal of power supply connected to ....

Negative terminal of power supply connected to ....

Explain your reasoning.

....

....

....

....

Hence deduce which terminals of the hidden circuit shown above correspond to the terminals of the hidden circuit that you tested.

Terminal L corresponds to ....

Terminal M corresponds to ....

Terminal N corresponds to ....

(5)

Leave blank

Leave blank

(b) (i) Measure as accurately as possible the length l, the width w and the thickness t of the wooden block.

l = ...

w = ...

t = ...

Calculate the volume $V = lwt$ of the block. Using the mass given on the top face of the block, calculate a value for the density of the material of the block.

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(4)

(ii) Place the block in the tray of water with the top face uppermost. Determine the average thickness t_B of the block that is beneath the surface of the water. The block may float with the top face at an angle, hence you are to determine the average thickness. Use the four small pins to mark the position of the surface of the water on the sides of the block.

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Explain, with the aid of a diagram, where you placed the pins.

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(3)

Leave blank

(iii) Evaluate the ratio t_B / t.

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(3)

QA

(Total 24 marks)

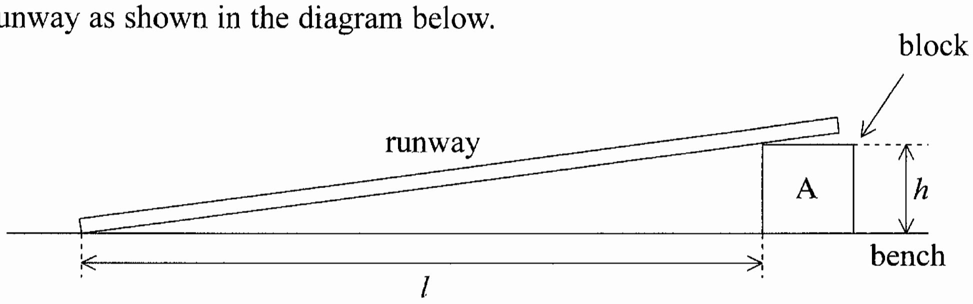
N 2 4 3 1 5 A 0 5 1 2

Turn over

Leave blank

Question B

(a) You have been provided with a runway and two blocks. Place the block labelled A under the runway as shown in the diagram below.



Record the height h of the block and the horizontal length l to determine the angle θ that the runway makes with the horizontal using $\tan\theta = h/l$.

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(2)

(b) Determine the time t for the trolley to travel a distance x of 0.800 m from rest down the runway. Hence determine the acceleration a of the trolley using $a = 2x / t^2$.

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(3)

(c) The ratio R of the frictional force acting on the trolley to the weight of the trolley is given by the equation

$$R = \sin\theta - \frac{a}{g}$$

where g is the gravitational field strength.

Calculate a value for R using your data from parts (a) and (b).

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(1)

N 2 4 3 1 5 A 0 6 1 2

Leave blank

(d) Repeat parts (a), (b) and (c) to obtain a second value for R using the block labelled B to support the runway.

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(5)

(e) Estimate the percentage uncertainty in the time taken for the trolley to travel 0.800 m down the runway using the times recorded in part (d).

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(2)

(f) Determine the percentage difference between your two values of R.

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The percentage uncertainty in t^2 is twice the percentage uncertainty in t. Comment on the extent to which the percentage difference between your two values of R could be attributed to the percentage uncertainty in t^2, which you may assume is the same for each value of R.

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(4)

Leave blank

(g) The equation in part (c) may be rewritten in the form

$$a = g\sin\theta - gR$$

A student suggests that if the value of R is assumed constant then R can be found by a graphical method. Plan an experiment to determine R.

Your plan should include

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

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

(iii) how you would use the graph to find R.

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(7)

QB

(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	$1\ \text{eV} = 1.60 \times 10^{-19}\ \text{J}$	
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$	
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 $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $\quad F\Delta t = \Delta p$

Mechanical energy

Power $\quad P = Fv$

Radioactive decay and the nuclear atom

Activity $\quad A = \lambda N \quad$ (Decay constant λ)

Half-life $\quad \lambda t_{\frac{1}{2}} = 0.69$

Electrical current and potential difference

Electric current $I = nAQv$

Electric power $P = I^2R$

Electrical circuits

Terminal potential difference $V = \varepsilon - Ir$ (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 $\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

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 $= \dfrac{\text{Useful output}}{\text{Input}}$

For a heat engine, maximum efficiency $= \dfrac{T_1 - T_2}{T_1}$

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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