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 13 May 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	

Supervisor's Data and Comments			
1A	a(i)	Tick if the circuit was set up for the candidate (Give details below)	
1A	a(iv)	Tick if the resistor was connected into the circuit for the candidate	
1A	b(i)	Width *w* to 0.1 mm	
1A	b(i)	Thickness *t* to 0.1 mm	
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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N 3 3 4 0 6 A 0 1 1 6

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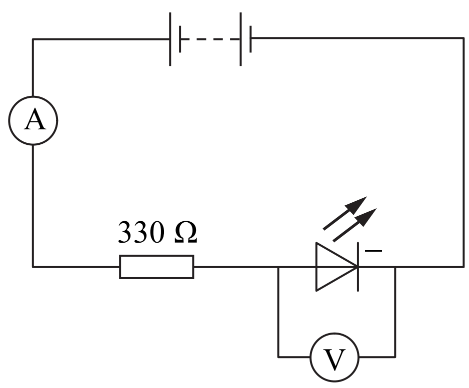
Question 1A

(a) (i) Set up the circuit as shown in the diagram below. Make sure the light emitting diode (LED) is connected the right way round. 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. Measure the current I in the circuit and the potential difference V across the LED.

I = ...

V = ...

Circle the words that most clearly describe the brightness of the LED.

Very bright Bright Dim No light

(2)

(iii) Calculate the resistance R of the LED.

....

....

....

(2)

N 3 3 4 0 6 A 0 2 1 6

Leave blank

(iv) Connect the 10 kΩ resistor in series with the 330 Ω resistor and repeat your measurements of I and V. If you do not know how to connect the resistor into the circuit ask the Supervisor for assistance. You will only lose 1 mark for this. Record your measurements below and calculate a second value for the resistance of the LED.

I = ...

V = ...

....

....

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(4)

(v) From your observations of the LED, suggest how the intensity of the light emitted by the LED is related to the resistance of the LED.

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....

(1)

Leave blank

(b) (i) Determine the width *w* and the thickness *t* of the metre rule.

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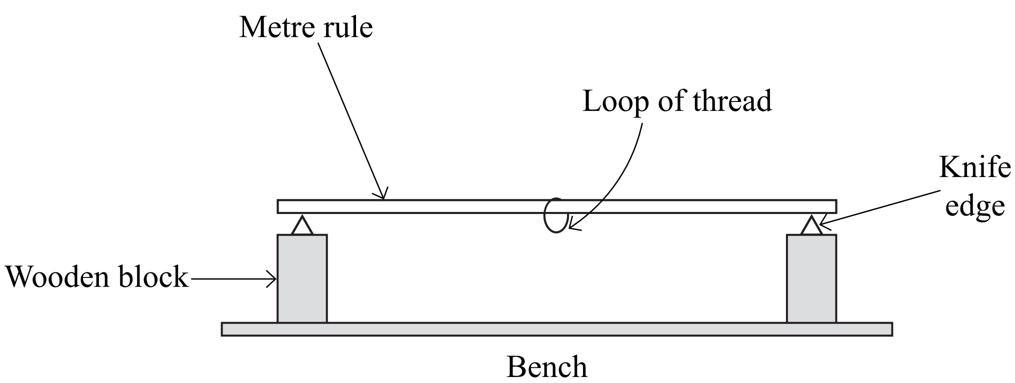
(4)

(ii) Set up the apparatus as shown in the diagram below with the knife edges at the 5.0 cm and 95.0 cm marks on the rule and the loop of thread at the 50.0 cm mark.



(iii) Use the half metre rule to determine an accurate value of the vertical displacement *x* at the centre of the metre rule when a mass $M = 0.500$ kg is suspended from the centre of the rule.

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(1)

(iv) Explain how you did this. You may add to the diagram if you wish.

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(2)

Leave blank

(v) Estimate the percentage uncertainty in your value of x.

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(2)

(vi) Calculate a constant E for the material of the rule where

$$E = \frac{L^3 M g}{4 w t^3 x}$$

L = the distance between the two knife edges
g = the gravitational field strength.

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(4)

Q1A

(Total 24 marks)

N 3 3 4 0 6 A 0 5 1 6

Turn over

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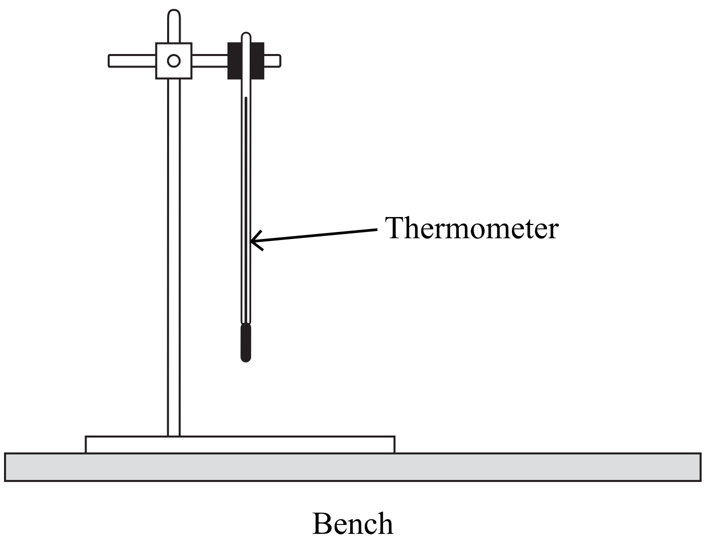
Question 1B

(a) It is expected that the rate of fall of temperature of a thermometer removed from boiling water is directly proportional to the temperature difference between the thermometer and room temperature. You are to investigate this relationship.

Record room temperature, θ_R.

θ_R = ...

You are to carry out a trial experiment so that you can gauge how quickly the temperature of the thermometer falls. Place the bulb of the thermometer into the supply of boiling water. When the temperature on the thermometer has remained close to 100 °C for about one minute, quickly remove the thermometer from the boiling water and clamp it, using the cork near the top of the thermometer. This is shown in the diagram below.



Immediately after clamping the thermometer, start the stopwatch and at the same time record the initial temperature θ_S on the thermometer.

θ_S = ...

Also record the total time T taken for the temperature of the thermometer to fall to 40 °C.

T = ...

(1)

N 3 3 4 0 6 A 0 7 1 6

Turn over

Leave blank

(b) You should now be familiar with how quickly the temperature falls. Replace the bulb of the thermometer into the supply of boiling water. Repeat the instructions in part (a) and, as soon as you have clamped the thermometer, record the temperature θ as a function of the time t until the temperature reading is approximately 40 °C. Use the table below to record your readings. Times should be recorded to the nearest second.

Describe a difficulty of repeating this experiment to obtain an average set of data.

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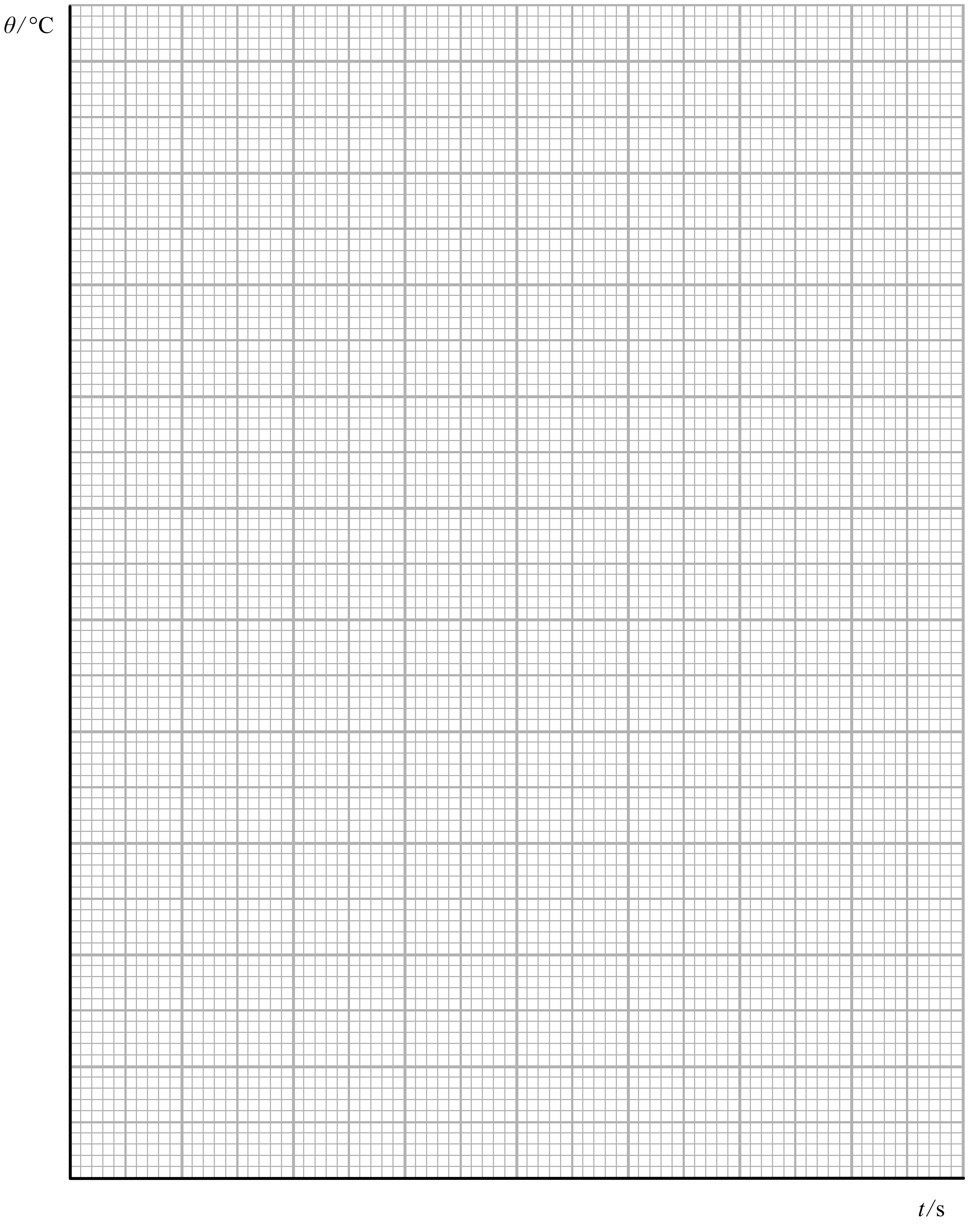
(4)

(c) Using the grid on the opposite page, plot a graph of θ against t.

(3)


θ/°C
t/s

Leave blank

(d) If the rate of fall of temperature of the thermometer is directly proportional to the temperature difference between the thermometer and room temperature, then

$$\frac{\Delta\theta}{\Delta t} = k(\theta - \theta_R)$$

θ = the temperature at which the rate of fall of temperature $\frac{\Delta\theta}{\Delta t}$ is measured,

θ_R = room temperature.

The gradient of your graph is the rate of fall of temperature $\Delta\theta/\Delta t$. You are to determine the gradient of your graph at each of two different temperatures.

State the two temperatures at which you are going to determine the gradient.

Higher temperature θ_2 = ...

Lower temperature θ_1 = ...

Explain your choice of temperatures.

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Calculate the gradients of your graph at the two temperatures.

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(4)

Leave blank

(e) Determine a value for *k* at each of the two temperatures at which you measured the gradient of the graph.

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(3)

(f) Determine the percentage difference between your two values of *k*. Comment on the extent to which your results confirm the suggestion in (a) with reference to the nature of the experiment.

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(3)

Leave blank

(g) A student wishes to use a datalogger to investigate further how the rate of fall of temperature is directly proportional to the temperature difference between a temperature sensor and the room, using the equation:

$$\frac{\Delta\theta}{\Delta t} = k(\theta - \theta_R)$$

You are to plan this investigation. Your plan should include:

(i) a block diagram showing the equipment required,

(ii) an indication of the set time interval between temperature readings,

(iii) an indication of how the temperature-time data would be analysed,

(iv) a sketch of the final graph that would need to be plotted to verify the relationship,

(v) an indication of the expected results,

(vi) an indication of how *k* would be determined from the graph.

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Leave blank

(6) **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)
Elementary (proton) charge	$e = 1.60 \times 10^{-19}\ \mathrm{C}$	
Electronic mass	$m_e = 9.11 \times 10^{-31}\ \mathrm{kg}$	
Electronvolt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$	
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 = $F \times$ (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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