H2 PHYSICS

Exam papers with worked solutions

(Selected from Top JC)

SET B

PAPER 2

Answer

Compiled by

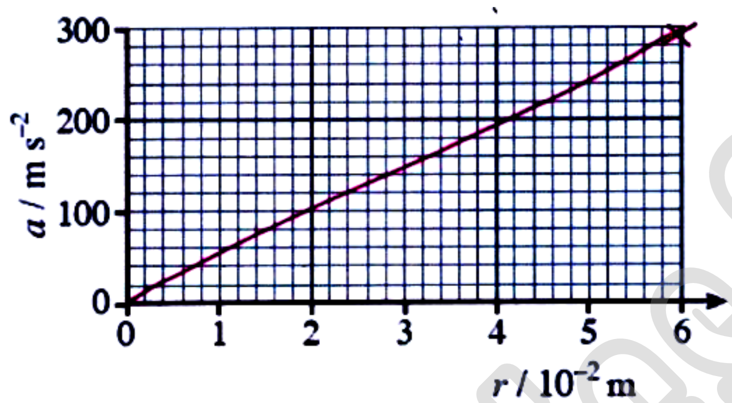
THE PHYSICS CAFE

1 (a) $\omega = 11.0 \times 2\pi$ M1
$= 22.0\pi = 69.1$ rad s^{-1} A1

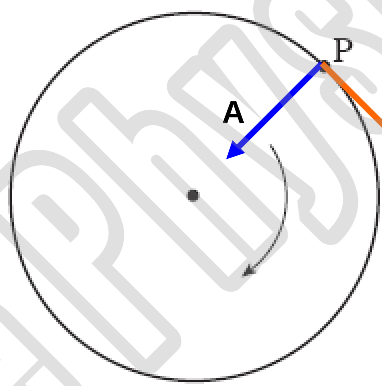
(b) (i) $v = r\omega = 0.060 \times 22.0\pi$ M1
$= 1.32\pi = 4.15$ m s^{-1} A1

(ii) $a = r\omega^2 = 0.060 \times (22.0\pi)^2$ M1
$= 286.7$ m s^{-2} (approximately 290 m s^{-2}) Hence proved. A1

(c) B1



(d) (i) $F = ma = (2.0 \times 10^{-12}) \times 286.7 = 5.73 \times 10^{-10}$ N B1
(ii) A – B1
(iii) B – B1



2 (a) Damped oscillation means there exists a dissipative force. Hence energy of oscillation decreases with time. B1
Since energy is proportional to the square of amplitude of oscillation, the decreasing amplitude implies motion is damped. B1

(b) (i) $2.5T = 2 \times 10^{-3}$ s M1
$f = 1/T = 1.25 \times 10^3$ Hz A1

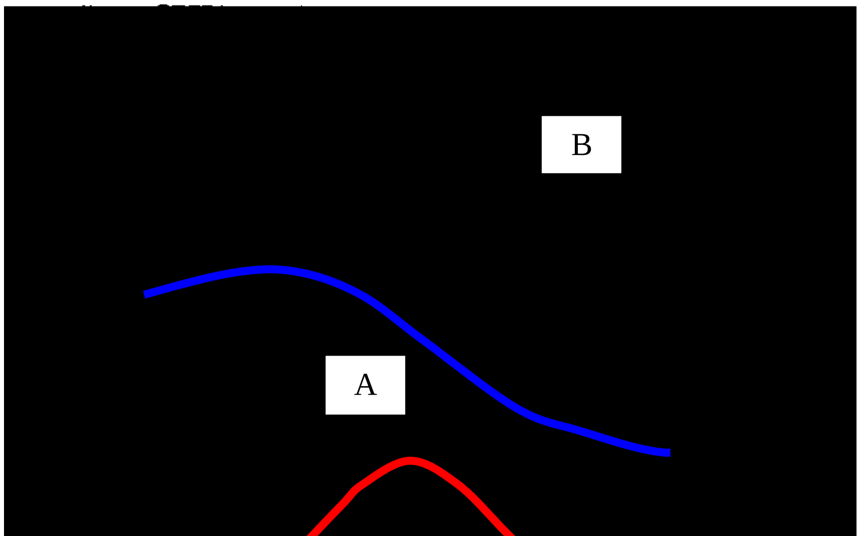
(ii) $a_o = \omega^2 x_o = (2\pi f)^2 (x_o)$
$= 4\pi^2 (1250)^2 (6 \times 10^{-3})$ [a is max when x_0 is max, i.e. at t = 0] M1
$= 3.70 \times 10^5$ m s^{-2} A1

(iii) graph with shape $y = -\cos\theta$ with decreasing amplitude B1

Label T, label a_0 at t = 0 s. B1

Explanation:
For SHM, acceleration is directly proportional to displacement and opposite in direction to displacement.
Hence the graph is the reflection of the graph given about the t-axis.

(c) B1 B1



3 (a) Work done per unit positive charge by an external agent to bring a charged particle from infinity to a point at in an electric field at constant speed. B1 B1

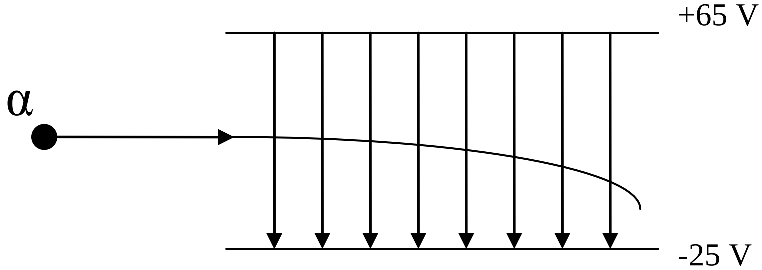
(b) (i) Note: mass of 1 alpha particle = 4u M1

$$\frac{1}{2}mv^2 = 6.5MeV$$

$$\frac{1}{2}(4\times1.67\times10^{-27})v^2 = 6.5\times10^6(1.6\times10^{-19})$$ A1

$$v = 1.77\times10^7 ms^{-1}$$

(ii)



B1 for straight uniform lines and correct direction of E field lines.

B1 for correct parabolic shape for path.

(iii) $E = \frac{\Delta V}{d} = \frac{60-(-25)}{0.03} = 3000 NC^{-1}$ M1

$F = Eq = (3000)(2)(1.6\times10^{-19})$ M1

$= 9.6\times10^{-16} N$ A1

(iv) $\Delta p = Ft = 9.6\times10^{-16}(5) = 4.8\times10^{-15} kgms^{-1}$ B1

4 (a) (i) h = slope of the graph = $\frac{1.8\times10^{-19}}{2.6\times10^{14}}$ = 6.9 × 10^{-34} J s M1 A1

(ii) frequency intercept = 4.9 × 10^{14} Hz;
therefore minimum energy = hf = 4.9 × 10^{14} × 6.9 × 10^{-34} = 3.4 × 10^{-19} J M1 A1

(students must use value for h obtained in (b)(i)

(b) Light consists of photons. Since each photon has energy hf if f is less than $\frac{work\ function}{h}$ then an electron will not be ejected.

(c) (i) By Conservation of Energy,
E_k = eV = 75.0 × 1.6 × 10^{-19} J M1

$E_k = \frac{p^2}{2m}$ = 75.0 × 1.6 × 10^{-19} J

de Broglie hypothesis:

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE_k}}$ M1

λ= 1.4 ×10^{-10} m A1

(ii) The wavelength of the electrons can be determined from the positions of maximum and minimum and compared to the wavelength calculated from de Broglie's hypothesis.

5 (a) [1]

$$I = \frac{E}{R_I + R_L}$$

(b) (i) [2]

$$P_L = I^2 R_L = \left(\frac{E}{R_I + R_L}\right)^2 R_L = \frac{E^2 R_L}{(R_L + R_I)^2}$$

(ii) [2]

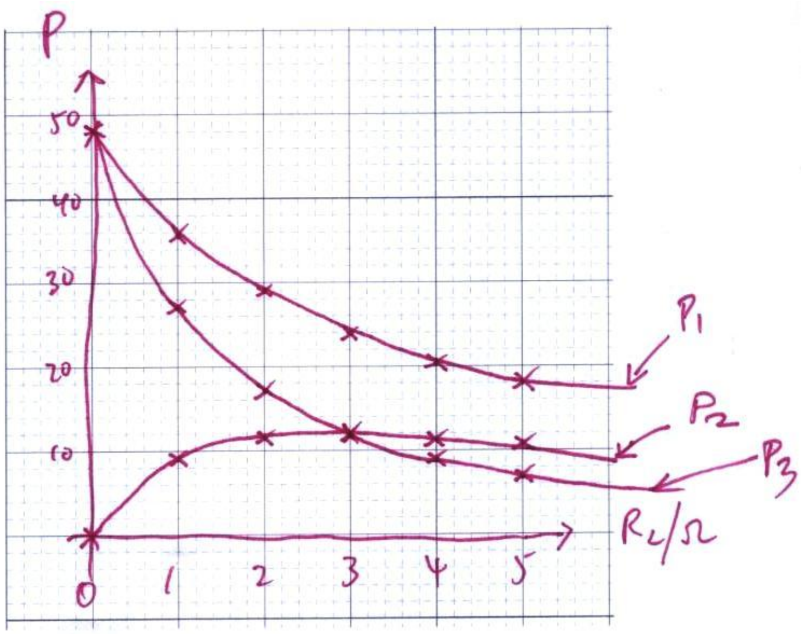
$$P_S = IE = \left(\frac{E}{R_I + R_L}\right) E = \frac{E^2}{R_L + R_I}$$

(c) (i) [3]

R_L / Ω	0	1	2	3	4	5
P1 = P(supplied) (watts)	48.0	36.0	28.8	24.0	20.6	18.0

P2 = P(delivered to R_L) (watts)	0	9.0	11.5	12.0	11.8	11.2
P3 = P(delivered to R_I) (watts)	48.0	27.0	17.3	12.0	8.8	6.8

(ii) [3]



(iii) Maximum power: 12 W [1]

(iv) Yes, because P1 = P2 + P3 for all values of R_L. [2]

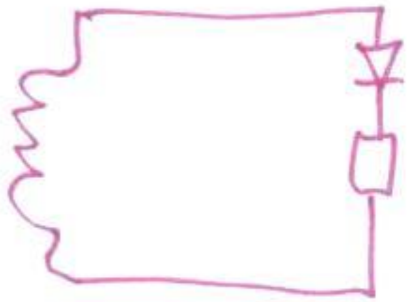
(d) (i) [2]

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = N \quad \text{and} \quad \frac{I_p}{I_s} = \frac{N_s}{N_p} = \frac{1}{N}$$

(ii) [2]

$$\frac{R_I}{R_L} = \left(\frac{V_p}{I_p}\right)\left(\frac{I_s}{V_s}\right) = \left(\frac{V_p}{V_s}\right)\left(\frac{I_s}{I_p}\right) = N\left(\frac{1}{\left[\frac{1}{N}\right]}\right) = N^2$$

(e) (i) [1]



(ii) The instantaneous voltage is not always constant (i.e. varying d.c.). [1]
OR Only half the power supplied to the secondary circuit is converted to useful power output.