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N02/430/S(2)M++

MARKSCHEME

November 2002

PHYSICS

Standard Level

Paper 2

12 pages

Subject Details: **Physics SL Paper 2 Markscheme**

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalised. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalised once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Deduct **1 mark in the paper** for gross sig dig error *i.e.* for an **error of 2 or more digits**.

e.g. if the answer is 1.63:

2	*reject*
1.6	accept
1.63	accept
1.631	accept
1.6314	*reject*

Indicate the mark deduction by **"SD-1"**. However if a question specifically deals with uncertainties and significant digits, and marks for sig digs are already specified in the markscheme, then do **not** deduct again.

SECTION A

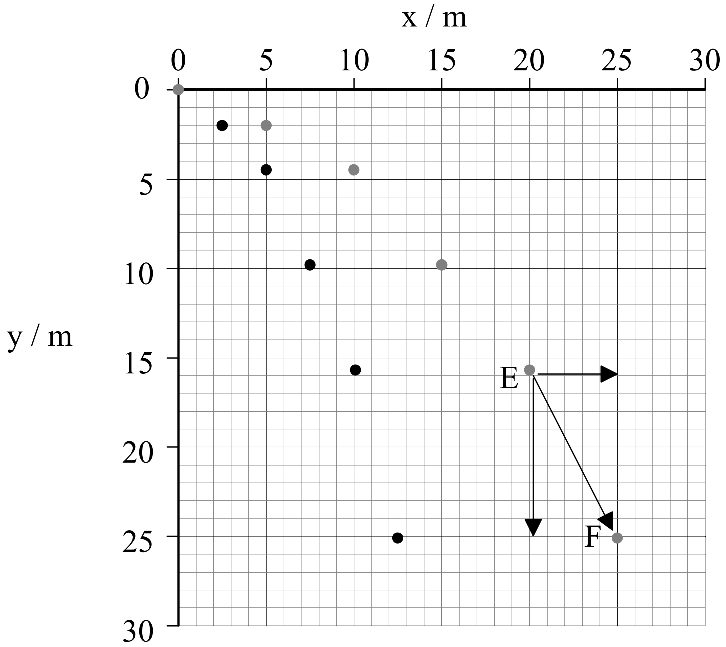
A1. Projectile motion on a planet

(a) horizontal: projectile moves 5 m in 0.5 s;
so $v = \frac{5}{0.5} = 10\ \mathrm{m\,s^{-1}}$; ***[2 max]***

(b) horizontal distance travelled between images is always the same;
so no significant atmosphere, since air resistance would otherwise slow the horizontal motion; ***[2 max]***

(c) different planet mass than Earth;
and different radius than Earth; ***[2 max]***

(d) displacement vector;
horizontal component vector;
vertical component vector; ***[3 max]***



(e) vertical: 9 m in 0.5 s;
$v = 18\ \mathrm{m\,s^{-1}}$; ***[2 max]***

(f) half previous horizontal spacing;
same vertical positions at each time interval; ***[2 max]***

A2. Portable radio power supply

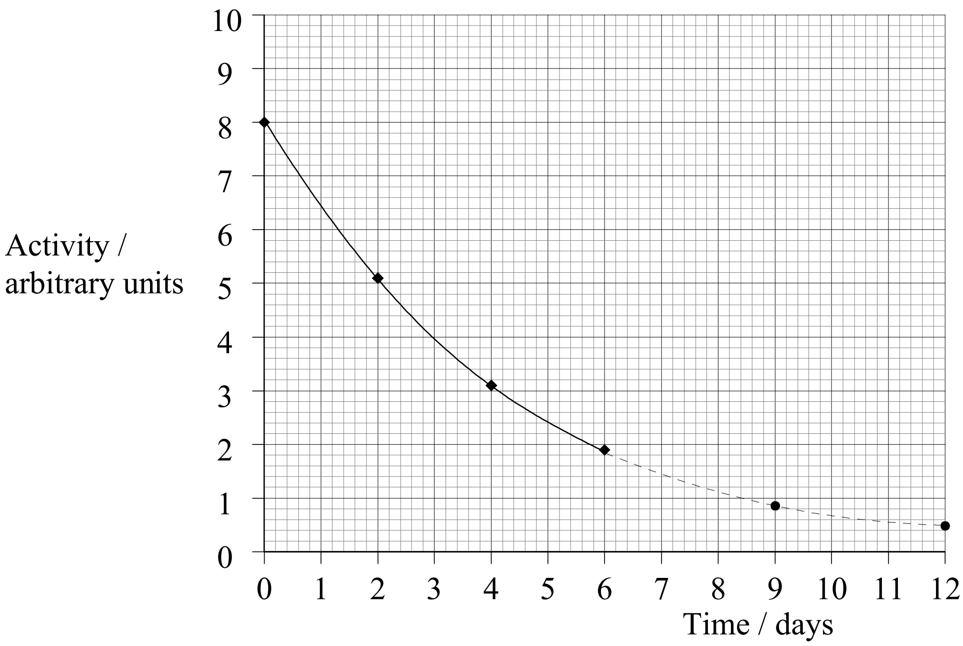
(a) need 8 V drop across R to get 12 V across radio;
$R = \frac{V}{I}$;
$= \frac{8}{0.4} = 20\,\Omega$; ***[3 max]***

(b) $P = VI = 8 \times 0.4 = 3.2\,\text{W}$;
choose 5 W resistor since it can handle 3.2 W / *OWTTE*;
10 W is overkill / *OWTTE*; ***[2 max]***

(c) overheat / burn out / cause damage / *OWTTE* ***[1]***

A3. Radioactive decay

(a)



best fit smooth curve ***[1]***

(b) (i) after 5 days, activity is about 2.4 units ***[1]***

(ii) half-life is 3 days;
when activity drops from 8 to 4 units; ***[2 max]***

(c) general shape;
precise shape (*i.e.* activity at 9 days is 1); ***[2 max]***

SECTION B

B1. Part 1 Millikan-type experiment

(a) change in electric potential energy = work done against electric force;
$qV = qEd$;
deduction from above that $E = \dfrac{V}{d}$; **[3 max]**

(b) $E = \dfrac{V}{d} = \dfrac{200}{4 \times 10^{-3}} = 50\,000\ \text{V m}^{-1}$ **[1]**

(c) $mg = qE = q\dfrac{V}{d}$;
$q = \dfrac{mgd}{V} = \dfrac{2.4 \times 10^{-15} \times 10 \times 4 \times 10^{-3}}{200}$
$= 4.8 \times 10^{-19}\ \text{C}$; **[3 max]**

(d) charge on original drop is $3e$
by simple proportionality (not recalculating) Carmel's second drop has charge $2e$;
while Juan's would have $1.5e$;
not an integral multiple of e. Fractional charges highly dubious! / *OWTTE*; **[3 max]**

B1. Part 2 Pendulum collision

(a) (i) $\frac{1}{2} m_1 v_1^2 = m g h_1$;
$v = \sqrt{2gh_1}$; **[2 max]**

(ii) $p_{\text{before}} = m_1\sqrt{2gh_1}$;
$p_{\text{after}} = (m_1 + m_2)v'$;
$p_{\text{before}} = p_{\text{after}}$;
to give $v' = \dfrac{m_1\sqrt{2gh_1}}{m_1 + m_2}$; **[4 max]**

(b) conservation of energy **[1]**

(c) larger mass ascending / *OWTTE* **[1]**

B1. Part 3 Beats

(a) *Mark by overall judgement, look for five of the following aspects, written or diagrammatically:*
principle of superposition: (likely to be implicit);
resultant wave / disturbance will be of large amplitude (constructive interference) at times like X where two waves are in phase;
and zero amplitude (destructive interference) at times they are out of phase;
like Y (on diagram);
correct labels on diagram;
thus resultant amplitude varies, and is heard as fluctuation of loudness; ***[5 max]***

(b) if components are closer in frequency, it would take a longer time for the two component waveforms to get back into phase (as can be seen from diagram) / *OWTTE*;
so the beat frequency will be smaller; ***[2 max]***

B2. Part 1 Thermodynamics of two-stage gas process

(a) sketch rough hyperbola section;
going to double volume and half pressure; ***[2 max]***

(b) molecules have further to go before striking a wall;
so collide with walls less frequently, resulting in lower pressure;
OR
there are fewer molecules per unit volume;
so fewer collisions per unit time with walls; ***[2 max]***

(c) KE does not change;
since temperature remains constant; ***[2 max]***

(d) straight line from origin through and beyond state 2;
to twice the pressure and twice the absolute temperature; ***[2 max]***

(e) *Look for at least three of the four aspects listed below.*
heat increases kinetic energy of molecules;
molecules moving faster, so strike walls more often;
and with higher velocity;
both aspects lead to bigger rate of momentum change at wall; ***[3 max]***

(f) yes, since the gas is heated, and temperature increases ***[1]***

(g) initial temperature is $20\,^{\circ}\mathrm{C}$ or 293 K;
stays the same after first process
second process $PV = nRT$, so $T \propto P$ at constant V;
so T doubles to 586 K or $313\,^{\circ}\mathrm{C}$;
or they might use $\frac{P_1}{T_1} = \frac{P_2}{T_2}$; ***[3 max]***

B2. Part 2 A car rolling down a hill

(a) loss on $PE = mg\Delta h$;
$= 800 \times 10 \times 20 = 1.6 \times 10^5$ J ;
gain in $KE = ½mv^2 = 400 \times 25 = 10\,000$ J ;
loss in energy $= 1.5 \times 10^5$ J ;
= work done against friction = Fd;
to give $F = \frac{(1.5 \times 10^5)}{200} = 750$ N ; ***[5 max]***

(b) PE at point A: $mgh = 800 \times 10 \times 50 = 400\,000$ J ;
work in traveling 600 m is $Fd = 750 \times 600 = 450\,000$ J ;
thus insufficient energy to do the required work against friction, will not reach the service station; ***[3 max]***

(c) air resistance;
air resistance increases with speed; ***[2 max]***

B3. Part 1 Transformers and power transmission

(a) *Mark by overall judgement and look for the following features:*
diagram of transformer:
with primary;
and secondary coils;
Iron core;

description:
alternating current in primary creates varying magnetic field;
which links the secondary via the iron core;
varying magnetic field produces alternating e.m.f. in secondary; ***[5 max]***

(b) *look for the following:*
power input = power output if 100 % efficient;
since $P = VI$;
if V goes up then I goes down;
power loss I^2R in transmission lines of resistance R;
so power loss is reduced; ***[5 max]***

(c) voltage goes up by a factor of 100;
hence current goes down by a factor of 100 = 0.1 A; ***[2 max]***

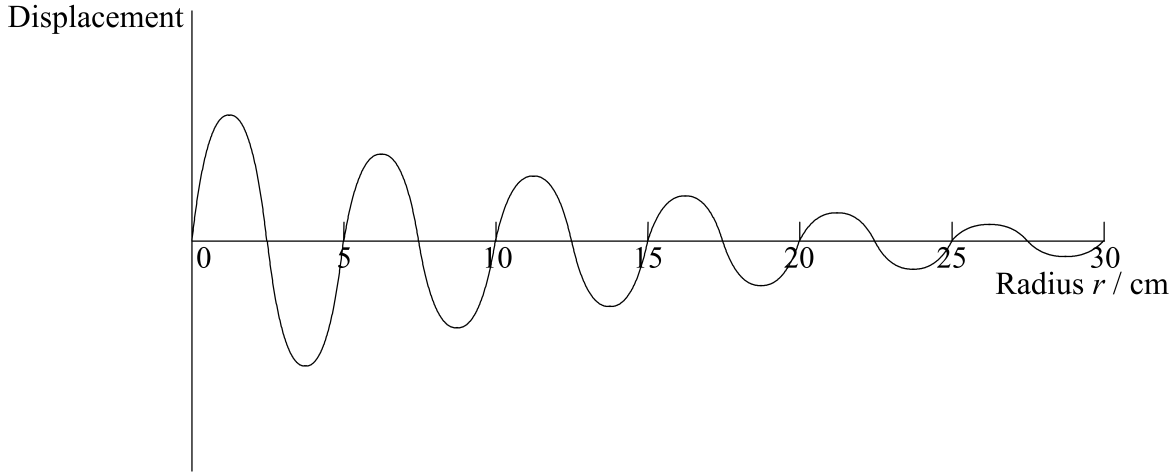
B3. Part 2 Properties of circular waves on water

(a) motion of the particles is perpendicular;
to direction of wave travel / *OWTTE*;
or by suitable diagram; ***[2 max]***

(b) (i) 5 cm in $\frac{1}{3}$ second;
so $v = 15\,\text{cm}\,\text{s}^{-1}$; ***[2 max]***

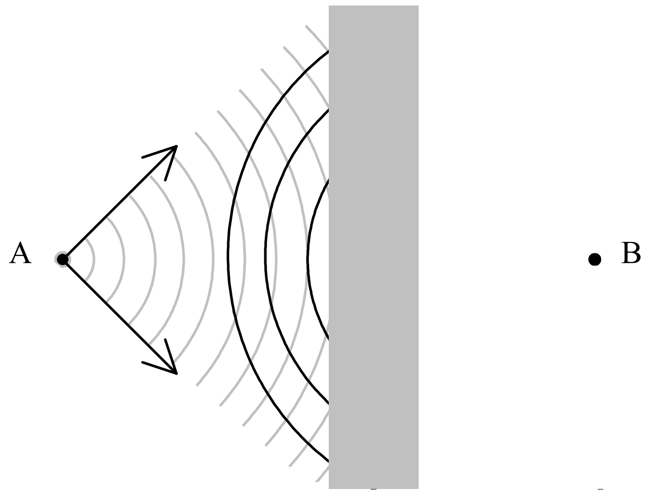
(ii) amplitude will decrease;
because wavefront circumference is increasing so energy is more “spread out”;
OWTTE; ***[2 max]***
*Allow **[1]** for saying energy dissipates with time or distance due to frictional effects.*

(iii)



oscillations;
correct wavelength (5.0 cm);
decreasing amplitude; ***[3 max]***

(c)



(i) correct wavefront *[1]*

(ii) two rays at right angles to the wavefronts *[1]*

(iii) reflected rays;
extended backwards to intersect at B; ***[2 max]***
B should be roughly as far behind the left hand side of the barrier as A is in front.