2. *Formulae and variation*

1	$X = \dfrac{U^2V}{U^2 2W}$ $U^2X + 2WX = U^2V$ $U^2X - U^2V = -2WX$ $U^2(X - V) = -2WX$ $U^2 = \dfrac{-2WX}{X - V}$ $U = \pm\sqrt{\dfrac{-2WX}{X - V}}$	M_1 M_1 A_1	Collecting terms of U^2 C.A.O $U = \pm\sqrt{\dfrac{2WX}{v - X}}$
		3	
2.	$P = Kt + Ct^2$ $45 = 20K + 400C.....(i)$ $60 = 24K + 576C.....(ii)$ $(80C + 4K = 9)2$ $(48C + 2K = 5)4$ $160C + 8K = 18$ $192C + 8K = 20$ $-32\ C = -2$ $C = \dfrac{1}{16} \therefore K = 1$ $P = 32 + \dfrac{32 \times 32}{16}$ $= 96$	M1 M1 A1 B1	Allow for one ✓equation ✓Attempt to solve For both values
		4	
3.	$V = \dfrac{K}{W^2} + C$ $W = 2, V = 14$ $14 = \dfrac{K}{2^2} + C \Rightarrow 56 = K + 4c.....(i)$ $9 = \dfrac{K}{3^2} + C \Rightarrow \dfrac{81 = K + 9c}{-25 = -5C}$ ……(ii) $(i)-(ii)$ $5 = c$ $56 = k + 20$ $36 = k$	B1 M1	

	$V = \frac{36}{W^2} + 5$ $V = \frac{36}{6^2} + 5 = 5$	A1 B1	
		04	
4.	$T^2 = \frac{1}{4}\left(\frac{2}{x+y}\right)$ $4T^2(x+y) = 2$ $x+y = \left(\frac{2}{4T^2}\right)$ $y = \frac{1}{2T^2} - x$	M1 M1 A1	Removal of root sign Simplification Y expressed in simplified form
		03	

1. $P = kr^2$; $R = MT^2$

$18 = 9k \quad 3 = 25m$

$K = 2 \qquad M = \frac{3}{25}$

$P = 2R^2 \qquad R = \frac{3}{25} T^2$

$\left(P = 2\right)^2 \frac{3}{25} T^2 = \frac{18}{625} T^4$

$P = \frac{18 \times 10000}{625} = 288$

2. $v^2 = \frac{r}{r + c}$

$v^2 (r + c) = r (r + c)$

$v^2 r + vc = r$ ***Removing the sg. Root.***

$r - v^2 r = vc$

$r (1 - v^2) = vc$ ***Factorization.***

$r = \frac{vc}{1 - v^2}$ ***C.A.O***

3. $X \alpha \frac{Y^3}{\sqrt{Z}} \Rightarrow x = KY^3$

$6 = \frac{K(3)^3}{\sqrt{\quad}}$

$$6 = \frac{25}{27K}$$

$$K = \frac{10}{9}$$

$$\therefore X = \frac{10}{9}\frac{Y^3}{\sqrt{Z}}$$

$$X = \frac{10}{9}\frac{(7)^3}{9}$$

$$= \left(\frac{10 \times 34}{27}\right)^3$$

$$= 127.04$$

(a) $Y^3 = \frac{9}{10} x Z$

$$Y = \sqrt[3]{\frac{9}{10} x 4 x 8}$$

$$Y = \sqrt[3]{\frac{144}{5}} = 3.07$$

(b) $X_1 = \frac{KY^3}{\sqrt{Z}}$

$X_2 = \frac{K(1.2y)^3}{\sqrt{0.64Z}}$ M_1

$$\frac{1.728KY^3}{\sqrt{0.8\ Z}} - \frac{KY^3}{\sqrt{Z}} \quad M_1$$

$$\left(\frac{\frac{2.16KY^3}{\sqrt{Z}} - \frac{KY^3}{\sqrt{Z}}}{\frac{KY^3}{\sqrt{Z}}}\right) x\ 100\ \% \qquad M_1$$

$= 116\%$ A_1

4. $K(b-a) = ab$

$Kb - ka = ab$

$Kb - ab = ka$

$B(k-a) = ka$

$B = \frac{ka}{K-a}$

5. $x - 2.5 - \sqrt{3} \qquad x - 2.5 + \sqrt{3} = 0$

$x^2 - 2.5x + x\sqrt{3} - 2.5x + 6.25 - 2.5\sqrt{3}$

$x\sqrt{3} + 2.5\sqrt{3} = 0$

$x^2 - 5x + 6.25 - 3 = 0$

$x^2 - 5x + 3.25 = 0$

$4x^2 - 20x + 13 = 0$

6. $Z = \frac{Kx^2}{\sqrt{y}}$

$Z = \frac{(1.2x)^2 K}{\sqrt{0.64y}}$

$= \frac{1.44Kx^2}{0.85y}$

$= 1.8 \frac{Kx^2}{\sqrt{y}}$

% increase = 80%

7. $ar^3 = 48$

$ar^6 = 384$

$\therefore \frac{ar^6}{ar^3} = \frac{384}{48}$

$r^3 = 8$

$r = 2$

$ar^3 = 48$

$8a = 48$

$a = 6$

$Sn = \frac{a(r^n - 1)}{r - 1}$

$\frac{6(2^6 - 1)}{2 - 1}$

$= 6(64 - 1)$

$= 6 \times 63$

$= 378$

8. $P = \frac{KQ^2}{R}$

$2 = \frac{16K}{6}$

$K = ¾$

$P = ¾ \frac{Q^2}{R} = ¾ \times \frac{64}{4} = 12$

9. $B \& M^2 = {}^{1}/_{N}$

$B = Km^2 + {}^{Q}/_{N}$

$(96 = 4K + 2Q)^3$

$(46 = 3K + 0.5Q)^4$

$104 = 4Q$

$Q = 26$

$K = 11$

Expression $B = 11m^2 + {}^{26}/_{N}$

10. $3x = y - 1$ ……. i

$\frac{2x + 2}{y - 5} = \frac{1}{2}$

$4x + 4 = y - 5$

$4x + 9 = y$ …… ii

$3x = y - 1$

$4x = y - 9$

$-x = 9 \quad x = -9$

$-27 = y - 1$

$y = -26$

11. $P = \sqrt[3]{\frac{x-1}{x+2}} \Rightarrow P^3 = \frac{x-1}{x+2}$

$P^3x - 2P^3 = x - 1$

$P^3x - x = -1 - 2p^3$

$x(P^3 - 1) = -1 - 2P^3$

$x = \left(\frac{-1 - 2P^3}{P^3 - 1}\right) - 1$

$x = \frac{1 + 2p^3}{1 - p^3}$

12. $a^4 = \frac{1 + d^2}{b^2} + \frac{b}{3}$

$3d^2 = 3a^4b^2 - b^2 - 3$

$d = \sqrt{\frac{3a^4b^2 - b^2 - 3}{3}}$

13. (a) $Z = \frac{KX^2}{y^2}$

$Z = \frac{100k}{16} = 15$

$K = \frac{12}{5}$

$Z = \frac{12x^2}{5^{y^2}}$

(b) $Z = 21.90$

14. $R = kn + t\sqrt{n}$

$9k + 3t = 42$

$25k + 5t = 100$

$45k + 15t = 210$

$75k + 15t = 300$

$-30k = -90$

$k = 3$

$t = 5$

$R = 3(16) + S(4) = 68$

15. $a^2 = \frac{b^2 d^2}{b^2 + d}$

$a^2b^2 + a^2d = b^2d^2$

$b^2d^2 - a^2b^2 = a^2d^2$

$b^2(d^2 - a^2) = a^2d^2$

$b^2 = \frac{a^2d^2}{d^2 - a^2}$

$b = \mp\sqrt{\frac{a^2d^2}{d^2 - a^2}}$

16. $P = KQ + m\sqrt{Q}$

$22 = K(4) + m(2)\ldots\ldots\ldots\ldots(1)$

$42 = K(g) + n(3)\ldots\ldots\ldots\ldots(2)$

$22 = 4K + 2m$

$42 = 9K + 3m$

$3(22) = 3(4K) + 3(2m)$

$2(42) = 2(9K) + 2(3)$

$66 = 12k + 6m$

$84 = 18K + 6m$

$18 = 6k = k = 3$

$22 = 4(3) + 2m$

$22 - 12 = 2m$

$20 = 2m$

$M = 10$

$= 3(25) + 10(5)$

$= 75 + 50$

$= 125$

17. $b = \sqrt{k - ac}$

$b^2 = k - ac$

$b^2 - k = -ac$

$\frac{b^2 - k}{-9} = c$

$C = \frac{b^2 - k}{-9}$ or $c = \frac{k - b^2}{9}$

$C = \frac{1 - 2^2}{4}$

$= {}^{-3}/_{4} = -0.75$

18. $V = 30, r = 2$

$K = Ur^2$

$= 30 \times 22 = 120$

When $r = 4$

$V = {}^{120}/_{42} = 7.5 m/s$

19. $P = \sqrt[3]{\frac{XY}{z + X}}$

$P^3 = \frac{XY}{z + X}$

$Xy = P^3Z + P^3X$

$Xy - P^3X = P^3 z$

$X(y - P^3) = P^3 z$

$\therefore X = \frac{P^3 z}{Y - P^3}$

20. $X \propto y + {}^{1}/_{z,2}$, $x = Ky + M$

$X = 6, y = 3, z = 2 - 6 = 3k + M$

$X = 8, y = 5, z = 1 - 8 = 5k + M$

$X4\ \ 24 = 12k + M$

$-16 = -7k, k = 1$

When $y = 10$,

$z = \frac{16}{7}(10) - \frac{24}{7(64)} = \frac{160}{7} - \frac{24}{448} = \frac{10216}{448} = 22.8$

21. $T_{11} = a + 10d$

$T_2 = a + d$

$a + 10d = 4a + 4d$ .....(i)

$3a - 6d = 0$

$S7 = {}^{7}/_{2}\{2a + 6d\} = 175$ ...(ii)

$2a + 6d = 50$

$3a - 6d = 0$

$5a = 50$

$a = 10$

$d = 5$

22. (i) $R = m + nI$

$55 = M + 20n$……(i)

$58 = m + 28n$…..(ii)

$-3 = -8n$

$n = {}^{3}/_{8} = 0.375$

$55 = m + {}^{60}/_{8}$

$m = 55 - 7.5 \Rightarrow m = 47.5$

$R = 47.5 + 60 \times {}^{3}/_{8}$

$R = 70$ ohms

23. $\left(1 - \frac{1}{(2x)}\right)^5 = (1 - 2x)^5$

$= 1^5(-2x)^o + 5.1^4(-2x)^1 + 10.1^3(-2x)^2 + 101^2(-2x)^3$

$= 1 - 10x + 40x^2 - 80x^3$

$(1 - 2x)^5 = (0.98)^5 = (1 - 0.02)^5$

$\therefore 2x = 0.02$

$x = 0.01$

Thus $(0.98)^5 = 1 - 10(0.01) + 40(0.01)^2 - 80(0.01)^3$

$= 1 - 0.1 + 0.004 - 0.00008 = 0.9039$