N99/430/S(2)M

INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
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MARKSCHEME

November 1999

PHYSICS

Standard Level

Paper 2

13 pages

SECTION A

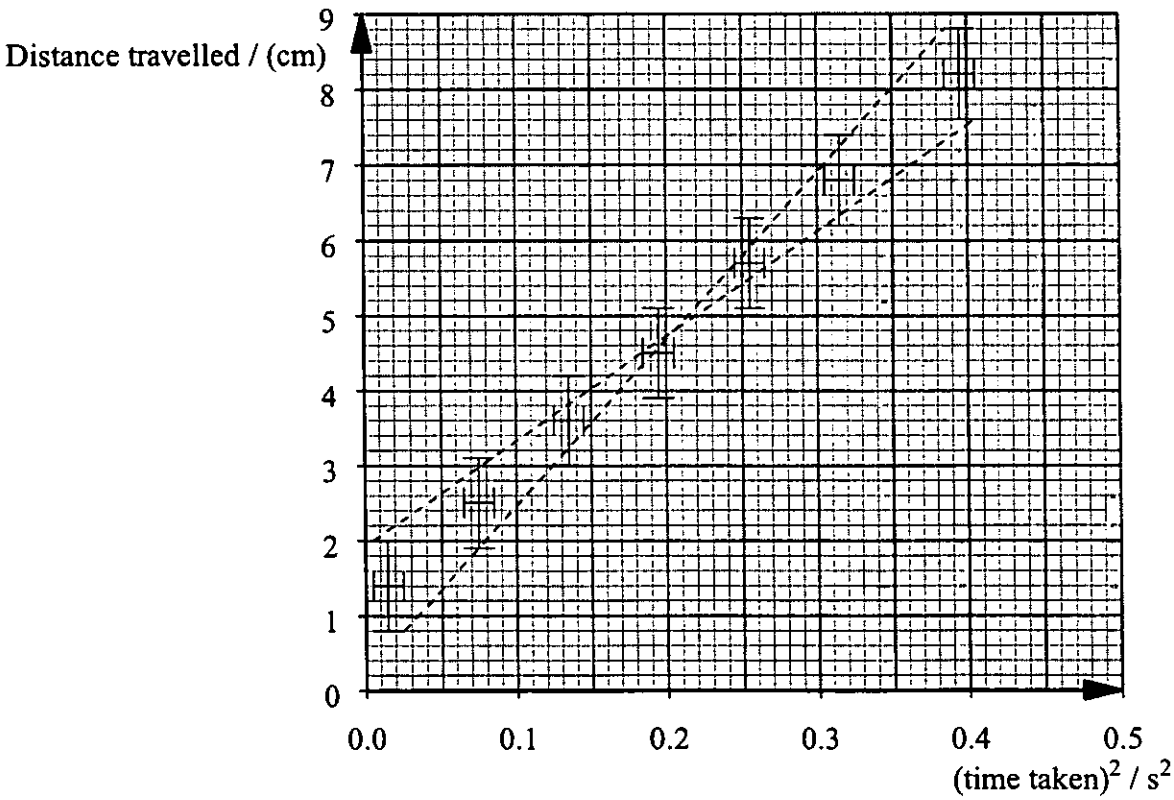
A1. (a) (i) Correct answer = 0.5 × acceleration down slope *[2]*
*(Any mention of 'acceleration' or 'g' or 'g/2' gains **[1 mark]**)*

(ii) Good straight line as expected BUT not through origin. *[1]*
Therefore same actual error on each reading - line shifted *etc.* *[1]*

(iii) No - since line is not through the origin.
OR
Yes - if systematic error assumed *[2]*
*(Accept yes - since straight line for **[1 mark]**)*
(Bald yes or no - zero marks)

(iv) Gradient calculation ≈ 7 / 0.4 ≈ 18.0 cm s^{-2} = 0.18 m s^{-2} *[1]*
Therefore acceleration = 2 × 0.18 = 0.36 m s^{-2} *[1]*
(look for correct calculation from student's best fit line)
(Watch for ecf)
(OK to calculate from equation if systematic error is taken into account)

(b) Steepest line *[1]*
Shallowest line *[1]*
*(Accept not going to absolute 'corner' of error range for **[1 mark]**)*



A2. (a) (gravitational) PE → KE → Heat (accept internal energy of water) *[1]*
(Allow the mark if only PE → KE is mentioned)
(Reject → temperature)
(also KE → Sound, but ignore!)
(Look for changes rather than just the energies involved)

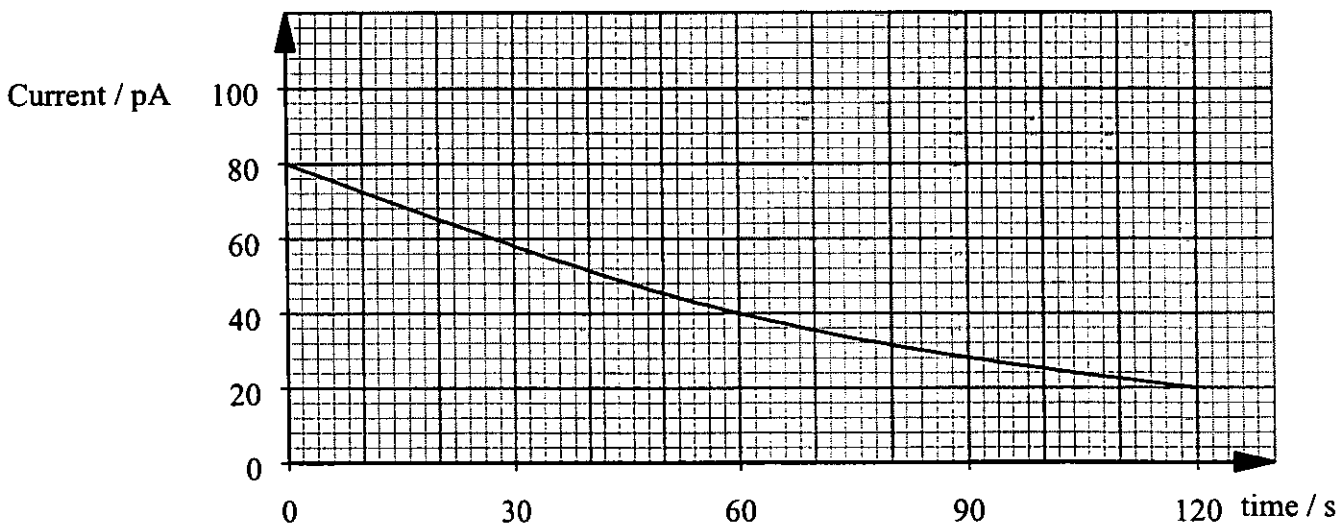
(b) In one second, mass = 6000 kg *[1]*
So PE = $6000 \times 10 \times 75 = 4.5 \times 10^6$ J *[1]*
Available power = 4.5×10^6 w *[1]*
(Allow 4.4 MW if g = 9.8 has been used) *[1]*
Valid assumption
e.g. turbine 100% efficient;
All water 'captured'
All PE goes into electrical
Initial KE (water) = final KE etc.

(c) 70% of 4.5×10^6 J = 3.15×10^6 J *[1]*
Use of $E = m c \Delta \theta$ *[1]*
So temp rise $= 3.15 \times 10^6 / (6000 \times 4200)$ *[1]*
$= 0.125$ °K *[1]*

A3. (a) (i) The alpha particles ionise the air molecules *[1]*
The potential difference across the chamber will cause the ions to migrate *[1]*
Thereby creating a current *[1]*

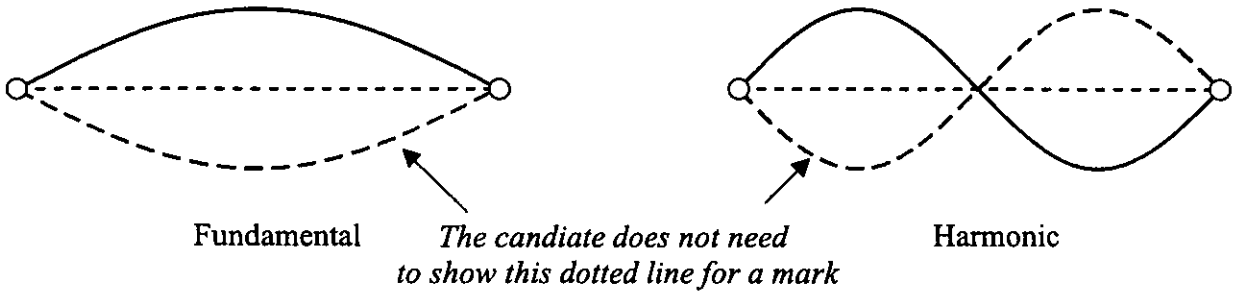
(ii) The activity of the Radon decreases with time
OR
The number of alpha particle emitted decreases with time *etc.* *[1]*

(b) Starts at 80 pA PLUS general decreasing exponential shape *[1]*
Drops to 40 pA at 60 s PLUS 20 pA at 120 s *[1]*



SECTION B

B1. (a) Appropriate diagrams here ***[1 mark]*** each. ***[2]***

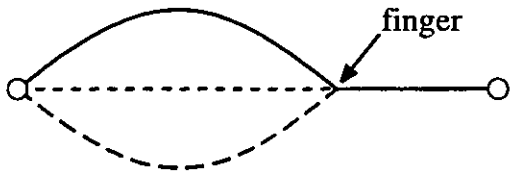


(b) (i) Realisation that l, length of string = half wavelength ***[1]***
Therefore wavelength = 0.800 m ***[1]***

(ii) As appropriate: 2 or 3 × fundamental ***[1]***

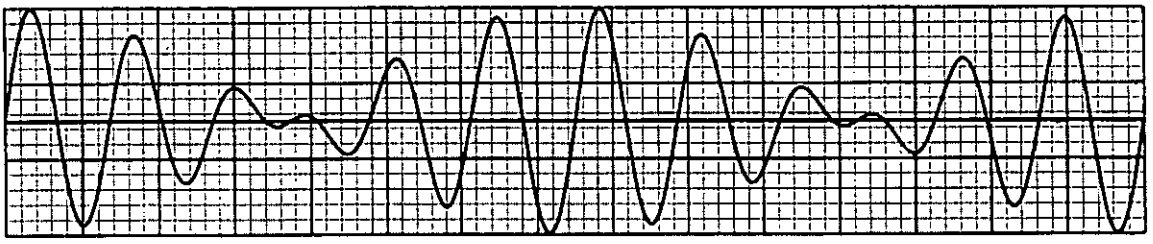
(c) (i) Fundamental shown on shorter string ***[1]***

(it is not necessary to show finger)



(ii) Speed constant explicit or implied from ratio calculation ***[1]***
New wavelength = 0.8 × 440 / 524 = 0.672 m ***[1]***
New string length = half of this figure, *i.e.* 0.336 m. therefore finger placed 6.4 cm from end. ***[1]***
*Bald 0.336 m gets **[3 marks]**.*

(d) Sound whose amplitude rises and falls periodically *[1]*
Produced by superposition of two waves of <u>similar</u> frequency *[1]*
At some moment the two waves interfere constructively,
producing constructive interference / loud sound *[1]*
Later the two waves interfere destructively
producing destructive interference / cancellation of sound *[1]*
Any additional detail / quality gets one mark each up to a max of ***[2 marks]***
e.g. correct diagram for the superposition of the waves; identifying constructive interference section of diagram; knowing that beat frequency = frequency difference etc.



(e) (i) Suitable source *[1]*
(e.g. single narrow slit or distant straight filament)
Double slit *[1]*
Screen or suitable eyepiece *[1]*
(e.g. travelling microscope or micrometer eyepiece)
Sensible layout with reasonable distances seen / implied *[1]*
N.B. *Use of a laser on a double slit is not correct - award a maximum of* ***[2 marks]***.

(ii) Appropriate pattern consisting of fringes *[1]*
Approximately equally spaced *[1]*
Any further quality / detail *[1]*
e.g. correct attempt to sketch intensity distribution etc.

(iii) The two sources are coherent. *[1]*
Idea that light arrives at the screen with a phase difference that depends on the path length difference. *[1]*
Bright fringes appear where distances of screen to S_1 and S_2 differ by an integral number of wavelengths (or explanation of dark fringes)
[1]

B2. (a) (i) Two **vertical** forces on diagram so as to produce a couple with the correct orientation (up on LHS, down on RHS) *[1]*
(Ignore any correct extra forces on other sides but incorrect extra forces loses mark)

(ii) Poles such that the field left to right *[2]*
*Essentially two or nothing, but **[1 mark]** possible if only one pole is marked!*

(iii) To reverse the current direction *[1]*
Every 180° / when coil is vertical *[1]*
So that rotation is maintained (or words to that effect) *[1]*

(b) (i) Voltmeter parallel *[1]*
Ammeter series *[1]*

(ii) Use of Power = voltage × current *[1]*
P = 6V × 0.50A *[1]*
= 3.0 W *[1]*

(iii) Work done = 6.0 × 10 × 0.8 = 48 J *[1]*
Therefore power = $\frac{48}{24}$ *[1]*
= 2.0 W *[1]*

(iv) Efficiency = $\frac{\text{Power OUT}}{\text{Power IN}}$ *[1]*

= $\frac{2.0}{3.0}$ = 67% *[1]*

(c) (i) Idea that transformer is made up of two coils around an iron core explicit or implied *[1]*
Step-down transformer **OR** fewer turns on secondary *[1]*
a.c. therefore changing field due to primary *[1]*
Induces changing e.m.f in secondary *[1]*

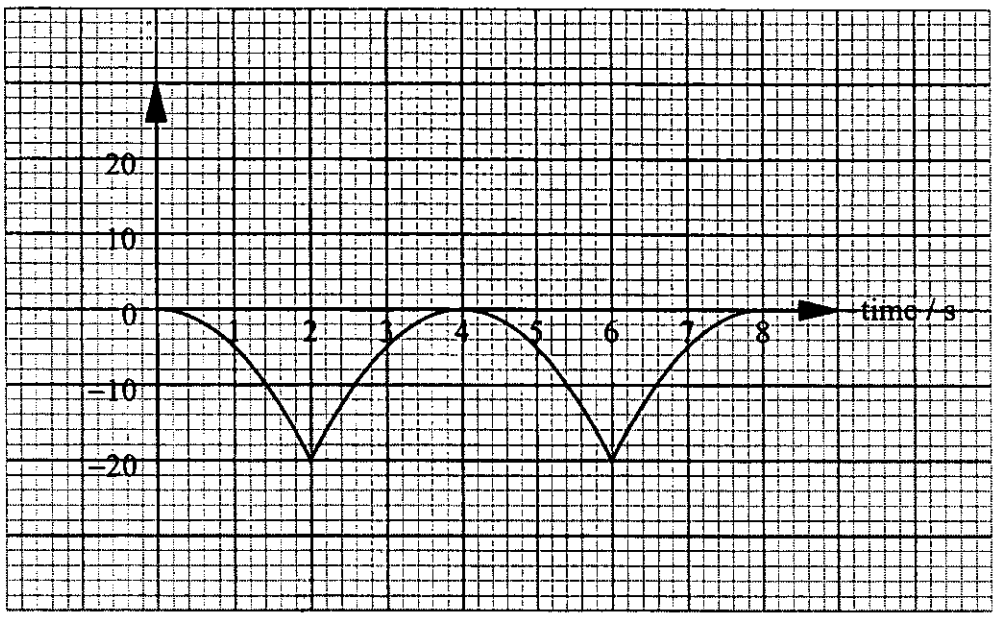
(ii) Use of turns ratio = p.d. ratio *[1]*
Secondary turns = $(\frac{2}{230}) \times 690 = 18$ *[1]*

(iii) 1 kWh = 3.6×10^6J *[1]*
Energy in = energy out / 0.8 *[1]*
= 4.5×10^6 J *[1]*

B3. (a) use of $s = ut + \frac{1}{2} a t^2$ **or** similar plus correct substitution *[1]*
Proper rearrangement to get $t = 2s$ *[1]*
*(**N.B.** watch for t = distance / g!! award **[0 marks]**)*

(b) Correct maximum value of displacement *[1]*
Correct time period *[1]*
Shape *[2]*

Answer is

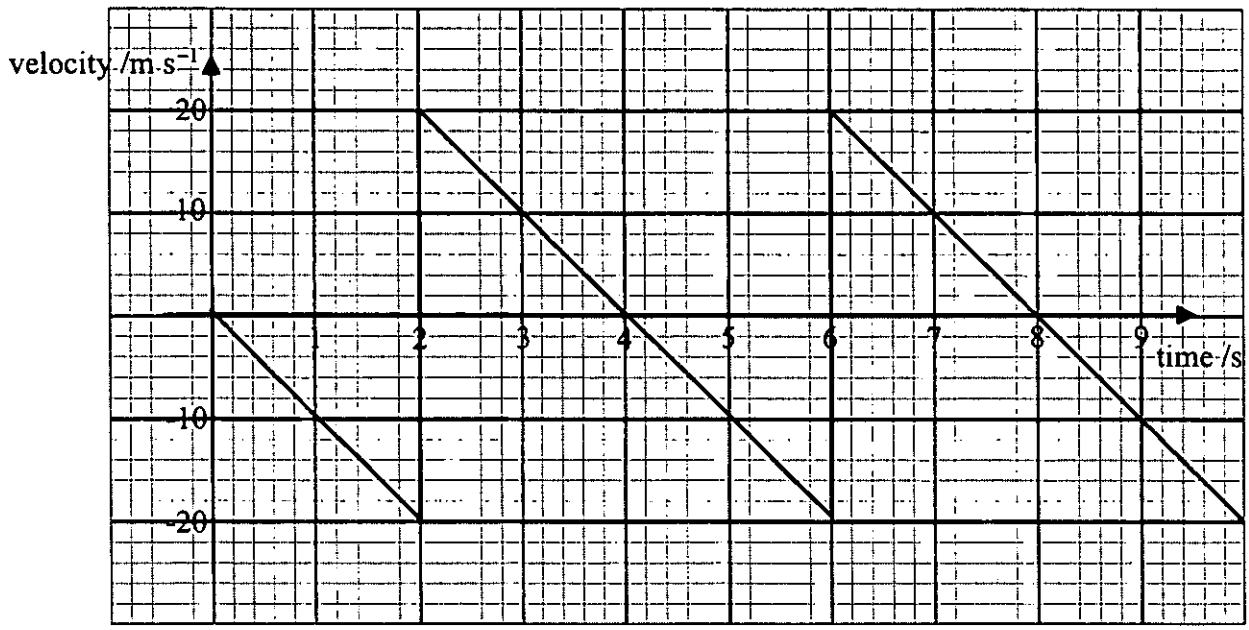


Accept answer flipped in x-axis — i.e. positive displacements
*Graph translated up by +20 m scores **[3 marks]** out of **[4 marks]***

(c) Use of $v = u + a t$ **or** similar *[1]*
Proper rearrangement *[1]*
Again - care with student versions!

(d) Correct maximum value of velocity *[1]*
Correct time period *[1]*
Reversal of velocity *[1]*
Shape *[1]*

Answer is



Accept answer flipped in x-axis - i.e. positive velocities initially

(e) (i) Force *(accept reaction)* from ground *[1]*
Ball's weight *[1]*
(reject friction)

(ii) Ball pushing on ground DOWN *[1]*
(Need both direction AND the object receiving the force)

Ball attracting the earth *[1]*
UP *[1]*

Maximum mark without any directions is ***[1 mark]***

(iii) Use of acceleration = rate of change of velocity *[1]*
do not accept f = ma - it gains the mark in part (iv) below!
Change of velocity = 40 m/s *[1]*
So acceleration = 40 / 0.1 = 400 m s^{-2} *[1]*

(iv) Use of: $f = m\,a$ *[1]*
so resultant $f = 0.5 \times 400$ *[1]*
$= 200$ N *[1]*

(f) No *[1]*
Since SHM is ... OR SHM is like... *[1]*
e.g. in SHM, acceleration is proportional to displacement;
in SHM, V/E graph is sinusoidal.