| Centre No. | | | | | | Paper Reference | | | | | | | Surname | Initial(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Candidate No. | | | | | | 6 | 7 | 3 | 2 | / | 0 | 1 | Signature | |

Paper Reference(s)

**6732/01**

# Edexcel GCE

## Physics

## Advanced Subsidiary

Unit Test PHY2

Wednesday 17 January 2007 – Afternoon

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

| Question Number | Leave Blank |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| Total | |

| Materials required for examination | Items included with question papers |
|---|---|
| Nil | Nil |

**Instructions to Candidates**

In the boxes above, write your centre number, candidate number, your surname and initials and your signature.
Answer ALL questions in the spaces provided in this question paper.
In calculations you should show all the steps in your working, giving your answer at each stage.
Calculators may be used.
Include diagrams in your answers where these are helpful.

**Information for Candidates**

The marks for individual questions and the parts of questions are shown in round brackets.
There are seven questions in this paper. The total mark for this paper is 60.
**The list of data, formulae and relationships is printed at the end of this booklet.**

**Advice to Candidates**

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.



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**1.** The relationship between physical quantities can be expressed as a **word equation**.

For example

$$\text{Current} = \frac{\text{Charge}}{\text{Time}}$$

Complete the following **word equations**.

| |
|---|
| Pressure = |
| Resistivity = |
| Pressure × Volume = <br>of an ideal gas |

Q1

**(Total 5 marks)**

Leave blank

**2.** A 240 V 60 W light bulb has a tungsten filament which has a working temperature of 2600 °C.

(a) Calculate the resistance of the tungsten filament at this temperature.

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Resistance = ...............................................

**(2)**

(b) The filament has a cross-sectional area of $3.1 \times 10^{-10}\,m^2$. Tungsten contains $3.4 \times 10^{28}$ free electrons per cubic metre. Determine the drift speed of the electrons in the filament when the current is 0.25 A.

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Drift speed = ..............................................

**(3)**

(c) Explain fully why the resistance of a tungsten filament increases with temperature. You may be awarded a mark for the clarity of your answer.

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**(4)**

**Q2**

**(Total 9 marks)**

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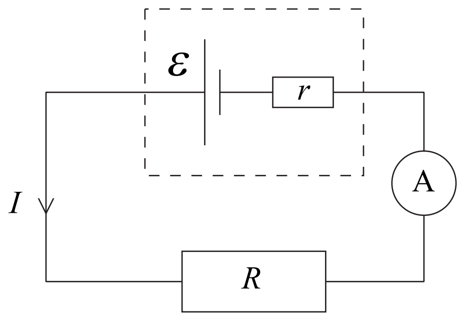
**3.** A student sets up the following circuit using a cell of e.m.f. $\mathcal{E}$ and internal resistance $r$.

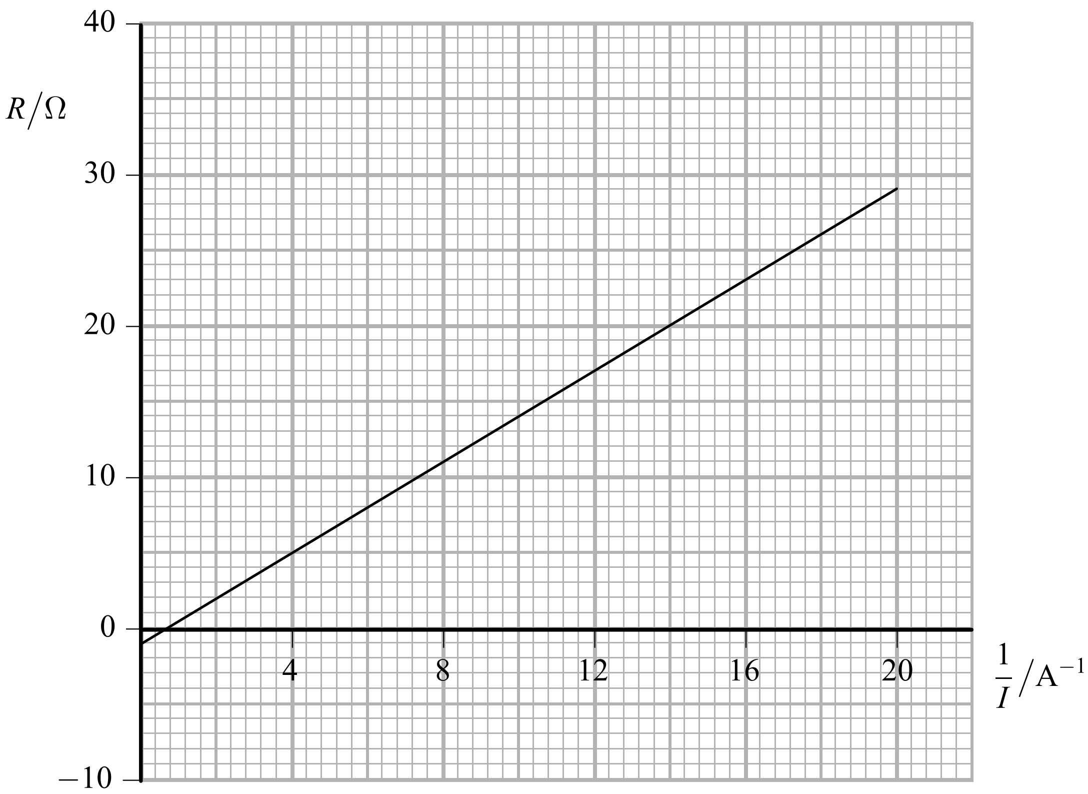



(a) Complete the equation for the total e.m.f. $\mathcal{E}$ in terms of the other quantities given in the diagram.

$\mathcal{E} =$

**(1)**

(b) He measures the current $I$ for different values of resistance $R$. He then plots a graph of $R$ against $1/I$.






N 2 3 6 0 0 A 0 4 1 6

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The equation for this graph is

$$R = \frac{\mathcal{E}}{I} - r$$

(i) Show how this equation is derived from the one you have stated above.

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**(1)**

(ii) Use the graph to determine the value for the e.m.f. of the cell. Show all your working.

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E.m.f. = ..................................

**(2)**

(iii) Show that when the external resistance is 5 Ω the power dissipated in that resistance is about 0.3 W.

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**(3)**

(c) The student repeats the experiment adding an identical cell in series. Draw on the graph the result of this experiment.

**(3)**

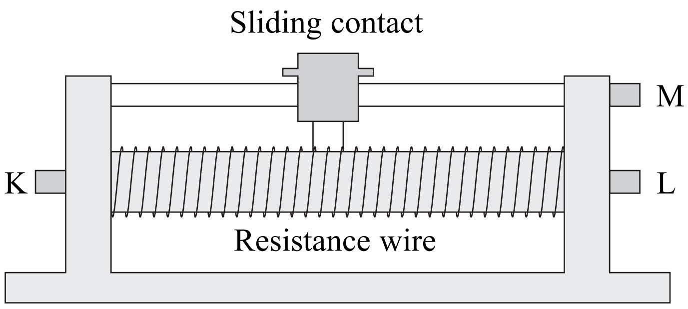
**Q3**

**(Total 10 marks)**

Leave blank

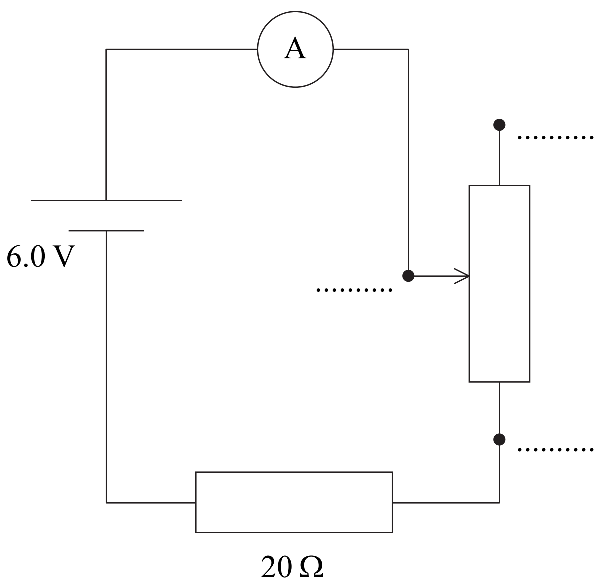
**4.** A variable resistor consisting of a wire and sliding contact has three terminals labelled K, L and M.

**Figure 1**




The variable resistor is connected in series with a 6.0 V supply of negligible internal resistance, an ammeter and a 20 Ω fixed resistor.

**Figure 2**




(a) Label the terminals K, L and M on Figure 2.

**(1)**



N 2 3 6 0 0 A 0 6 1 6

Leave blank

(b) (i) The variable resistor has a maximum resistance of 10 Ω. The resistance of the fixed resistor is 20 Ω. Determine the potential difference across the resistor when the sliding contact is at the mid-point of the variable resistor.

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Potential difference = ..................................................

**(3)**

(ii) What assumption have you made about the ammeter?

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**(1)**

(c) The same components can be used in a second circuit to vary the potential difference across the fixed resistor fully from 0 V to 6.0 V. Draw the circuit diagram for this potential divider arrangement.

**(3)** **Q4**

**(Total 8 marks)**

N 2 3 6 0 0 A 0 7 1 6

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**5.** (a) You are asked to determine the specific latent heat of vaporisation of water by an electrical method.

(i) Outline your method. Include a diagram of the apparatus you would use.

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**(4)**

(ii) State one precaution that you would take to ensure an accurate result.

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**(1)**

(b) A student heats 400 g of water from 0 °C until it has all changed to steam.

(i) Show that the energy required to raise the temperature of 400 g of water from 0 °C to its boiling point is approximately $2 \times 10^5$ J. The specific heat capacity of water is 4200 J kg$^{-1}$ K$^{-1}$.

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**(2)**

(ii) Calculate the energy required to change 400 g of water, at its boiling point, to steam. The specific latent heat of vaporisation of water is $2.3 \times 10^6$ J kg$^{-1}$.

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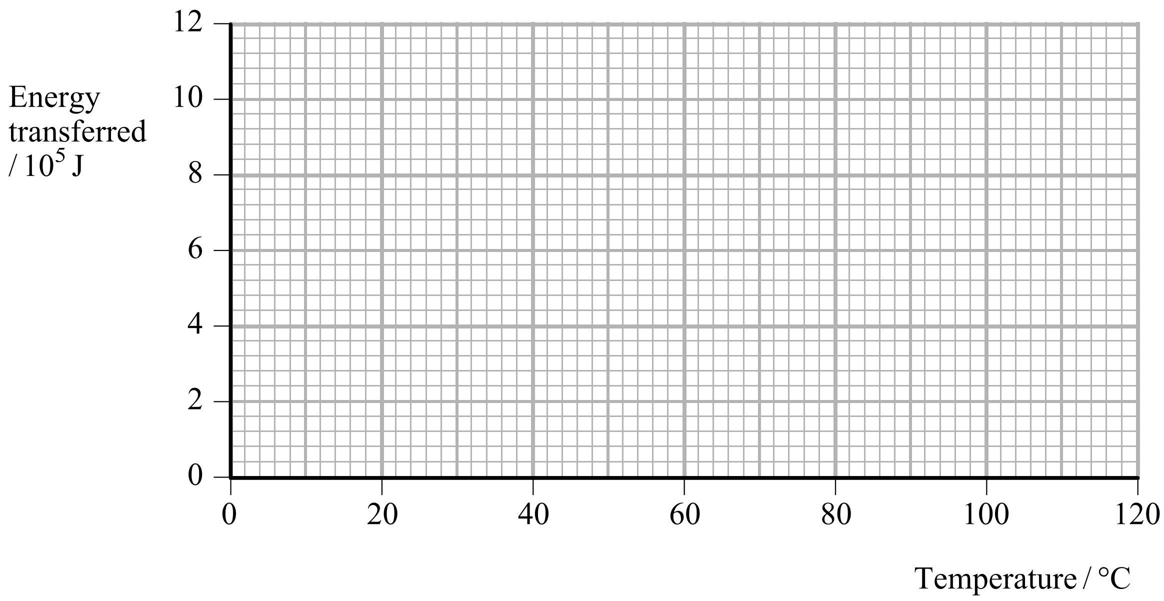
Energy = ..................................................

**(1)**

(iii) Use the axes below to plot a graph of energy transferred to the water against temperature.




**(2)**

**(Total 10 marks)**

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**Q5**



N 2 3 6 0 0 A 0 9 1 6

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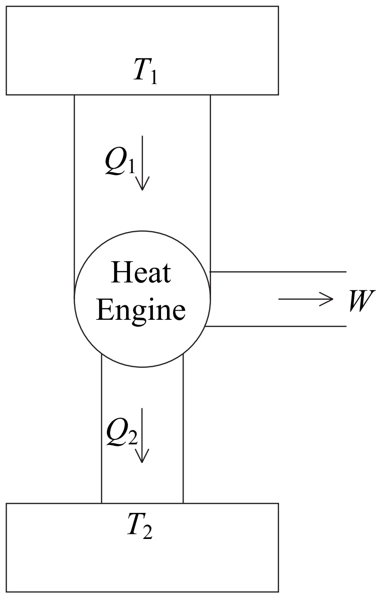
**6.** (a) The diagram can be used to illustrate the principle of a heat engine.




State what each of the following symbols represents.

$T_1$ ..............................................................................................................................

$T_2$ ..............................................................................................................................

$W$ ..............................................................................................................................

$Q_2$ ..............................................................................................................................

**(4)**

(b) (i) A steam engine is a type of heat engine. The maximum thermal efficiency of a certain steam engine is 24% when the steam enters at a temperature of 227 °C.

Calculate the temperature at which the steam leaves.

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Temperature = ..........................................

**(3)**

(ii) State one way in which the efficiency of the steam engine could be increased.

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**(1)**

**Q6**

**(Total 8 marks)**



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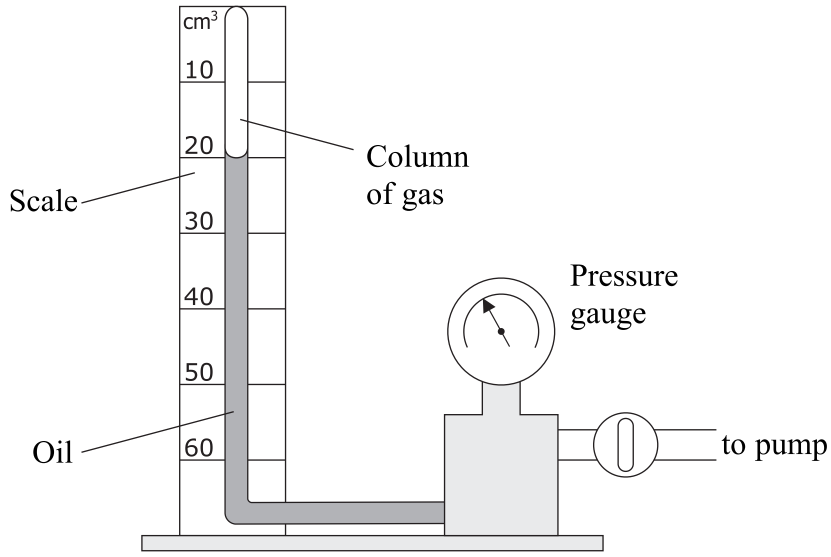
**7.** A student uses the following apparatus to measure the volume occupied by a fixed mass of gas at different pressures. The temperature of the gas remains at 22 °C throughout the experiment.




(a) The volume of the gas is 20 cm$^3$ when the gas pressure is $200 \times 10^3$ Pa. Calculate the pressure exerted by the gas when its volume decreases by 5.0 cm$^3$.

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Pressure = ................................................

**(3)**

(b) The column of oil in the tube has a cross-sectional area of $7.9 \times 10^{-5}$ m$^2$. Calculate the force exerted on the surface of the oil when the gas pressure is $200 \times 10^3$ Pa.

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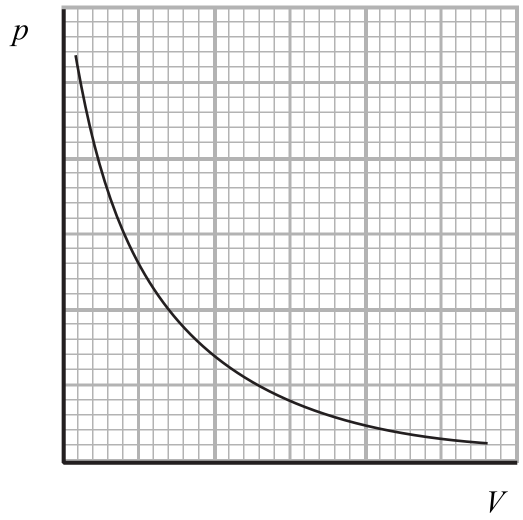
Force = ....................................................

**(2)**

(c) The student draws a sketch graph of her results and obtains the graph shown below.




(i) She then correctly uses the pressure law to calculate the pressure exerted by 20 $cm^3$ of the gas at 35 °C. What value does she obtain?

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Pressure = ................................................

**(3)**

(ii) Use the axes to sketch a graph the student would have obtained had the gas been at this higher temperature.

**(2)**

**(Total 10 marks)**

Leave blank

**Q7**

**TOTAL FOR PAPER: 60 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 | |
| Planck constant | $h = 6.63 \times 10^{-34}$ J s | |
| 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 $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

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 $\lambda$)

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

***Electrical current and potential difference***

Electric current $I = nAQv$

Electric power $P = I^2 R$

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

***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 $\Delta Q$; Work done on body $\Delta W$)

Efficiency of energy transfer $= \frac{\text{Useful output}}{\text{Input}}$

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

***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)

$\cos\theta \approx 1$

***Experimental physics***

Percentage uncertainty $= \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$

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