6733/2A
Physics
Group 1

# Edexcel GCE

| Centre Number | | | | | |
|---|---|---|---|---|---|
| Candidate Number | | | | | |
| Paper reference | | | | | |
| Surname | | | | | |
| Other names | | | | | |
| Candidate signature | | | | | |

| For Examiner's use only |
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| For Team Leader's use only |
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| Question numbers | Leave blank |
|---|---|
| A | |
| B | |
| Total | |

# Physics

## Advanced Subsidiary

## Unit Test PHY3 Practical Test
## Group 1

## Monday 17 May 2004 – Morning

Time: 1 hour 30 minutes

| Supervisor's Data and Comments | | | |
|---|---|---|---|
| 1A | (a) | Diameter | |
| | | Weight $W$ | |
| | (b) | Tick if help given<br>Give details below | |
| Comments | | | |
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## 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.**

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Edexcel
*Success through qualifications*

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## Question 1A

(a) (i) Check that the rod part of the stand labelled S is of uniform cross-section by taking suitable measurements. Your method and all your measurements should be shown below.

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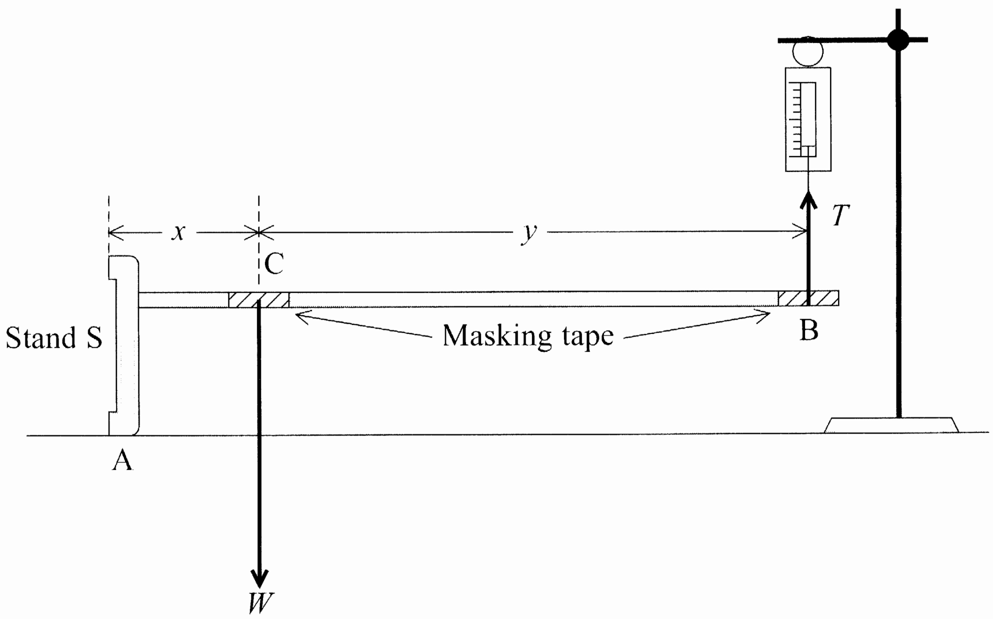
**(4)**

(ii) Balance the stand on the knife edge so that the rod is horizontal. Mark on the piece of tape the position C of the balance point.

Now set up the arrangement shown below.




Support the rod with the newton-meter at a point B on the tape near the end. Mark this point.

Adjust the height of the newton-meter so that the rod is horizontal. Explain how you ensured that the rod was horizontal.

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**(1)**

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(iii) The principle of moments shows that

$$W = \frac{T(x+y)}{x}$$

where $W$ is the weight of the stand and $T$ is the newton-meter reading.

Measure and record the distances $x$ and $y$, and record the value of $T$.

$x$ ..........................................................................................................................

$y$ ..........................................................................................................................

$T$ ..........................................................................................................................

Use these data to calculate a value for the weight $W$ of the stand.

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**(4)**

(iv) Estimate the percentage uncertainty in your value for $y$. Discuss the difficulty of estimating the percentage uncertainty for $x$.

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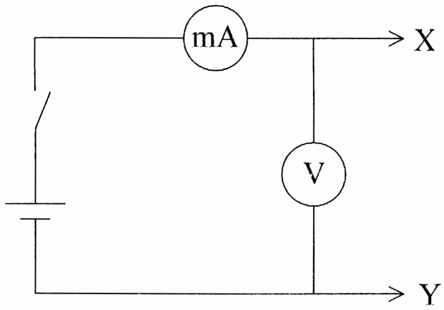
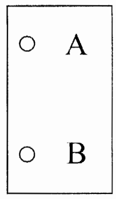
**(3)**

(b) (i) Set up the test circuit as shown in the diagram. Leads X and Y are labelled. Before you switch on the power supply, have your circuit checked by the Supervisor. 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 two marks for this.




Test circuit




Unknown circuit

**(2)**

(ii) Connect X to A and Y to B to measure the current in and the voltage across the unknown circuit.

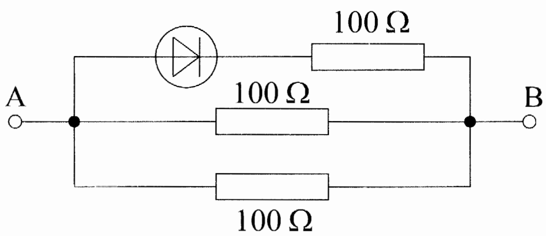
Repeat this with X connected to B and Y connected to A.

Summarise your results in the table below. Complete the table by inserting appropriate units and determining the resistance in each case.

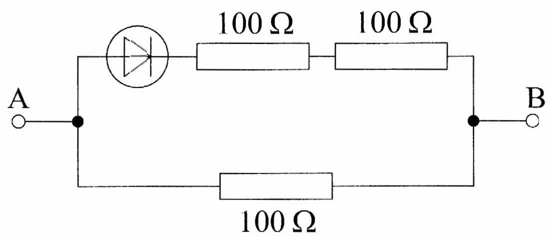
| X connected to | Y connected to | Current/ | Voltage/ | Resistance/ |
|---|---|---|---|---|
| A | B | | | |
| B | A | | | |

**(4)**

(iii) A technician makes up the following 3 circuits for an examination such as this.




J

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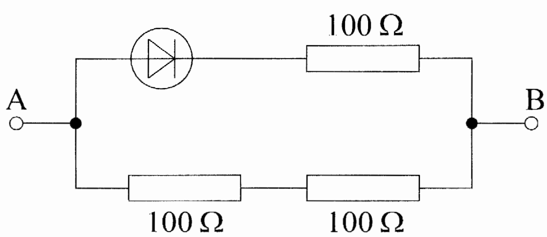


L



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Explain carefully which of the circuits is the one you tested.

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(iv) Deduce the resistance of the diode when it is conducting.

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**(3)**

**(Total 24 marks)**

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**Q1A**

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## Question 1B

(a) Record the temperature $\theta_0$ of the water in the beaker labelled 'Water at room temperature'.

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Pour 20 $cm^3$ (20 ml) of this water into the measuring cylinder.

The beaker which is labelled 'For hot water' has a horizontal line drawn on it at the 100 $cm^3$ mark. Fill the beaker to the horizontal line with boiling water from the kettle. You are now to measure the fall in temperature $\Delta\theta$ of this hot water when 20 $cm^3$ of the water at room temperature is added. Record the temperature $\theta_i$ of the hot water just before the 20 $cm^3$ is added and the temperature $\theta_f$ just after the water is added. Show all your measurements and calculations in the space below. State any special precautions which you took to ensure an accurate value for $\Delta\theta$.

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**(5)**

(b) For the mixing of a fixed volume of hot water and a fixed volume of water at room temperature it is suggested that

$$\Delta\theta = k(\theta_f - \theta_0)$$

where $k$ is a constant.

Using your results from part (a) determine a value for $k$.

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(c) You are now to repeat the experiment using a lower value of $\theta_i$, keeping the volume of hot water as 100 $cm^3$ and the volume of added water at 20 $cm^3$. Describe carefully how you can do this without refilling the beaker with hot water. Record your results and determine a second value for $k$.

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**(5)**

(d) Determine the percentage difference between your two values of $k$. Comment on the extent to which your results confirm the suggested relationship, assuming that the total experimental error is of the order of 10%.

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**(3)**

(e) Describe how you would continue the experiment in order to investigate more fully the suggested relationship. Your account should include

(i) a description of what you would do,

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(ii) a sketch of the graph that would be plotted, showing the expected result,

(iii) an indication of how the value of $k$ could be determined from the graph.

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**(8)**

**(Total 24 marks)**

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**Q1B**

**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 | $1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$ | |
| Planck constant | $h = 6.63 \times 10^{-34}\ \mathrm{J\ s}$ | |
| 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 $$F = m\frac{\Delta v}{\Delta t} = \frac{\Delta p}{\Delta t}$$

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

### *Mechanical energy*

Power $$P = Fv$$

### *Radioactive decay and the nuclear atom*

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

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 $\Delta T$) |
| Celsius temperature | $\theta/°\mathrm{C} = T/\mathrm{K} - 273$ | |

***Kinetic theory of matter***

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|---|---|
| | $T \propto$ 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 $\Delta Q$; Work done on body $\Delta W$) |
| 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) |
| | $\cos\theta \approx 1$ | |