FORM 5

CHAPTER 1

Self Test 1

1 (a) Increases by four times.
(b) Decreases by 10%

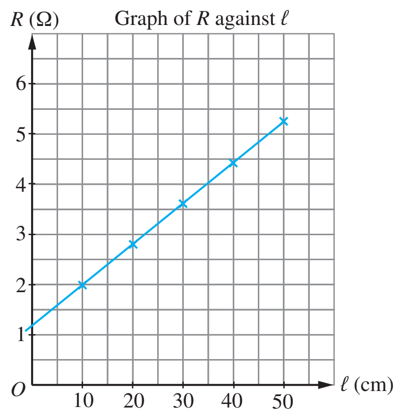
2 (a) $t = kA$ (b) $V = km^2$
(c) $W = kph$ (d) $K = kmv^2$

3

x	1	3	5	7	9
y	2	54	250	686	1 458
$\frac{y}{x^2}$	2	6	10	14	18
$\frac{y}{x^3}$	2	2	2	2	2

The value of $\frac{y}{x^2}$ is not a constant, therefore y does not vary directly as x^2.
The value of $\frac{y}{x^3}$ is a constant, therefore y varies directly as x^3.
$\therefore y = 2x^3$

4



R does not vary directly as ℓ. The straight line does not pass through the origin, O.

5 (a)
$y \propto x^3$
$y = kx^3$
$k = \frac{y}{x^3}$
$= \frac{192}{4^3}$
$= 3$
$\therefore y = 3x^3$

(b)
$y \propto \sqrt{x}$
$y = k\sqrt{x}$
$k = \frac{y}{\sqrt{x}}$
$= \frac{192}{\sqrt{4}}$
$= 96$
$\therefore y = 96\sqrt{x}$

(c)
$y \propto x$
$y = kx$
$k = \frac{y}{x}$
$= \frac{192}{4}$
$= 48$
$\therefore y = 48x$

6
$V \propto r^3$
$V = kr^3$
$k = \frac{V}{r^3}$
$= \frac{4}{1^3}$
$= 4$
$\therefore V = 4r^3$
$m = 4(2)^3$
$= 32$

$256 = 4n^3$
$n^3 = \frac{256}{4}$
$n = \sqrt[3]{64}$
$= 4$

7
$d \propto t^2$
$d = kt^2$
$k = \frac{d}{t^2}$
$= \frac{27}{3^2}$
$= 3$
$\therefore d = 3t^2$
$d = 3(6)^2$
$= 108$

8 (a)
$A \propto \sqrt[3]{r}$
$A = k\sqrt[3]{r}$
$k = \frac{A}{\sqrt[3]{r}}$
$= \frac{5}{\sqrt[3]{1}}$
$= 5$
$\therefore A = 5\sqrt[3]{r}$

(b)
$A = 5\sqrt[3]{64}$
$= 20$

(c)
$25 = 5\sqrt[3]{r}$
$\sqrt[3]{r} = 5$
$r = 5^3$
$= 125$

9 (a) $p \propto qr$ (b) $V \propto s\sqrt[3]{r}$ (c) $E \propto mv^2$

10 (a)
$x = ky^2z$
$k = \frac{x}{y^2z}$
$= \frac{10}{(5^2)4}$
$= \frac{1}{10}$
$x = \frac{1}{10}y^2z$

(b)
$5 = \frac{1}{10}y^2(10)$
$y^2 = 5$
$y = \sqrt{5}$

11
$W \propto X\sqrt[3]{Y}$
$k = \frac{W}{X\sqrt[3]{Y}}$

$= \frac{36}{(6)\sqrt[3]{27}}$

$= 2$

$W = 2X\sqrt[3]{Y}$

$40 = 2(4)\sqrt[3]{p}$

$\sqrt[3]{p} = 5$

$p = 125$

$68 = 2q\sqrt[3]{8}$

$q = 17$

$p - q = 125 - 17$

$= 108$

12 (a) $V \propto r^2h$

$V = k\,r^2h$

$k = \frac{V}{r^2h}$

$= \frac{9.856}{(1.4)^2(1.6)}$

$= \frac{22}{7}$

$V = \frac{22}{7}r^2h$

(b) $V_{\text{new}} = \frac{22}{7}(1.1r)^2(0.9t)$

$= 1.089\left(\frac{22}{7}r^2h\right)$

Percentage of changes $= \frac{1.089 - 1}{1} \times 100\%$

$= 8.9\%$

13 (a) $V \propto t$

$V = kt$

$k = \frac{V}{t}$

When $t = 0$, $V = V_{original}$, therefore when $t = 2$, $V = 40\%V_{original}$

$k = \frac{0.4V_{\text{original}}}{2}$

$= 0.2V_{original}$

$\therefore V = 0.2V_{original}\,t$

(b) When $V = V_{original}$

$V_{original} = 0.2V_{\text{original}}\,t$

$t = \frac{V_{\text{original}}}{0.2V_{\text{original}}}$

$= 5$ hours

Time needed for the swimming pool to dry $= 5 - 2$

$= 3$ hours

Self Test 2

1 $f \propto \frac{1}{l}$

(a) Decreases two times

(b) Increases

2

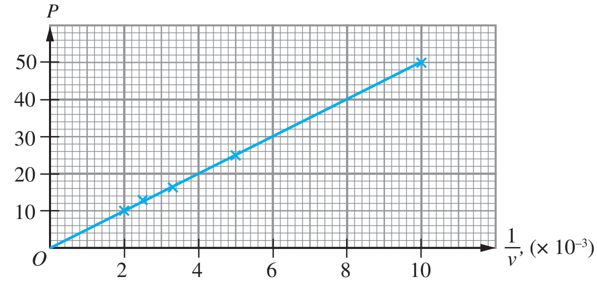
x	2	4	6	8	10
y	120	60	40	30	24
xy	240	240	240	240	240
x^2y	480	960	1 440	1 920	2 400

The value of *xy is a constant whereas* x^2y *is not a constant. Therefore, y varies inversely as x.*

$\therefore y = \frac{240}{x}$

3

V	100	200	300	400	500
$\frac{1}{V}(\times 10^{-3})$	10.0	5.0	3.3	2.5	2.0
P	50.0	25.0	16.7	12.5	10.0



P varies inversely as V. The graph produced is a straight line that passes through the origin.

4 (a) $y \propto \frac{1}{x}$

$y = k\left(\frac{1}{x}\right)$

$k = xy$

$= 8(12)$

$= 96$

$y = \frac{96}{x}$

(b) $y \propto \frac{1}{x^2}$

$y = k\left(\frac{1}{x^2}\right)$

$k = x^2y$

$= 8^2(12)$

$= 768$

$y = \frac{768}{x^2}$

(c) $y \propto \frac{1}{\sqrt[3]{x}}$

$y = k\left(\frac{1}{\sqrt[3]{x}}\right)$

$k = \sqrt[3]{x}y$

$= \sqrt[3]{8}(12)$

$= 24$

$y = \frac{24}{\sqrt[3]{x}}$

5 $Q \propto \frac{1}{P^3}$

$Q = k\left(\frac{1}{P^3}\right)$

$k = P^3Q$

$= (0.8)^3(31.25)$

$= 16$

$Q = \frac{16}{p^3}$

$m = \frac{16}{2.5^3}$

$= 1.024$

$n^3 = \frac{16}{250}$

$= \frac{8}{125}$

$n = \frac{2}{5} = 0.4$

6 $\frac{p}{q} = \frac{3}{5} \quad \rightarrow \quad \frac{q}{p} = \frac{5}{3}$

$T \propto \frac{1}{S}$

$T = k\left(\frac{1}{S}\right)$

$k = TS$

Use the proportional concept, $rp = 6q$

$r = 6\left(\frac{q}{p}\right)$

$= 6\left(\frac{5}{3}\right)$

$= 10$

7 (a) $y \propto \frac{1}{\sqrt[3]{x}}$

$y = k\left(\frac{1}{\sqrt[3]{x}}\right)$

$k = \sqrt[3]{x}y$

$= \sqrt[3]{8}(15)$

$= 30$

$y = \frac{30}{\sqrt[3]{x}}$

(b) $y = \frac{30}{\sqrt[3]{27}}$

$= 10$

(c) $7.5 = \frac{30}{\sqrt[3]{x}}$

$\sqrt[3]{x} = \frac{30}{7.5}$

$x = 4^3$

$= 64$

8 $p \propto \frac{1}{\sqrt{q}}$ and $q = r + 5$

$p = k\left(\frac{1}{\sqrt{q}}\right)$

$k = p\sqrt{r+5}$

$= 30(\sqrt{11+5})$

$= 120$

$p = \frac{120}{\sqrt{q}}$ or $\frac{120}{\sqrt{r+5}}$

(a) When $r = 20$, $p = \frac{120}{\sqrt{20+5}}$

$p = 24$

(b) When $p = 12$

$\frac{120}{\sqrt{r+5}} = 12$

$\sqrt{r+5} = \frac{120}{12}$

$r + 5 = 10^2$

$r = 95$

9 $t \propto \frac{1}{p}$

$t = k\left(\frac{1}{p}\right)$

$k = tp$

$= 5(4)$

$= 20$

$t = \frac{20}{p}$

When $p = 10$, $t = \frac{20}{10}$

$= 2$

Self Test 3

1 (a) $z \propto \frac{x^3}{y}$ (b) $F \propto \frac{mv^2}{r}$ (c) $\rho \propto \frac{m}{r^2h}$

2 (a) $D \propto \frac{B}{\sqrt{C}}$

$D = k\left(\frac{B}{\sqrt{C}}\right)$

$k = \frac{D\sqrt{C}}{B}$

$= \frac{20\sqrt{4}}{0.5}$

$= 80$

$D = \frac{80B}{\sqrt{C}}$

(b) $D \propto \frac{B^2}{C}$

$D = k\left(\frac{B^2}{C}\right)$

$k = \frac{DC}{B^2}$

$= \frac{20(4)}{0.5^2}$

$= 320$

$D = \frac{320B^2}{C}$

3 $z \propto \frac{x}{y^2}$

$z = k\left(\frac{x}{y^2}\right)$

$k = \frac{y^2z}{x}$

$= \frac{3^2(8)}{4}$

$= 18$

$z = \frac{18x}{y^2}$

(a) $1.2 = \frac{18(2.4)}{y^2}$

$y^2 = \frac{18(2.4)}{1.2}$

$y = \sqrt{36}$

$= 6$

(b) $14 = \frac{18x}{3.6^2}$

$x = \frac{14(3.6^2)}{18}$

$= 10.08$

4 (a) $U \propto \frac{V^2}{\sqrt[3]{W}}$

$U = k\left(\frac{V^2}{\sqrt[3]{W}}\right)$

$k = \frac{U\sqrt[3]{W}}{V^2}$

$= \frac{36\sqrt[3]{8}}{3^2}$

$= 8$

$U = \frac{8V^2}{\sqrt[3]{W}}$

(b) $40 = \frac{8(5)^2}{\sqrt[3]{p}}$

$\sqrt[3]{p} = \frac{8(5)^2}{40}$

$p = 5^3$
$= 125$

$72 = \frac{8(q)^2}{\sqrt[3]{64}}$

$q^2 = \frac{72 \times \sqrt[3]{64}}{8}$
$= 36$

$q = 6$ (take the positive value only)

$p + q = 125 + 6$
$= 131$

5 (a) $F \propto \frac{mr}{t^2}$

(b) $F = k\left(\frac{mr}{t^2}\right)$

$k = \frac{Ft^2}{mr}$
$= \frac{0.06(1)^2}{6(100)}$
$= \frac{1}{10\,000}$

$F = \frac{mr}{10\,000t^2}$

When $m = 18$ g, $t = 3$ s (time for 1 complete rotation), $r = 100$ cm

$F = \frac{18(100)}{10\,000(3)^2}$
$= 0.02$ N

6 Given $F \propto \frac{G}{H}$

$F = k\left(\frac{G}{H}\right)$

$k = \frac{FH}{G}$
$= \frac{3(6)}{9}$
$= 2$

$F = \frac{2G}{H}$

(a) $16 = \frac{2G}{4}$

$G = 16(2)$
$= 32$

(b) $F_{new} = \frac{2(1.2)G}{0.9H}$
$= \frac{4}{3}\left(\frac{2G}{H}\right)$
$= \frac{4}{3}F_{original}$

Percentage of changes in $F = \frac{\frac{1}{3}}{} \times 100\%$

$= 33\frac{1}{3}\%$

F increases $33\frac{1}{3}\%$.

7 Let number of days $= d$
number of tailors $= t$
duration of working $= h$

$d \propto \frac{1}{th}$

$d = k\left(\frac{1}{th}\right)$

$k = dth$
$= (16)(6)(5)$
$= 480$

$d = \frac{480}{th}$

(a) $d_2 = \frac{480}{(4)(6)}$
$= 20$ days

(b) $10 = \frac{480}{th}$

$th = 48$

To complete the order within 10 days, the number of tailors and their working hours need to be increased.
$t = 8$ and $h = 6$

SPM PRACTICE

Paper 1

1 B

2 B $s \propto t^3$

$s = kt^3$

$k = \frac{s}{t^3}$
$= \frac{24}{2^3}$
$= 3$

$s = 3t^3$

3 B $x \propto y\sqrt{z}$

$x = ky\sqrt{z}$

$k = \frac{x}{y\sqrt{z}}$

Use concept of proportion: $\frac{60}{6\sqrt{4}} = \frac{140}{7\sqrt{p}}$

$\sqrt{p} = \frac{140(6)(2)}{7(60)}$

$p = 4^2$
$= 16$

4 D $y \propto \frac{1}{\sqrt{x}}$ and $x = z + 4$

$y = k\left(\frac{1}{\sqrt{x}}\right)$

$k = y\sqrt{x}$ or $k = y\sqrt{z+4}$
$= 3\sqrt{5+4}$
$= 9$

$y = \frac{9}{\sqrt{x}}$

5 A $c \propto \frac{1}{5d+3}$

$c = k\left(\frac{1}{5d+3}\right)$

$k = c(5d+3)$

Use concept of proportion : $0.5[5(2.2)+3] = 3.5(5d+3)$

$5d + 3 = \frac{7}{3.5}$

$5d = 2 - 3$

$d = -\frac{1}{5}$
$= -0.2$

6 D $X \propto \frac{Y^3}{Z}$

$X = k\left(\frac{Y^3}{Z}\right)$

$k = \frac{XZ}{Y^3}$

$\frac{4(6)}{2^3} = \frac{32p}{8^3}$

$p = \frac{4(6)(8^3)}{2^3(32)}$
$= 48$

7 D $v \propto \dfrac{r^3}{\sqrt{s}}$

$v \propto r^3 s^{-\frac{1}{2}}$

$\therefore x = 3, y = -\dfrac{1}{2}$

8 D $D \propto \dfrac{E^2}{F}$

$D = k\left(\dfrac{E^2}{F}\right)$

$k = \dfrac{DF}{E^2}$

$\dfrac{6(15)}{m^2} = \dfrac{4p}{n^2}$

$p = \dfrac{6(15)n^2}{4m^2}$ and $\dfrac{m}{n} = \dfrac{3}{2}$

$= \dfrac{45n^2}{2m^2}$

$= \dfrac{45}{2} \times \left(\dfrac{n}{m}\right)^2$

$= \dfrac{45}{2} \times \left(\dfrac{2}{3}\right)^2$

$= 10$

9 B $M \propto \dfrac{1}{N}$

$M = k\left(\dfrac{1}{N}\right)$

$k = MN$

$xy = 4z$

$0.8 = 4z$

$z = 0.2$

10 A $R \propto \dfrac{P}{I^2}$

$R = k\left(\dfrac{P}{I^2}\right)$

$k = \dfrac{I^2R}{P}$

$\dfrac{(500)^2(0.4)}{120} = \dfrac{(50)^2(0.5)}{P}$

$P = \dfrac{(50)^2(0.5)(120)}{(500)^2(0.4)}$

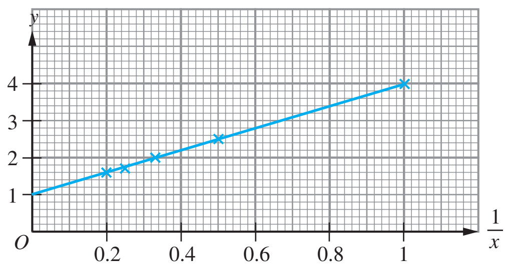
$= 1.5$ kW

Paper 2

Section A

1

x	1	2	3	4	5
$\dfrac{1}{x}$	1.0	0.5	0.33	0.25	0.20
y	4.00	2.50	2.00	1.75	1.60



The straight line does not pass through the origin, therefore y does not vary inversely as x.

2 $S \propto \dfrac{R^3T}{V}$

$S = k\left(\dfrac{R^3T}{V}\right)$

$k = \dfrac{SV}{R^3T}$

$= \dfrac{9(9)}{3^3(6)}$

$= \dfrac{1}{2}$

$S = \dfrac{R^3T}{2V}$

3 $y \propto \dfrac{x}{\sqrt[3]{z}}$

$y = k\left(\dfrac{x}{\sqrt[3]{z}}\right)$

$k = \dfrac{y\sqrt[3]{z}}{x}$

Use concept of proportion: $\dfrac{65(\sqrt[3]{8})}{5} = \dfrac{39(\sqrt[3]{z})}{9}$

$\sqrt[3]{z} = \dfrac{65(\sqrt[3]{8})(9)}{5(39)}$

$z = 6^3$

$= 216$

4 $I \propto Pt$

$I = kPt$

$k = \dfrac{I}{Pt}$

Use concept of proportion : $\dfrac{400}{1\,250(4)} = \dfrac{I}{20\,000(5)}$

$I = \dfrac{400(20\,000)(5)}{1\,250(4)}$

$= 8\,000$

Interest received = RM8 000

5 $L \propto \dfrac{1}{t}$

$L = k\left(\dfrac{1}{t}\right)$

$k = Lt$

Use concept of proportion : $(2)(20) = 5t$

$t = \dfrac{2(20)}{5}$

$= 8$ minutes

Section B

6 (a) Let the quantity of sales/quantity of demand = X

number of salesmen = n

Selling price = p

$X \propto \dfrac{n^2}{p}$

$X = k\left(\dfrac{n^2}{p}\right)$

$k = \dfrac{Xp}{n^2}$

$= \dfrac{9\,000(100)}{50^2}$

$= 360$

$X = \dfrac{360n^2}{p}$

(b) $X_b = \dfrac{360(2n)^2}{p}$

$= 4\left(\dfrac{360n^2}{p}\right)$

$= 4\,X_{initial}$

$= 4(9\,000)$

$= 36\,000$

(c) $X_c = 1.4X_{\text{initial}} \rightarrow (X_c = X_{\text{initial}} + 40\%\ X_{\text{initial}})$

The quantity of demand increases by 1.4 times, therefore the price will decrease by 1.4 times.

$h_{\text{new}} = \dfrac{\text{RM100}}{1.4}$

$= \text{RM}71.43$

7 Let working days $= T$

number of workers $= p$

$T \propto \dfrac{1}{p}$

$T = k\left(\dfrac{1}{p}\right)$

$k = Tp$

$= 90(10)$

$= 900$

$T = \dfrac{900}{p}$

(a) $p = \dfrac{900}{60}$

$= 15$ workers

(b) $p_{\text{new}} = 0.9p_{\text{initial}}$

p increases by 0.9 times, therefore T decreases by 0.9 times

$T_{\text{new}} = \dfrac{T_{\text{initial}}}{0.9}$

$= \dfrac{10}{9}T_{\text{initial}}$

Percentage of change in the working days $= \dfrac{1}{9} \times 100\%$

$= 11\frac{1}{9}\%$

or

$p = 10 - 10\%(10)$

$= 9$

$T = \dfrac{900}{9}$

$= 100$ days

Working days increases by 10 days

Percentage of increment in working days $= \dfrac{10}{90} \times 100\%$

$= 11\frac{1}{9}\%$