M00/430/S(2)M

INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

May 2000

PHYSICS

Standard Level

Paper 2

15 pages

SECTION A

A1. (a) Work done $= Fd = \Delta(\text{KE}) = \frac{1}{2}mv^2$ ***[1]***

to give $F = \dfrac{mv^2}{d}$ ***[1]***

[2 max]

(b)

$v\,/\,\text{m s}^{-1}$	$d\,/\,\text{m}$	$\dfrac{v^2}{d}\,/\,\text{m s}^{-2}$
0	0	0
3.0	0.08	**113**
10.0	0.35	**286**
15.0	0.65	**346**
20.0	1.02	**392**

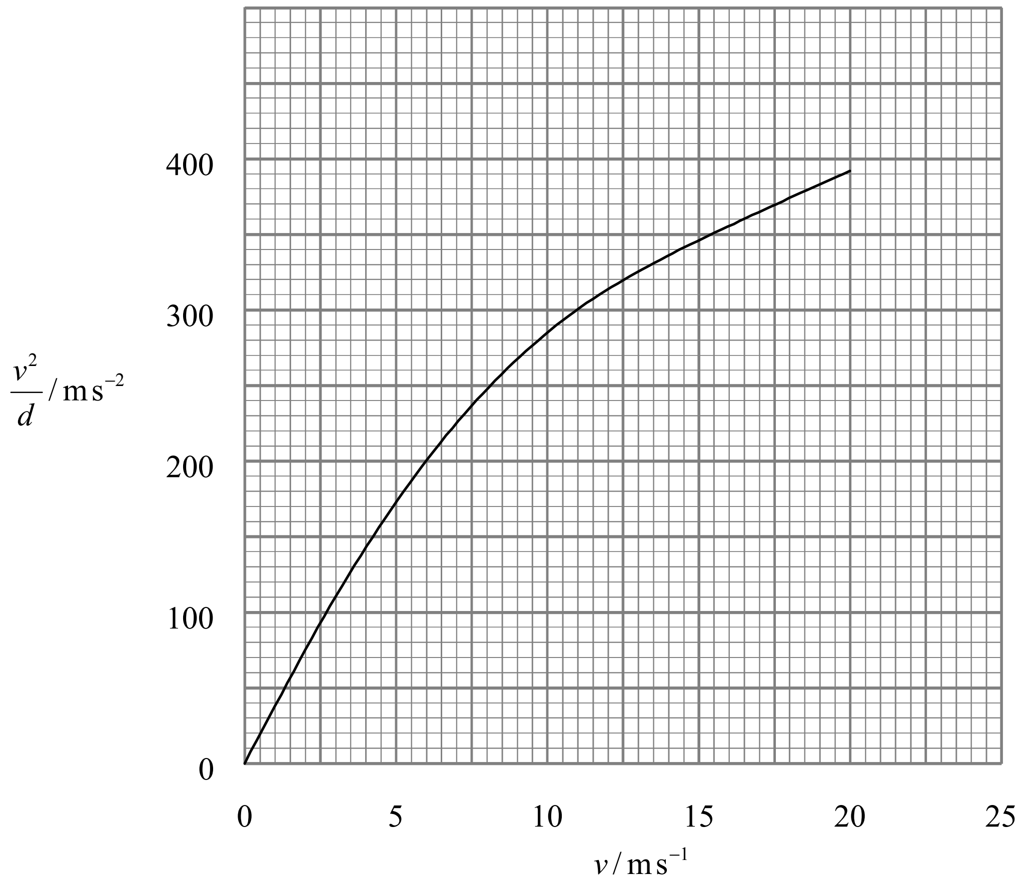
$\dfrac{v^2}{d}$ column *(All or nothing here!)* ***[1]***

[1 max]

continued...

Question A1 continued

(c)



correctly labelled axes **[1]**
appropriate scales **[1]**
data points **[1]**
line of best fit **[1]**
(If the point (0 , 0) is not shown deduct ***[1]****.*
If a straight line is drawn deduct ***[1]****.)* ***[4 max]***

(Do not penalise for plotting v against $\frac{v^2}{d}$*.)*

(d) from the graph $\frac{v^2}{d} = 330\ (\pm 20)$ **[1]**

to give $F = 2\times10^5$ N $(1.9 \rightarrow 2.1\times10^5$ N) **[1]**

[2 max]

A2. (a) Downwards on PQ upwards on RS *[1]*

[1 max]

(b) Initially there is no back emf *[1]*

As the coil rotates the magnetic flux linking the coil is changing *[1]*

this will induce an emf in the coil *[1]*

which is in a direction such as to oppose the current *[1]*

(Essentially the answer should show evidence of the understanding of induced emf's and the effect they will have on the current in the coil.) *[4 max]*

A3. (a) (i) Energy supplied $= 1.5 \times 10^3 \times \Delta t = 1.5 \times 10^3 \times 12$ *[1]*

$= ms\Delta\theta$ *[1]*

correct substitution to give $120\ \text{J kg}^{-1}\ {}^{\circ}\text{C}^{-1}$ *[1]*

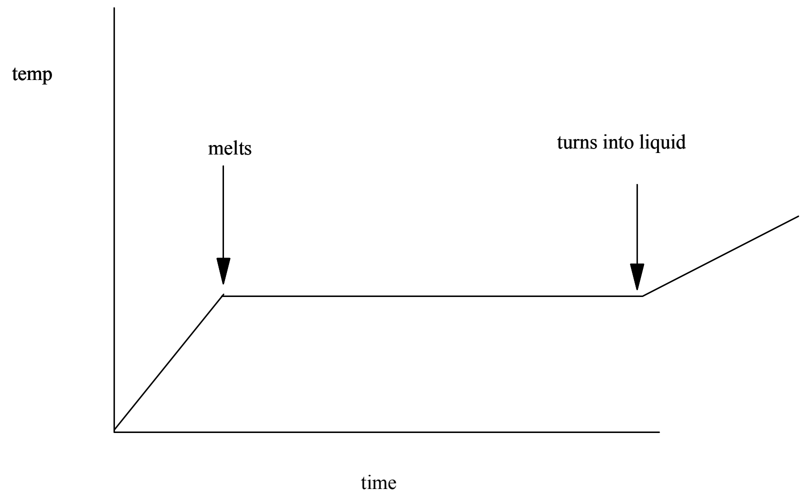
[3 max]

(ii) energy supplied $= mL = 1.5 \times 10^3 \times 180$ *[1]*

correct substitution to give $540\ \text{kJ kg}^{-1}$ *[1]*

[2 max]

(b)



region of constant temp *[1]*

melting point, liquefaction point *[1]*

*(Deduct **[1]** if appropriate temps not labelled or labelled incorrectly. Slopes need not be different.)* *[2 max]*

A4. (a) correct equation ${}^{6}_{3}\text{Li} + {}^{1}_{0}\text{n} \rightarrow {}^{3}_{1}\text{H} + {}^{4}_{2}\text{He}$ ***[1]***

(The He does not have to be correct at this point, just the atomic number and the mass number.)

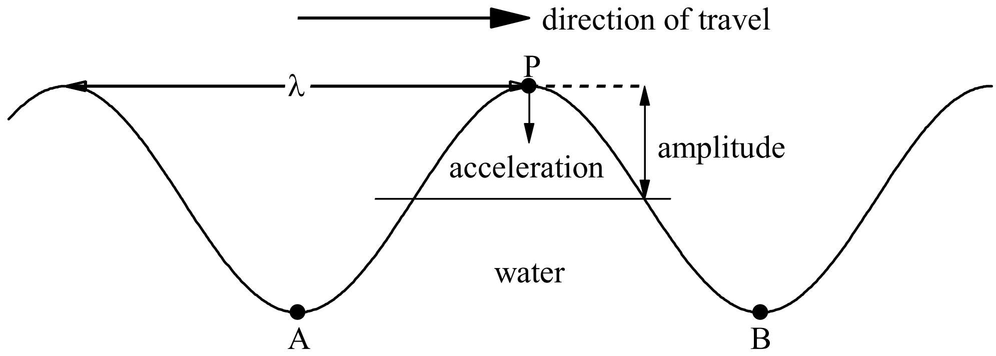
Helium ***[1]***
[2 max]

(b) 3 half-lives are needed to reduce activity by $\frac{1}{8}$ ***[1]***

half life $= 12.2$ years
therefore time taken $= 3 \times 12.2$
$= 36.6$ years ***[1]***
[2 max]

SECTION B

B1. (a)

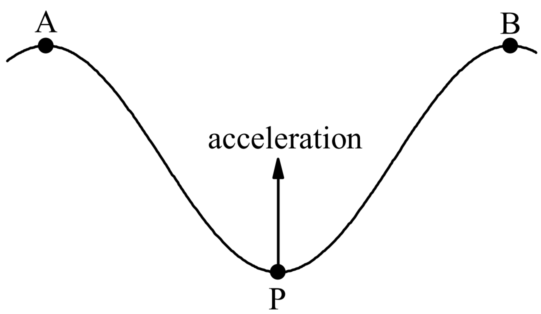


(i) wavelength *[1]*
[1 max]

(ii) amplitude *[1]*
[1 max]

(iii) at right angles to the tangent at P and downwards *[1]*
[1 max]

(b)



P now at the minimum *[1]*
correct shape of wave *[1]*
towards the centre of the "circle" *[1]*
[3 max]

continued…

Question B1 continued

(c) (i) correct substitution to give speed $= 12.6\ \text{m s}^{-1}$ ***[1]***
[1 max]

(ii) Use $f = \frac{c}{\lambda}$ ***[1]***
to give $f = 0.13$ Hz ***[1]***
[2 max]

(iii) recognition that molecule takes one time period ***[1]***
$T = \frac{1}{f}$ ***[1]***
To give $T = 7.7$ s ***[1]***
[3 max]

(d) average speed $\frac{2\pi r}{t}$ ***[1]***
$r = \text{amplitude} = 1.0$ m ***[1]***
substitute to give $v = 0.82\ \text{m s}^{-1}$ ***[1]***
[3 max]

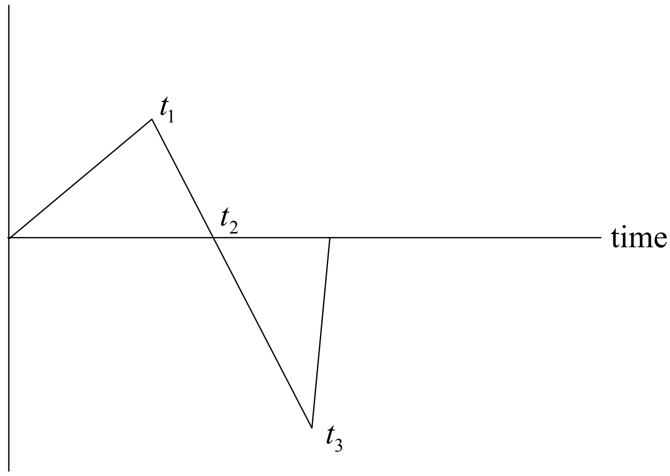
(e) energy proportional to v^2 ***[1]***
v proportional to A ***[1]***
Therefore energy proportional to A^2 ***[1]***
[3 max]

(f) (i) $VI = \text{Power}$ ***[1]***
to give $I = 1.8 \times 10^5$ A ***[1]***
[2 max]

(ii) V stepped up by a factor of 10^3 ***[1]***
therefore current stepped down by a factor of 10^3 ***[1]***
to give a 180 A ***[1]***
[3 max]

(iii) power losses depend on $I^2 R$ ***[1]***
So if current goes down by a factor of 10^3 power losses go down by a factor of 10^6. ***[1]***
[2 max]

B2. (a) (i)



correctly labelled axes **[1]**
correct different slopes **[1]**
(steeper going down)
t_1 fuel out **[1]**
t_2 maximum height **[1]**
t_3 hits the ground **[1]**
velocity less at t_1 than at ground **[1]**
[6 max]

(ii) areas are equal to the distance travelled up and travelled down **[1]**
the areas are equal **[1]**
[2 max]

(b) (i) $v = at$ **[1]**
$= 40 \text{ m s}^{-1}$ **[1]**
[2 max]

(ii) height when fuel runs out $= \frac{1}{2}at^2$ **[1]**
$= 100 \text{ m}$ **[1]**
[2 max]

(iii) height reached after fuel runs out given by $v^2 = 2gs$ **[1]**
$= 80 \text{ m}$ **[1]**
maximum height $= 180$ m **[1]**
[3 max]

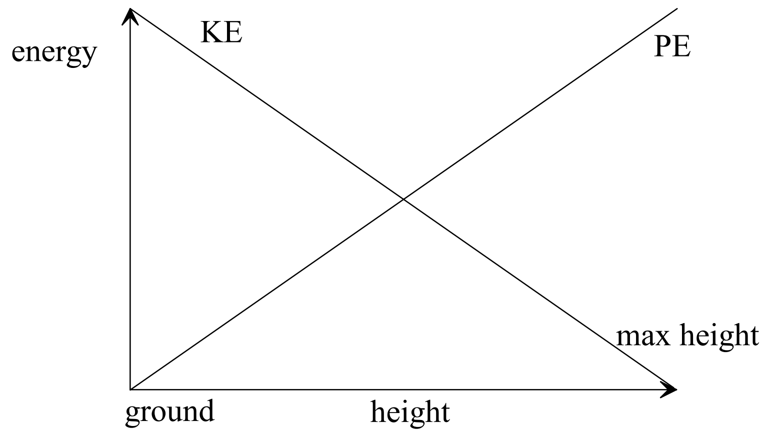
(iv) time to reach maximum height from time that fuel runs out
$\frac{40}{10} = 4.0$ s **[1]**
total time $= 5.0 + 4.0 = 9.0$ s **[1]**
[2 max]

(v) use $s = ut + \frac{1}{2}gt^2$ **[1]**
to give 6.0 s **[1]**
[2 max]

continued…

Question B2 continued

(c)



labelled axes **[1]**
correct sketch for KE **[1]**
correct sketch for PE **[1]**
showing same slopes and max PE = max KE **[1]**
[4 max]

(d) when fuel runs out $m = 0.14$ kg **[1]**
$\text{KE} = \frac{1}{2}mv^2 = 112$ J **[1]**
[2 max]

B3. (a) (i) When a pd is applied across the ends of a conductor the electrons are accelerated. ***[1]***
They collide with the lattice ions and impart energy to the lattice. ***[1]***
[2 max]

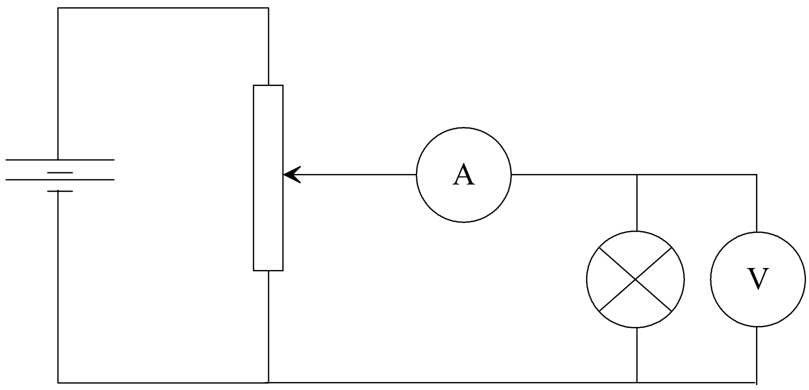
(ii) The current is proportional to the number of electrons crossing a given cross-section in a given time. ***[1]***

If the area of a wire is doubled then for the same pd the number of electrons crossing a cross-section will double. ***[1]***

The current therefore doubles such that $\frac{V}{I}$ is halved. ***[1]***

(Answers will be open-ended but these are the essential points to look for.) ***[3 max]***

(b)



Correct connection of rheostat to battery ***[1]***
Correct connection of lamp to rheostat ***[1]***
Correct position of ammeter ***[1]***
Correct position of voltmeter ***[1]***

*(The essential thing here is that the rheostat is connected as a potential divider. If candidates connect it as a variable resistance then the maximum mark is **[2]** and zero marks if connected as a variable resistor and the meters are connected incorrectly.)* ***[4 max]***

Question B3 continued

(c) (i) No **[1]**
[1 max]

(ii) $\frac{12}{0.20} = 60\ \Omega$ **[1]**
Resistance is the initial slope of the graph **[1]**
$= \frac{1}{0.04} = 25\ \Omega \pm 2\ \Omega$ **[1]**
[3 max]

(d) power $= VI$ **[1]**
$= 12 \times 0.2 = 2.4\ \text{W}$ **[1]**
[2 max]

(e) (i) The battery has an internal resistance **[1]**
of value comparable to the lamp resistance **[1]**
(Essentially internal resistance must be mentioned and for the ***[1]*** *and for the other mark some idea of how it will affect the external p.d.)* **[2 max]**

(ii) voltage drop across battery $= 1.2\ \text{V}$ **[1]**
therefore pd "across" internal resistance $= 1.2\ \text{V}$ **[1]**
therefore internal resistance $= \frac{1.2}{0.18} = 6.7\ \Omega$ **[1]**
[3 max]

(f) (i) $V_{\text{US}} I_{\text{US}} = V_{\text{UK}} I_{\text{UK}}$ **[1]**
to give $\text{US} : \text{UK} = 24 : 11$ *(Accept 2 : 1)* **[1]**
[2 max]

(ii) The ratio this time is in terms of $I^2 R$ (or $\frac{V^2}{R}$) **[1]**
to give $\text{US} : \text{UK} = 1 : 4.8$ *(Accept 1 : 5 or 1 : 4 if answer given as 2 : 1 above.)* **[1]**
[2 max]

(iii) $1 : 1$ **[1]**
[1 max]