Skema Paper 1

Question	Answer		Question	Answer
1	C		26	A
2	B		27	C
3	D		28	C
4	A		29	C
5	C		30	A
6	A		31	D
7	C		32	A
8	A		33	C
9	C		34	A
10	D		35	D
11	A		36	C
12	C		37	A
13	C		38	A
14	D		39	A
15	D		40	B
16	A		41	C
17	C		42	A
18	C		43	C
19	D		44	C
20	D		45	C
21	D		46	B
22	C		47	C
23	D		48	D
24	D		49	D
25	D		50	C

1 (a) $m_B v_1 = (m_B+m_W)v_2$ ……..(1)

$$v_1 = \frac{m_B + m_W}{m_B} v_2$$

$$\frac{1}{2}(m_B + m_W)v_2^{\,2} = (m_B + m_W)gh \quad \text{……..(2)}$$

$$v_2 = \sqrt{2gh}$$

$$v_1 = \frac{m_B + m_W}{m_B}\sqrt{2gh} \quad \text{……..……(3)}$$

(b) $$v_1 = \frac{5x10^{-3} + 2}{5x10^{-3}}\sqrt{2x9.81x3x10^{-2}}$$ ……..(4)

$V_1 = 307 \text{ m s}^{-1}$ ……(5)

2 (a) $\omega = \omega_o + \alpha t$

$= 27.5 + (-10)(0.30)$……(1)

$= 24.5 \text{ rad s}^{-1}$ ……(2)

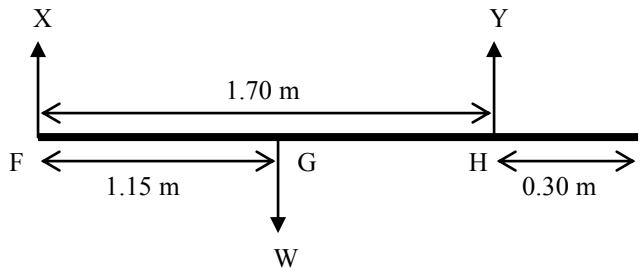
(b) $\theta = \omega_o t + \frac{1}{2}\alpha t^2$ ……(3)

$= 27.5(0.30) + \frac{1}{2}(-10)(0.30)^2$……(4)

$= 7.80$ rad

$= 1.24$ rev……(5)

3 (a)



……(1)

(b) Taking moment at F,

1.15W = 1.70Y……(2)

1.15 x 82 x 9.81 = 1.70 Y

Y = 544.17 N……..(3)

X + Y = 82 x 9.81…….(4)

X = 82 x 9.81 – 544.17

X = 260.25 N

4 $\gamma = \frac{C_p}{C_v}$

$\gamma = \frac{C_v + R}{C_v}$

$C_v = \frac{R}{\gamma - 1}$

$= \frac{8.31}{1.4 - 1}$ ……..(1)

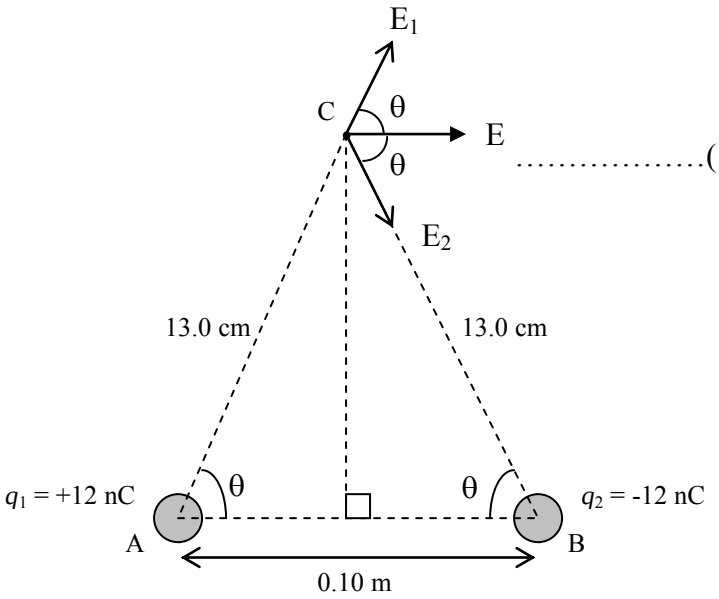
= 20.79 J mol^{-1} K^{-1} …….(2)

$\Delta U = nC_v\Delta T$ ……..(3)

= 2500(20.79)(26-35)……(4)

= - 4.68 x 10^5 J…….(5)

5



……(1)

$E = E_1 \cos\theta + E_2 \cos\theta$……..(2)

$= 2\{\frac{12x10^{-9}}{4\pi(8.85x10^{-12})(13x10^{-2})^2}(\frac{0.05}{13x10^{-2}})\}$……(3)

$= 4911.32\ N\ C^{-1}$……(4)

Direction of E = in the direction of OX…….(5)

6 $B_1 = \mu_o n_1 I_1$

$= \frac{\mu_o N_1 I_1}{l}$ ……..(1)

$M = \frac{N_2 B_1 A}{I_1}$ ……..(2)

$= \frac{\mu_o A N_1 N_2}{l}$ ……(3)

$25 \times 10^{-6} = \frac{N_1}{l}(4\pi \times 10^{-7})(10 \times 10^{-4})(10)$……..(4)

$\frac{N_1}{l} = 1989\ m^{-1}$……(5)

7(a) $p = \frac{h}{\lambda}$

$= \frac{6.63x10^{-34}}{650x10^{-9}}$ ……..(1)

$= 1.02 \times 10^{-27}$ kg m s^{-1}……(2)

(b) E = pc

$= 1.02 \times 10^{-27} \times 3.00 \times 10^{8}$……..(3)
$= 3.06 \times 10^{-19}$ J

$\frac{5.00x10^{-3}}{3.06x10^{-19}} = 1.63x10^{16}$ s^{-1}……...(4) & (5)

8(a) mass defect = (28 x 1.007825u) + (34 x 1.008665u) – 61.928349u
= 0.585361u
= 0.585361 x 1.66 x 10^{-27}……..(1)
= 9.717 x 10^{-28} kg……(2)

(b) Binding energy per nucleon

$= \frac{9.717x10^{-28}x(3.00x10^{8})^{2}}{62}$ ……..(3) & (4)

= 1.411 x 10^{-12} J……(5)

9(a) moment of inertia of a rigid body

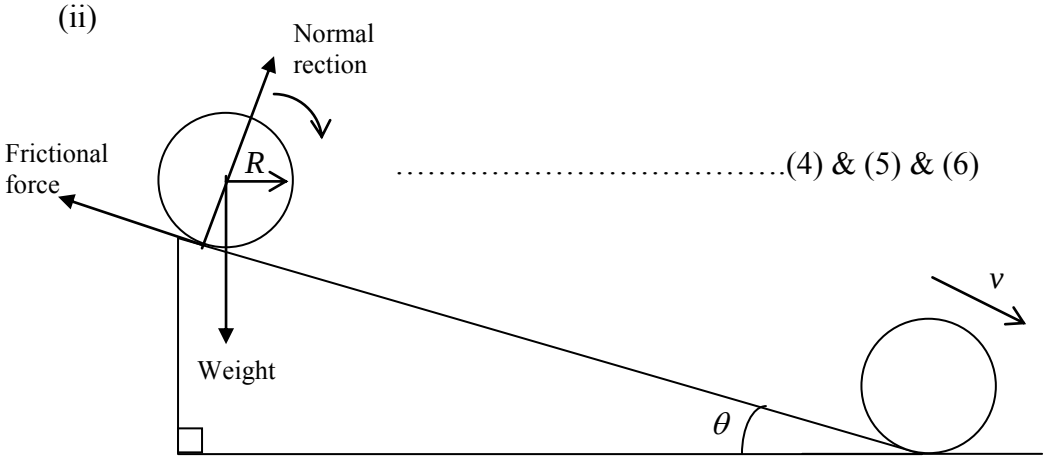
= $\sum_{i=1}^{n} m_i r_i^2$ ……(1)

Where m = mass of particles

r = perpendicular distance from the particle to the axis of rotation..(2)

(b)(i) Frictional force…….(3)

(ii)



…….(4) & (5) & (6)

(iii) Kinetic energy = $\frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$ …….(7)

$= \frac{1}{2}Mv^2 + \frac{1}{2}(\frac{2}{5}MR^2)(\frac{v}{R})^2$ ……(8)

$= \frac{7}{10}Mv^2$ …….(9)

(iv) work-energy theorem

$\frac{7}{10}Mv^2$ = (Mgsinθ)s where s = length of inclined plane …….(10)

Linear motion equation

$v^2 = u^2 + 2as$

$v^2 = 2as$ (u=0)

$2as = \frac{10}{7}(g\sin\theta)s$…….(11)

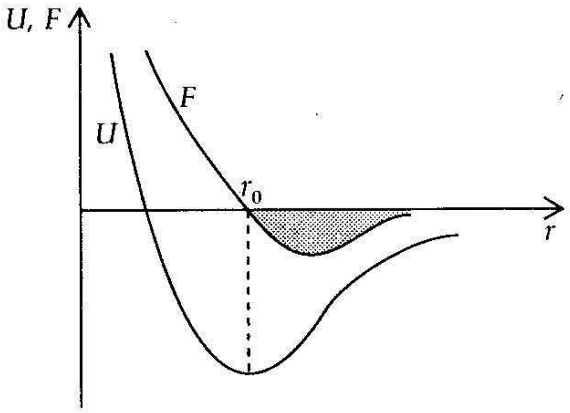
$$a = \frac{5}{7} g \sin\theta$$ .....(12)

(v) $$a = \frac{5}{7}(9.81)\sin 30^o$$ .....(13)

$a = 3.504 \text{ m s}^{-2}$.....(14)

Sliding has large linear acceleration.....(15)

10 (a)



U-r curve.....(1)

F-r curve.....(2)
r_o labeled correctly in U-r curve and F-r curve.....(3)

(b)(i) $$F = -\frac{dU}{dr}$$ .....(4)

$$U = \frac{A}{r^{12}} - \frac{B}{r^6} = Ar^{-12} - Br^{-6}$$

$$\frac{dU}{dr} = -12Ar^{-13} + 6Br^{-7}$$ .....(5)

$$\frac{dU}{dr} = -\frac{12A}{r^{13}} + \frac{6B}{r^7}$$

$$F = \frac{12A}{r^{13}} - \frac{6B}{r^7}$$ .....(6)

(ii) When $r = r_o$, $F = 0$

$$\frac{12A}{r_o^{13}} = \frac{6B}{r_o^{7}} \quad \text{……(7)}$$

$$r_o = (\frac{2A}{B})^{\frac{1}{6}} \quad \text{……(8)}$$

(iii) When $r = r_o$, $U = U_{\min}$

$$U_{\min} = \frac{A}{r_o^{12}} - \frac{B}{r_o^{6}} \quad \text{……..(9)}$$

$$U_{\min} = \frac{A}{(\frac{2A}{B})^{\frac{12}{6}}} - \frac{B}{(\frac{2A}{B})^{\frac{6}{6}}} \quad \text{……(10)}$$

$$U_{\min} = -\frac{B^2}{4A} \quad \text{……(11)}$$

$U_{\min}$ is the potential energy when temperature is 0 Kelvin……(12)

(iv) At breaking point,

$$\frac{dF}{dr} = 0 \quad \text{……..(13)}$$

$$F = \frac{12A}{r^{13}} - \frac{6B}{r^{7}} = 12Ar^{-13} - 6Br^{-7}$$

$$\frac{dF}{dr} = -\frac{156A}{r^{14}} + \frac{42B}{r^{8}} \quad \text{……(14)}$$

$$\frac{156A}{r^{14}} = \frac{42B}{r^{8}}$$

$$r = (\frac{26A}{7B})^{\frac{1}{6}} \quad \text{……..(15)}$$

11(a) Drift velocity is defined as the average velocity of free electron which is drifted in a specific direction……..…….(1)

(b)(i) $I = \frac{Q}{t}$

$I = \frac{Ne}{t}$, N=nV where n = number of free electron per unit volume……(2)

$I = \frac{nVe}{t}$, V = AL where L = length of wire

$I = \frac{nALe}{t}$ ……(3)

I = nAve where v = $\frac{L}{t}$ …….(4)

$J = \frac{I}{A}$ …….(5)

J = nve……(6)

(ii) J = σE

$J = \sigma \frac{V}{L}$ ……(7)

$\frac{I}{A} = \sigma \frac{V}{L}$

$V = \frac{L}{\sigma A} I$ …….(8)

V α I so it is equivalent to Ohm's law……(9)

$R = \frac{L}{\sigma A}$

R α $\frac{1}{A}$ ……..(10)

(c)(i) I = nAve

$v = \frac{5.0}{(1.2x10^{-6})(1.5x10^{29})(1.6x10^{-19})}$ ……..(11)

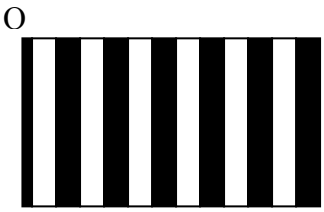
= 1.736 x 10^{-4} m s^{-1}……(12)

(ii) $\frac{I}{A} = \sigma \frac{V}{L}$ ……..(13)

$\sigma = \frac{(5.0)(1.50)}{(1.2x10^{-6})(0.24)}$ ……(14)

$= 2.604 \times 10^{7}\ \Omega^{-1}\ m^{-1}$……..(15)

12(a)

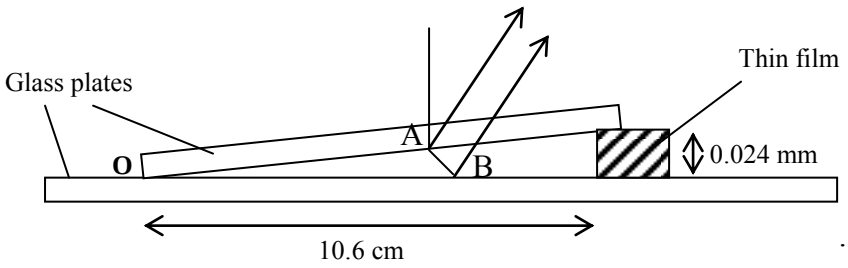


O is half size of the fringe……..(1)

Alternating bright and dark fringes…….(2)

O is dark fringe……..(3)

(b)



…….(4)

At A, there is no phase change after reflection

At B, there is a phase change of π rad after reflection……(5)

Optical path difference = $\frac{\lambda}{2}$ ……(6)

Path difference = 2t + $\frac{\lambda}{2}$ ……(7)

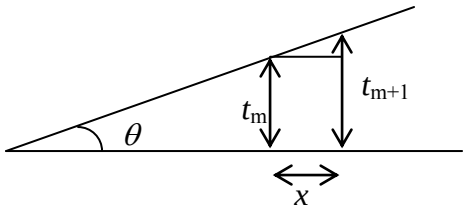
Constructive interference occurs, bright fringe is formed

$2t + \frac{\lambda}{2} = m\lambda$, m = 1,2,3,… ……(8)

Destructive interference occurs, dark fringe is formed

$2t + \frac{\lambda}{2} = (m+\frac{1}{2})\lambda$, m = 0,1,2,3,… ……(9)

(c)



$\tan\theta = \frac{t_{m+1} - t_m}{x}$ ……(10)

For m-th dark fringe, $2t_m = m\lambda$

For (m+1)-th dark fringe, $2t_{m+1} = (m+1)\lambda$

$t_{m+1} - t_m = \frac{\lambda}{2}$ ……..(11)

$\tan\theta = \frac{\lambda}{2x}$

$x = \frac{\lambda}{2\tan\theta}$ ……..(12)

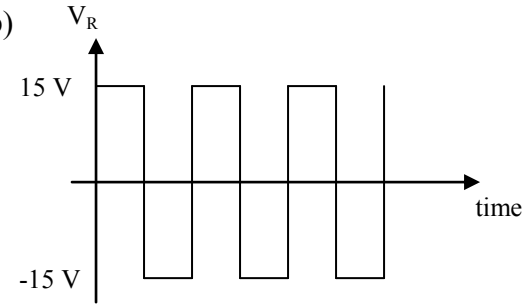
(d) $x = \frac{\lambda}{2\tan\theta}$, $\tan\theta = \frac{0.024x10^{-3}}{10.6x10^{-2}}$ ……(13)

$x = \frac{500x10^{-9}}{2(\frac{0.024x10^{-3}}{10.6x10^{-2}})}$ ……..(14)

x = 1.104 x 10^{-3} m……(15)

13(a) P : inverting input……(1)
Q : non-inverting input……..(2)

(b)



Shape of the graph……(3)
Label 15V and -15V……(4)

(c)(i) To reduce the distortion of output……(5)
To increase bandwidth……..(6)

(ii) Assume $V_P = V_Q = 0$…….(7)

$I_1 = \frac{V_1}{R_i}$ and $I_2 = -\frac{V_0}{R_f}$ ……(8)

Since $I_1 = I_2$, then

$\frac{V_0}{V_i} = -\frac{R_f}{R_i}$ ……(9)

9d)(i) Adder circuit ……..(10)

(ii) $V_0 = -[\frac{330}{33}(0.50) + \frac{330}{10}(0.20)]$ ……(11) & (12)

V_0 = -12V……(13)

(iii) The output voltage will saturated……(14)
Saturated voltage = -9V……..(15)

14. (*a*) (i) $^{4}_{2}\alpha + {}^{9}_{4}\text{Be} \longrightarrow {}^{12}_{6}\text{C} + {}^{1}_{0}X$ ---------- 2

(ii) α is a helium nucleus, X is a neutron ---------- 2

(iii) – It is deflected by electric or magnetic fields 1

– It does not produce any ionisation effects 1

(*b*) $1\text{ u} = \frac{1}{12} \times$ mass of an atom $^{12}_{6}\text{C}$

$= \frac{1}{12} \times \frac{12 \times 10^{-3}}{6.02 \times 10^{23}}$

$= 1.66 \times 10^{-27}\text{ kg}$ 1

From $E = mc^2$ 1

$= (1.66 \times 10^{-27})(3.00 \times 10^{8})^2 \times \frac{1}{1.60 \times 10^{-19}}$ 1

$= 9.34 \times 10^{8}\text{ eV}$ 1

$= 934\text{ MeV}$ 1

(*c*) $m \propto r$ 1

$\frac{m}{12} = \frac{26.2}{22.4}$

$m = 14$ 1

Nitrogen or carbon-14 (Either one) 1

Assumption: Both are equally charged 1