1/ a) $\sqrt{\dfrac{x^{-5}}{x^{-2}}} = \sqrt{x^{-3}} = \left(x^{-3}\right)^{\frac{1}{2}} = \underline{\underline{x^{-3/2}}}$

3 POSSIBLE END POINTS

or $\dfrac{1}{x^{3/2}} = \dfrac{1}{x \cdot x^{1/2}} = \underline{\underline{\dfrac{1}{x\sqrt{x}}}}$ (1)

(b) $p = \dfrac{a^2x + a^2y}{r} = \dfrac{a^2(x+y)}{r}$

$a^2 = \dfrac{p.r}{(x+y)} \quad \therefore \quad a = \sqrt{\dfrac{p.r}{(x+y)}}$ (1)

(c) $\dfrac{2}{2v+1} - \dfrac{3}{3v+2} = \dfrac{2(3v+2)-3(2v+1)}{(2v+1)(3v+2)} = \dfrac{\cancel{6v}+4-\cancel{6v}-3}{(2v+1)(3v+2)}$

$= \underline{\underline{\dfrac{1}{(2v+1)(3v+2)}}}$ (2)

(d) $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2} \quad \therefore \quad Z^2 = R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2$

$\therefore \quad Z^2 - R^2 = \left(\omega L - \frac{1}{\omega C}\right)^2 \quad \therefore \quad \sqrt{Z^2 - R^2} = \omega L - \frac{1}{\omega C}$

$\therefore \quad \dfrac{1}{\omega C} = \omega L - \sqrt{Z^2 - R^2} \quad \therefore \quad \dfrac{1}{C} = \omega\left(\omega L - \sqrt{Z^2-R^2}\right)$

$\therefore \quad C = \underline{\underline{\dfrac{1}{\omega\left(\omega L - \sqrt{Z^2 - R^2}\right)}}}$ (2)

(e)

$y = \sqrt{5x^2 - 4x - 1}$ so let $u = 5x^2 - 4x - 1$ and so $\dfrac{du}{dx} = 10x - 4$ (1)

$y = \sqrt{u} = u^{\frac{1}{2}}$ so $\dfrac{dy}{du} = \dfrac{1}{2}u^{-\frac{1}{2}}$ or $\dfrac{1}{2\sqrt{u}} = \dfrac{1}{2\sqrt{5x^2-4x-1}}$ (2)

So $\dfrac{dy}{dx} = \dfrac{dy}{du} \cdot \dfrac{du}{dx} = \dfrac{10x-4}{2\sqrt{5x^2-4x-1}} = \dfrac{5x-2}{\sqrt{5x^2-4x-1}}$ and finally = $\dfrac{5x-2}{\sqrt{(5x+1)(x-1)}}$ (1)

2/

(a) $\dfrac{dy}{dx} = \dfrac{2+y}{3+x}$ separate terms gives $\dfrac{dy}{2+y} = \dfrac{dx}{3+x}$

integrate both sides

~~so ln(2+y) = ln~~ $\displaystyle\int \frac{1}{2+y} \cdot dy = \int \frac{1}{3+x} \cdot dx$ gives (1)

$\ln(2+y) = \ln(3+x) + c$ let $c = \ln(A)$ (1)

$\ln(2+y) = \ln(3+x) + \ln(A) = \ln(A(3+x))$

raise each side to power of e gives $2+y = A(3+x)$

$\therefore$ $y = A(3+x) - 2$ (1)

(b)

$3\dfrac{dv}{dt} = 3+5v$ separate terms $\dfrac{3}{3+5v} \cdot dv = dt$

integrate both sides $\displaystyle 3\int \frac{1}{3+5v} \cdot dv = \int dt$ (1)

let $K = 3+5v$ $\therefore$ $\displaystyle\int \frac{1}{3+5v} \cdot dv = \int \frac{1}{K} \cdot dv$ $\qquad \dfrac{dK}{dv} = +5$

$\therefore$ $dv = \dfrac{dK}{+5}$ so $\displaystyle\int \frac{1}{K} \cdot dv = \int \frac{1}{K} \frac{dK}{+5} = +\frac{1}{5}\int \frac{1}{K} \cdot dK$

$= +\dfrac{1}{5}\ln(K) = +\dfrac{1}{5}\ln(3+5v)$

so $+\dfrac{3}{5}\ln(3+5v) = t + c$ general solution (2)

if $v = 2$ when $t = 0$

$\dfrac{3}{5}\ln(3+10) = c = \dfrac{3}{5}\ln(13)$ (2)

So $t = \dfrac{3}{5}\ln(3+5v) - \dfrac{3}{5}\ln(13) = \dfrac{3}{5}\ln\left(\dfrac{(3+5v)}{13}\right)$

$$\frac{5t}{3} = \ln\left(\frac{(3+5v)}{13}\right)$$ ~~take~~ raise each side to power of e

$$e^{5t/3} = \frac{3+5v}{13} \quad \text{so} \quad 13\,e^{5t/3} = 3+5v$$

$$13\,e^{5t/3} - 3 = 5v$$

$$v = \frac{1}{5}\left(13\,e^{5t/3} - 3\right)$$ 2

3/ (a) $i(t) = 6\sin(50\pi t - \pi/4)$

(i) Peak-to-Peak is $6+6 = \underline{\underline{12\,A}}$ (1)

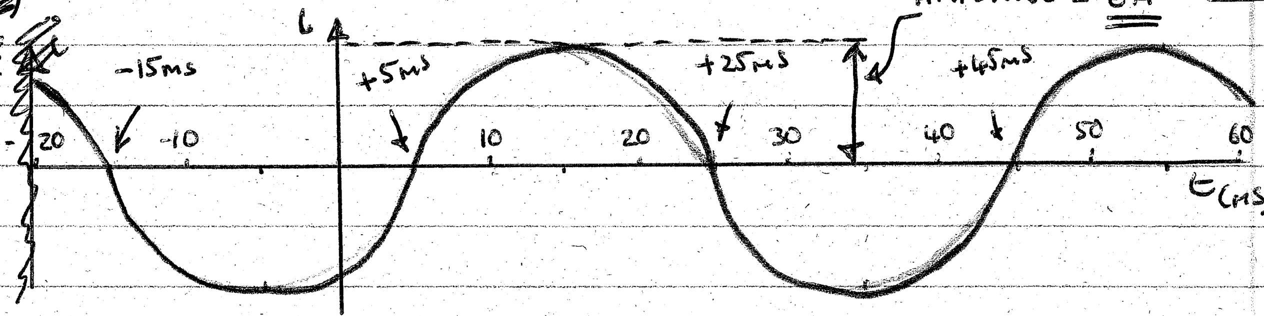
(ii) $\omega = \underline{\underline{50\pi}}$ radians (or 157.1) (1)

(iii) phase shift $= \underline{\underline{-\pi/4}}$ radians (or -0.785) (1)

(iv) $\omega = 2\pi F$ & $T = 1/F$ $\therefore$ $\omega = 2\pi/T$ or $T = \frac{2\pi}{\omega}$

$\therefore T = \frac{2\pi}{50\pi} = \frac{1}{25} = \underline{\underline{40\,ms}}$ (1)

(b)



AMPLITUDE = 6A — (1)

(4) FOR CROSSING

(c)

$i(t) = 6\sin(50\pi t - \pi/4) = \underline{\underline{6\cos(50\pi t - 3\pi/4)}}$ (1)

4/ (a) $-3.2\sin(\omega t) - 4.7\cos(\omega t) = R\sin(\omega t + \alpha)$

$R = \sqrt{3.2^2 + 4.7^2} = \underline{5.69}$ 1

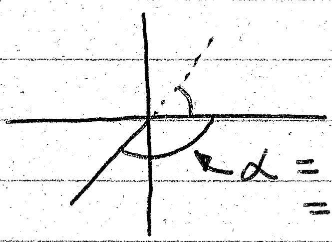
$R\sin(\omega t + \alpha) = R\sin(\omega t).\cos(\alpha) + R\cos(\omega t).\sin(\alpha)$
$= (R\cos(\alpha)).\sin(\omega t) + (R\sin(\alpha)).\cos(\omega t)$

$\therefore R\cos(\alpha) = -3.2$ & $R\sin(\alpha) = -4.7$

$\tan(\alpha) = \dfrac{R\sin(\alpha)}{R\cos(\alpha)} = \dfrac{-4.7}{-3.2} = 1.47$

$\therefore \alpha = \tan^{-1}(1.47) = 0.97$ radians (or $55.8°$)

However both $R\cos(\alpha)$ & $R\sin(\alpha)$ are both negative so α should be in 3rd quadrant



$\alpha = -\pi + 0.97$ or $(-180° + 55.8°)$
$= \underline{-2.17}$ or $(-124.2°)$ 1

__Check__ $R\cos(\alpha) = 5.69 \times \cos(-2.17) = -3.2$ ✓
$R\sin(\alpha) = 5.69 \times \sin(-2.17) = -4.7$ ✓

OR 2

So $-3.2\sin(\omega t) - 4.7\cos(\omega t) = \underline{\underline{5.69\sin(\omega t - 2.17)}}$

(b)
$v(t) = 6\sin(\omega t)$ $i(t) = 4\sin(\omega t - \pi/3)$

so $p(t) = v(t).i(t) = 24\sin(\omega t)\sin(\omega t - \pi/3)$

using $\sin A\sin B = -\frac{1}{2}[\cos(A+B) - \cos(A-B)]$ where $A = \omega t$ & $B = (\omega t - \pi/3)$ 2

so $p(t) = -\dfrac{24}{2}\left[\cos(\omega t + \omega t - \pi/3) - \cos(\omega t - \omega t + \pi/3)\right]$

$$p(t) = -12\left[\cos(2\omega t - \pi/3) - \cos(\pi/3)\right]$$ 2

$$= +12\left[\cos(\pi/3) - \cos(2\omega t - \pi/3)\right]$$

noting that $\cos(\pi/3) = 1/2$ then 2

$$p(t) = +12\left[\tfrac{1}{2} - \cos(2\omega t - \pi/3)\right]$$

$$= 6 - 12\cos(2\omega t - \pi/3)$$

$$p(t) = 6\left[1 - 2\cos(2\omega t - \pi/3)\right]$$ 2

5/ 5.1

(a) $A = \begin{vmatrix} 3 & 2 & -1 \\ 2 & -1 & 2 \\ 1 & -3 & -4 \end{vmatrix}$ using top row

$A = 3((-1.-4)-(2.-3)) - 2((2.-4)-(2)) - ((2.-3)-(-1))$ 1

$A = 3(4+6) - 2(-8-2) - (-6+1)$

$A = 3(10) - 2(-10) - (-5)$

$A = 30 + 20 + 5$ 2

$\underline{\underline{A = 55}}$

(b) $x - 4y - 2z = 21$
$3x + 2y - z = -2$
$2x + y + 2z = 3$

~~make augmented matrix~~

$$\begin{bmatrix} 1 & -4 & -2 \\ 3 & 2 & -1 \\ 2 & 1 & 2 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 21 \\ -2 \\ 3 \end{bmatrix}$$

Form Augmented matrix

$$\left[\begin{array}{ccc:c} 1 & -4 & -2 & 21 \\ 3 & 2 & -1 & -2 \\ 2 & 1 & 2 & 3 \end{array}\right]$$

New row 3 $= R_3 - 2 \times R_1$

$$\left[\begin{array}{ccc:c} 1 & -4 & -2 & 21 \\ 3 & 2 & -1 & -2 \\ 0 & 9 & 6 & -39 \end{array}\right]$$ 2

New $R_2 = R_2 - 3R_1$

$$\left[\begin{array}{ccc:c} 1 & -4 & -2 & 21 \\ 0 & 14 & 5 & -65 \\ 0 & 9 & 6 & -39 \end{array}\right]$$

New $R_3 = 14 \times R_3 - 9 \times R_2$

$$\left[\begin{array}{ccc:c} 1 & -4 & -2 & 21 \\ 0 & 14 & 5 & -65 \\ 0 & 0 & 39 & 39 \end{array}\right]$$ 2

Re-form original matrix

$$\begin{bmatrix} 1 & -4 & -2 \\ 0 & 14 & 5 \\ 0 & 0 & 39 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 21 \\ -65 \\ 39 \end{bmatrix}$$

So $x - 4y - 2z = 21$ — 1
$14y - 5z = -65$ — 2
$39z = 39$ — 3

From 3 $\underline{\underline{z = 1}}$ From 2 $14y - 5 = -65$, $14y = -70$, $\underline{\underline{y = -5}}$

From 1 $x - 4(-5) - 2 = 21$, $x + 20 - 2 = 21$
$x = 21 - 18$, $\underline{\underline{x = 3}}$ 3

6/

(a) 5τ + mentioned in lectures (can demonstrate as follows
$0.01 = e^{-N\tau/\tau}$ $\therefore N = -\ln(0.01) = 4.6$) ①

(b) $V(t) = V_0 e^{-t/\tau}$ so $1.8v = 12 e^{-t/40\times10^{-3}}$

$\frac{1.8}{12} = e^{-t/40\times10^{-3}}$ so $\ln\left(\frac{1.8}{12}\right) = \frac{-t}{40\times10^{3}}$ ①

so $t = -40\times10^{-3} \ln\left(\frac{1.8}{12}\right)$

$t = \underline{\underline{75.9\,\text{ms} \simeq 76\,\text{mS}}}$ ②

(c) let time to get to 26A be t_1 and to 38A = t_2

if $i(t) = I_0\left(1 - e^{-t/\tau}\right)$ so $\frac{i(t)}{I_0} = 1 - e^{-t/\tau}$

$1 - \frac{i(t)}{I_0} = e^{-t/\tau}$ so $\ln\left(1 - \frac{i(t)}{I_0}\right) = \frac{-t}{\tau}$

$\therefore\ t = -\tau \ln\left(1 - \frac{i(t)}{I_0}\right)$

so $t_1 = -10^{-2}\ln\left(1 - \frac{26}{40}\right)$ & $t_2 = -10^{-2}\ln\left(1 - \frac{38}{40}\right)$ ②

$\therefore t_2 - t_1 = -10^{-2}\left(\ln\left(1 - \frac{38}{40}\right) - \ln\left(1 - \frac{26}{40}\right)\right)$ ①

$= -10^{-2}\left(\ln\left(\frac{\left(1 - \frac{38}{40}\right)}{\left(1 - \frac{26}{40}\right)}\right)\right) = -10^{-2}\ln\left(\frac{1/20}{7/20}\right)$

$= -10^{-2}\ln\left(\frac{1}{7}\right) = \underline{\underline{19.5\,\text{mS}}}$ ③

[[t_1 is actually 10.5mS & t_2 is actually 30mS]]

1/

(a) loop I_1 $\quad -8 + I_1(4+4+6) - 4I_2 - 4I_3 + 6 = 0$

$$14I_1 - 4I_2 - 4I_3 = 2 \quad -(1)$$ (2)

loop I_2 $\quad I_2(4+5+1) - 4I_1 - I_3 = 0$

$$-4I_1 + 10I_2 - I_3 \quad -(2)$$ (2)

loop I_3 $\quad -6 + I_3(1+5+4) - 4I_1 - I_2 = 0$

$$-4I_1 - I_2 + 10I_3 = 6 \quad -(3)$$ (2)

(b) Form determinant from (1), (2) & (3)

using top row

$$\Delta = \begin{vmatrix} 14 & -4 & -4 \\ -4 & 10 & -1 \\ -4 & -1 & 10 \end{vmatrix} = 14(100-1) + 4(-40-4) - 4(4+40)$$

$$= 14 \times 99 + 4 \times (-44) - 4 \times 44$$

$$= 1386 - 176 - 176$$

$$\Delta = 1034$$ (2)

For I_1

using left-hand column

$$\Delta_1 = \begin{vmatrix} 2 & -4 & -4 \\ 0 & 10 & -1 \\ 6 & -1 & 10 \end{vmatrix} = 2(100-1) - 0 + 6(4+40)$$

$$= 2 \times 99 + 6 \times 44$$

$$= 198 + 264$$

$$\Delta_1 = 462$$ (2)

So $I_1 = \dfrac{\Delta_1}{\Delta} = \dfrac{462}{1034} = \dfrac{21}{47} = 0.447\text{ A} = 447\text{ mA}$ (1)

For I_2

using middle column

$$\Delta_2 = \begin{vmatrix} 14 & 2 & -4 \\ -4 & 0 & -1 \\ -4 & 6 & 10 \end{vmatrix} = -2(-40-4) + 0 - 6(-14-16)$$

$$= -2 \times (-44) - 6 \times (-30)$$

$$= 88 + 180$$

$$\Delta_2 = 268$$ (2)

So $I_2 = \dfrac{\Delta_2}{\Delta} = \dfrac{268}{1034} = \dfrac{134}{517} = 0.259\text{ A} = 259\text{ mA}$ (1)

For I_3

$$\Delta_3 = \begin{vmatrix} 14 & -4 & 2 \\ -4 & 10 & 0 \\ -4 & -1 & 6 \end{vmatrix}$$ using right-hand column

$= 2(4+40) - 0 + 6(140-16)$

$= 2 \times 44 + 6 \times 124$

$= 88 + \cancel{7}744$

$\Delta_3 = 832$ (2)

So $I_3 = \frac{\Delta_3}{\Delta} = \frac{832}{1034} = \frac{416}{517} = 0.805$ A or 805mA (1)

Check by putting in equation (1) $14I_1 - 4I_2 - 4I_3 = 2$

$14(0.447) - 4(0.259) - 4(0.805) = 2$ ✓

(2) $-4I_1 + 10I_2 - I_3 = 0$, $-4(0.447) + 10(0.259) - (0.805) = 0$ ✓

(3) $-4I_1 - I_2 + 10I_3 = 6$, $-4(0.447) - 0.259 + 10 \times (0.805) = 6$ ✓

(c) (i) Current in 6Ω resistor is $I_1 \therefore = \frac{21}{47} = 0.447$ A or 447mA (1)
Flowing UP

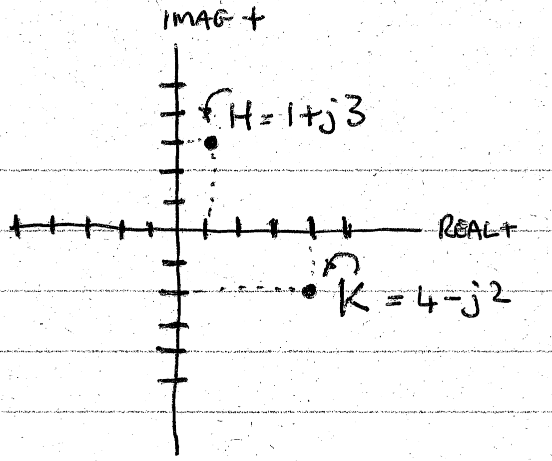
(ii) In resistor 1Ω I_2 flows right to left & I_3 flows left to right

so total current $= I_3 - I_2 = \frac{416}{517} - \frac{134}{517} = \frac{416-134}{517} = \frac{282}{517} = 0.545$A

So current is 0.545A (or 545mA) flowing left to right (2)

8/ ~~8~~

(a)



2

(b)

(i) $H-K=(1+j3)-(4-j2)=1+j3-4+j2$

$= \underline{\underline{-3+j5}}$ & $\underline{\underline{5.83\angle 121^\circ}}$ (or 2.11 radians) 2

(ii) $\dfrac{K}{H}=\dfrac{(4-j2)}{(1+j3)}=\dfrac{4.47\angle -26.6^\circ}{3.16\angle 71.6^\circ}=1.41\angle -98.2^\circ$ (or −1.71 radians)

& $\underline{\underline{-0.20-j1.40}}$ 2

(c) (i) $50\angle -60^\circ=(25-j43.3)\,\Omega$

so circuit consists of a $\underline{25\,\Omega}$ resistor

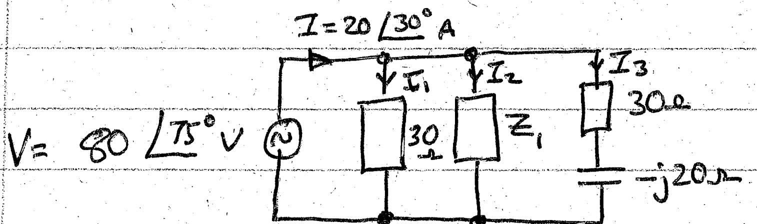
and a capacitive reactance of $-j\,\cancel{43}\,43.3\,\Omega$ 2

(ii) Reactance is $-j43.3\,\Omega$ so is capacitive

$X_C=43.3=\dfrac{1}{2\pi fC}$ $\therefore C=\dfrac{1}{2\pi f\,.\,43.3}$ where f is 400 Hz

so $C=\dfrac{1}{2\times\pi\times 400\times 43.3}=\underline{\underline{9.2\,\mu F}}$ 2

(d)



(i)

By Kirchoffs current law we know that $20\angle 30^\circ A = I_1+I_2+I_3$

I_1 (current in $30\,\Omega$ arm) $=\dfrac{V}{30\,\Omega}=\dfrac{80\angle 75^\circ}{30}=2.667\angle 75^\circ=0.69+j2.58\,A$

$$I_2 \left(\begin{smallmatrix}\text{current in} \\ (30-j20)\text{ arm}\end{smallmatrix}\right) = \frac{V}{(30-j20)} = \frac{80\angle 75^\circ}{36.06\angle -33.7^\circ} = 2.22\angle 75+33.7$$

$$= 2.22\angle 108.7^\circ = -0.71 + j2.10 \text{ A}$$

$$I_3 = 20\angle 30^\circ - I_2 - I_1 = (17.32 + j10) - (0.69 + j2.58) - (-0.71 + j2.10)$$

$$I_3 = 17.32 + j10 - 0.69 - j2.58 + 0.71 - j2.10$$

$$I_3 = \underline{\underline{17.34 + j5.32}} = \underline{\underline{18.14\angle 17.1^\circ}} \text{ A}$$ (3)

(ii)

$$\therefore Z_1 = \frac{V}{I_3} = \frac{80\angle 75^\circ}{18.14\angle 17.1^\circ} = \underline{\underline{4.41\angle 57.9^\circ\ \Omega \text{ or } 2.34 + j3.73\ \Omega}}$$ (5)

(iii) $Z_1 = 2.34 + j3.73\ \Omega$ $\therefore$ Z_1 consists of a resistance $\underline{2.34\ \Omega}$ (1)
& a reactance of $+j3.73$ ie an inductance

$$j3.73 = \omega L \quad \therefore L = \frac{3.73}{2\times\pi\times f} = \frac{3.73}{2\times\pi\times 10^3} = \underline{\underline{593\ \mu H}}$$ (1)

9/

(a) Mean $= \frac{1}{T}\int_0^T i(t)\,.\,dt$ (2)

(b) Period of waveform 4 ms

From $t = 0 \rightarrow 2$ ms ~~(15 V per millisecond)~~

$v(t) = \frac{30}{2\times10^{-3}}\,.\,t = 15000.t$ V/s (or $15.t$ V/ms)

Correct equations

from $t = 2 \rightarrow 4$ ms $v(t) = 0$ (1)

Mean $= \overline{V} = \frac{1}{T}\int_0^{4\times10^{-3}} v(t)\,.\,dt = \frac{1}{4\times10^{-3}}\left[\int_0^{2\times10^{-3}} 15000.t\,.\,dt + 0\right]$ (1)

$\overline{V} = \frac{1}{4\times10^{-3}}\left[\frac{15000\,t^2}{2}\right]_0^{2\times10^{-3}} = \frac{1}{4\times10^{-3}}\left[\frac{15000\,(2\times10^{-3})^2}{2} - 0\right]$

$\overline{V} = \frac{1}{4\times10^{-3}}\left[\frac{15000\times4\times10^{-6}}{2}\right] = \frac{1}{4\times10^{-3}}\times0.03 = 7.5$ V (2)

RMS $= \sqrt{\frac{1}{T}\int_0^T (v(t))^2\,.\,dt}$ (1)

$v(t)$ for $t = 0 \rightarrow 2$ ms $= 15000\,t$ $\therefore (v(t))^2_{t=0\rightarrow2ms} = 15000^2\,t^2$

$(v(t))^2_{t=0\rightarrow2ms} = 225\times10^6\,t^2$

$v(t)$ for $t = 2$ ms $\rightarrow 4$ ms $= 0$ $\therefore (v(t))^2 = 0$ (1)

RMS $= \sqrt{\frac{1}{4\times10^{-3}}\int_0^{2\times10^{-3}} 225\times10^6\,.\,t^2\,.\,dt + 0}$ (2)

$= \sqrt{\frac{1}{4\times10^{-3}}\,.\,225\times10^6\int_0^{2\times10^{-3}} t^2\,.\,dt}$

$$RMS = \sqrt{\frac{225\times10^{6}}{4\times10^{-3}}\left[\frac{t^3}{3}\right]_0^{2\times10^{-3}}}$$

$$= \sqrt{\frac{225\times10^{9}}{4}\left[\frac{(2\times10^{-3})^3}{3} - 0\right]}$$

$$= \sqrt{\frac{225}{4}\times10^{9}\cdot\frac{8\times10^{-9}}{3}}$$

$$RMS = \sqrt{\frac{1800}{12}} = \sqrt{150} = \underline{\underline{12.25\ V}}$$ (2)

(c)

$$v(t) = \cos(t) - 3 \quad \therefore (v(t))^2 = \cos^2(t) - 6\cos(t) + 9$$ (1)

Now must integrate $(v(t))^2$ but cannot integrate $\cos^2(t)$ directly so use $\cos^2(t) = \frac{1}{2}(1 + \cos(2t))$

~~$\int_0^T (v(t))^2 . dt$~~ So $(v(t))^2 = \frac{1}{2} + \frac{\cos(2t)}{2} - 6\cos(t) + 9$

$$= 9.5 + \frac{\cos(2t)}{2} - 6\cos(t)$$ (1)

Now integrate

$$\int_0^T (v(t))^2 . dt = \int_0^T \left(9.5 + \frac{\cos(2t)}{2} - 6\cos(t)\right) . dt$$ (2)

$$= \left[9.5t + \frac{\sin(2t)}{4} - 6\sin(t)\right]_0^T$$

$$= \left[9.5T + \frac{\sin(2T)}{4} - 6\sin(T)\right] - \left[0 + \frac{\cancel{\sin(0)}}{4} - 6\cancel{\sin(0)}\right]$$

$$= \left[9.5T + \frac{\sin(2T)}{4} - 6\sin(T)\right]$$ (2)

$$RMS = \sqrt{\frac{1}{T}\int_0^T (v(t))^2 \, dt}$$

$$= \sqrt{\frac{1}{T}\left[9.5T + \frac{\sin(2T)}{4} - 6\sin(T)\right]}$$

$$RMS = \sqrt{9.5 + \frac{\sin(2T)}{4T} - \frac{6\sin(T)}{T}}$$ 2

10/ 10.1

(a) $y = a.x^n$ take logs of both sides

$\log(y) = \log(a.x^n)$ (1)

$= \log(a) + \log(x^n)$

$= \log(a) + n.\log(x)$

rearranging $\log(y) = n.\log(x) + \log(a)$ (2)

which is of the form $y = m.x + c$ ← the straight line formula (1)

(~~a~~) plot $\log(y)$ against $\log(x)$ to see if its a straight line

(b) See graph paper. Data reveals a straight line so fits the form $y = a x^n$ (6)

(c) From answer to (a) we know that $\log(y)$ plotted against $\log(x)$ will form a straight line of the form

$\log(y) = n.\log(x) + \log(a)$ where

n is the gradient of that line & $\log(a)$ is the intercept ~~value~~. Taking two values of x & y

$x_1 = 1,\ y_1 = 3$ & $x_2 = 120,\ y_2 = 937$

$\log(y_2) = n.\log(x_2) + \log(a)$ — (1)

$\log(y_1) = n.\log(x_1) + \log(a)$ — (2)

Subtract (2) from (1)

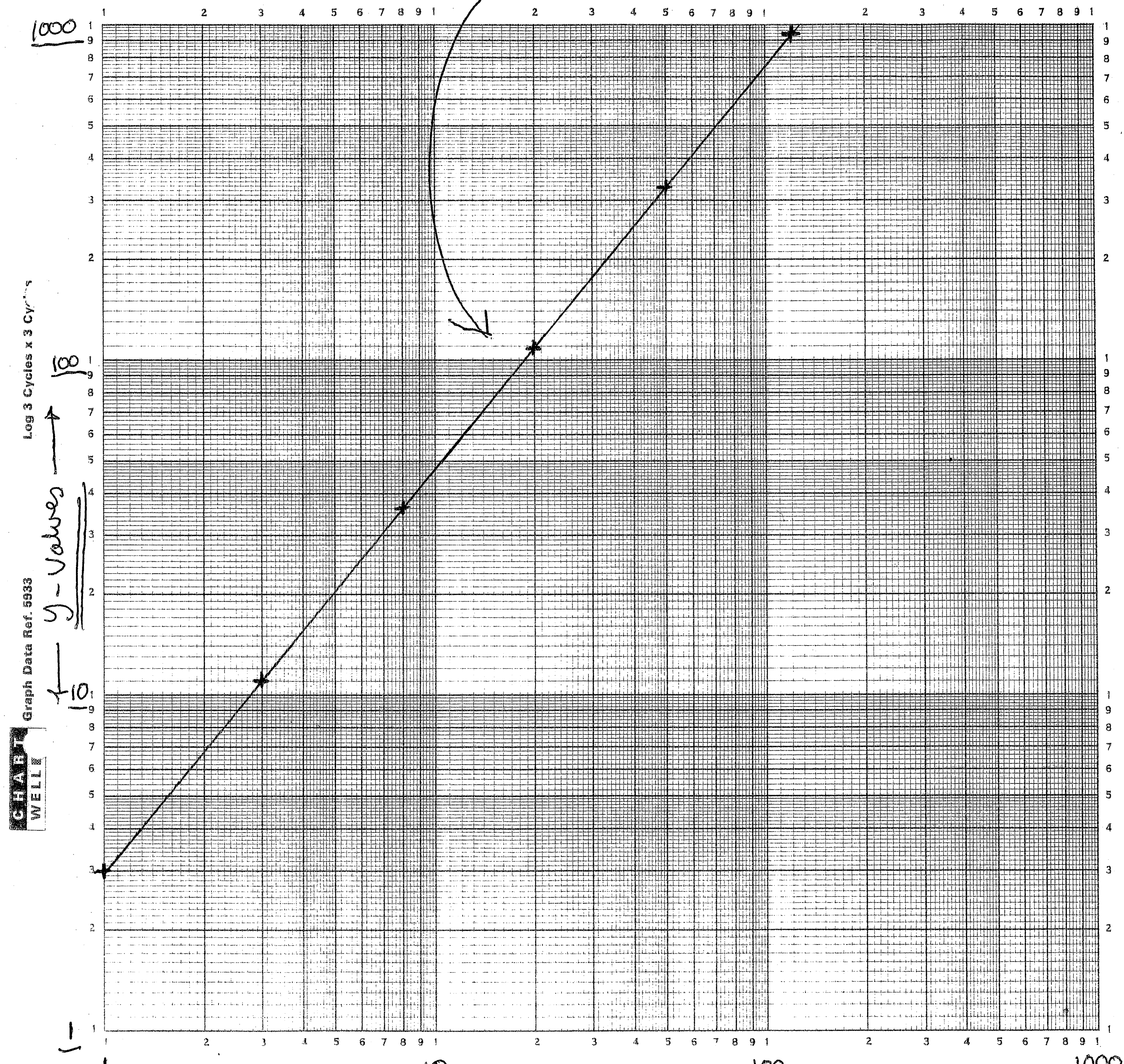
$(\log(y_2) - \log(y_1)) = n.(\log(x_2) - \log(x_1))$ (3)

$$\therefore\ n = \frac{(\log(y_2) - \log(y_1))}{(\log(x_2) - \log(x_1))}$$

$$= \frac{(\log(937) - \log(3))}{(\log(120) - \log(1))}$$

(i) $n = \dfrac{(2.97 - 0.48)}{(2.08 - 0)} = \dfrac{2.49}{2.08} = \underline{\underline{1.20}}$ (3)

Straight line on log-log graph paper so means of form $y = a x^n$



X - VALUES

(2) marks for correct use of ~~axes~~ axes

(2) marks for correct plotting of points

(2) marks for drawing straight line through data.

(ii) We know $n = 1.2$ so use this in equation

$$\log(y) = n.\log(x) + \log(a)$$

$$\therefore \log(a) = \cancel{n.\log(x)}\ \log(y) - n.\log(x)$$ (2)

lets use $y = 937$ when $x = 120$

$$\therefore \log(a) = \log(937) - 1.2 \times \log(120)$$

$$= 2.97 - 1.2 \times 2.08$$

$$= 2.97 - 2.50$$

$$\log(a) = 0.47$$

$$\text{So} \quad a = 10^{0.47}$$

$$a = 2.95 \simeq 3$$ (2)