SPM MODEL PAPER
Fully-worked Solutions

PAPER 1

1 $2(2x + 3) \leqslant x - 6$

$4x + 6 \leqslant x - 6$

$4x - x \leqslant -6 - 6$

$3x \leqslant -12$

$x \leqslant \frac{-12}{3}$

$\boldsymbol{x \leqslant -4}$

Answer: **D**

2 $\frac{2x - 3}{4} = \frac{2x + 3}{3}$

$3(2x - 3) = 4(2x + 3)$

$6x - 9 = 8x + 12$

$8x - 6x = -9 - 12$

$2x = -21$

$x = -\frac{21}{2}$

$x = \mathbf{-10.5}$

Answer: **C**

3 $\frac{(16m^4)^{\frac{1}{4}}}{2n} \times m^3n^4$

$= \frac{2m \times m^3n^4}{2n}$

$= \frac{2m^4n^4}{2n}$

$= \boldsymbol{m^4n^3}$

Answer: **C**

4 $V = \frac{4}{3}\pi r^3$

$3V = 4\pi r^3$

$r^3 = \frac{3V}{4\pi}$

$\boldsymbol{r = \left(\frac{3V}{4\pi}\right)^{\frac{1}{3}}}$

Answer: **A**

5 $\angle AST = \angle AUT = 30°$

$\angle SAT = 180° - 105° - 30° = 45°$

Since AS // PQ, $\angle SAT = \angle TPV = 45°$

$\angle TPQ = 180° - 45° = 135°$

$\angle STP = 180° - 105° = 75°$

Sum of angles in a pentagon

$= (5 - 2) \times 180°$

$= 540°$

$135 + k + 130 + h + 75 = 540$

$h + k + 340 = 540$

$h + k = \mathbf{200}$

Answer: **A**

6 Volume of cylinder + Volume of cone

$= \pi r^2h + \frac{1}{3}\pi r^2h$

$= \frac{22}{7}(14)^2(35) + \frac{1}{3}\left(\frac{22}{7}\right)(14)^2(7)$

$= 21\ 560 + 1\ 437\frac{1}{3}$

$= \mathbf{22\ 997\frac{1}{3}\ cm^3}$

Answer: **C**

7 $\frac{x}{6} + \frac{y}{3} = 1$

x-intercept = 6

y-intercept = 3

Gradient $= -\frac{y\text{-intercept}}{x\text{-intercept}} = -\frac{3}{6} = \mathbf{-\frac{1}{2}}$

Answer: **A**

8 Length of string = 54 cm

$3x + 1 + x + 6 + 4x - 9 = 54$

$8x - 2 = 54$

$8x = 56$

$x = \frac{56}{8}$

$x = 7$

Hence, the length of the longest part

$= 3x + 1$

$= 3(7) + 1$

$= \mathbf{22\ cm}$

Answer: **A**

9 $\angle QOS = 2 \times 57° = 114°$

$\angle OSP = 180° - 48° = 132°$

$\angle PQO = 90°$

The sum of all the angles in the quadrilateral $PQOS$ = 360°

$90 + 114 + 132 + x = 360$

$x = \mathbf{24}$

Answer: **B**

10 $\frac{P'Q'}{PQ} = \frac{1}{10}$

$\frac{10}{PQ} = \frac{1}{10}$

$PQ = 100$ cm

Likewise, $QR = RU = 100$ cm

Hence, the volume of the water tank

$= 100 \times 100 \times 100$

$= \mathbf{1\ 000\ 000\ cm^3}$

Answer: **D**

11 Point **A** is 3 cm from point M and less than 5 cm from point N.

Answer: **A**

12 Using the Pythagoras' theorem,
$AB = 3.0 \times 10^3$
Area of triangle ABC
$= \frac{1}{2} \times 4.0 \times 3.0 \times 10^{3+3}$
$= \mathbf{6.0 \times 10^6\ cm^2}$
Answer: **D**

13 Let the price, in RM, of a packet of *nasi lemak* be x.
$(80 + 55 + 50 + 65 + 60) \times x + (55 + 40 + 40 + 50 + 40) \times 2.40 = 1\ 098$
$310x + 540 = 1\ 098$
$310x = 558$
$x = \mathbf{1.80}$
Answer: **C**

14 Protein $(P) = \frac{250}{3\ 000} \times 360° = 30°$
Fat $(L) = 11°$
Sodium (N) – Calcium $(K) = 36°$
Sodium $(N) = 36° +$ Calcium (K)
Carbohydrate $(C) = 209°$
Sum of angles $= 360°$
$P + L + N + K + C = 360°$
$30° + 11° + 36° + K + K + 209° = 360°$
$286° + 2K = 360°$
$2K = 74°$
$K = 37°$
Hence, the angle of the sector for the intake of calcium is **37°**.
Answer: **C**

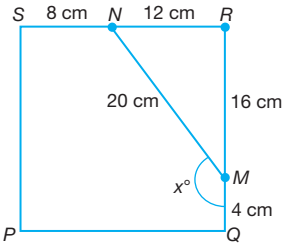
15 $y \propto x^{\frac{1}{3}}$
$y = kx^{\frac{1}{3}}$
$\frac{y}{x^{\frac{1}{3}}} = k$
$\frac{y}{\sqrt[3]{x}} = k$

x	27	64	125	216
$\sqrt[3]{x}$	3	4	5	6
y	3	4	5	6
$\frac{y}{\sqrt[3]{x}}$	1	1	1	1

Answer: **C**

16 $P \propto \frac{Q}{R^2}$
$P = k\left(\frac{Q}{R^2}\right)$
When $P = 1$, $Q = 12$, $R = 4$,
$1 = k\left(\frac{12}{4^2}\right)$
$1 = k\left(\frac{3}{4}\right)$
$k = \frac{4}{3}$
$\therefore P = \frac{4}{3}\left(\frac{Q}{R^2}\right)$
When $P = 3$, $Q = x$, $R = 2$,
$3 = \frac{4}{3}\left(\frac{x}{2^2}\right)$
$3 = \frac{4x}{12}$
$3 = \frac{x}{3}$
$x = \mathbf{9}$
Answer: **B**

17 $QM = \frac{1}{4}MR$
$MR = 4QM$
$QM + MR = 20$
$QM + 4QM = 20$
$5QM = 20$
$QM = 4$ cm
$\tan x° = -\tan \angle NMR$
$= -\frac{12}{16}$
$= -\frac{3}{4}$



Answer: **B**

18 Amount of the required insurance
$= \frac{80}{100} \times 300\ 000$
$= \mathbf{RM240\ 000}$
Answer: **D**

19 **Puan Sarita**
From the table, the premium rate is RM1.80.
Premium payable
$= \frac{250\ 000}{1\ 000} \times 1.8$
$=$ RM450.00
Encik Sathian
From the table, the premium rate is RM3.47.
Premium payable
$= \frac{250\ 000}{1\ 000} \times 3.47$
$=$ RM867.50
Difference in premiums
$= 867.50 - 450.00$
$= \mathbf{RM417.50}$
Answer: **A**

20 The inequality that does not represent the shaded region is $\boldsymbol{y < -x + 3}$.
Answer: **C**

21 Distance = 1 101 m
$\frac{1}{2} \times (30 + v)(3) + \frac{1}{2}(9)(v) = 1\ 101$
$3(30 + v) + 9v = 2\ 202$
$90 + 3v + 9v = 2\ 202$
$12v = 2\ 112$
$v = \mathbf{176}$
Answer: **C**

22 $|A| = -4$
$5(x + 2) - 8(x + 4) = -4$
$5x + 10 - 8x - 32 = -4$
$-3x - 22 = -4$

$-3x = 22 - 4$

$-3x = 18$

$x = \mathbf{-6}$

Answer: **C**

23 Let $A = \begin{bmatrix} 2 & 1 \\ 3 & -2 \end{bmatrix}$

$$A^{-1} = \frac{1}{-4-3}\begin{bmatrix} -2 & -1 \\ -3 & 2 \end{bmatrix}$$

$$= -\frac{1}{7}\begin{bmatrix} -2 & -1 \\ -3 & 2 \end{bmatrix}$$

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

$$\begin{bmatrix} x \\ y \end{bmatrix} = -\frac{1}{7}\begin{bmatrix} -2 & -1 \\ -3 & 2 \end{bmatrix}\begin{bmatrix} 4 \\ -1 \end{bmatrix}$$

$$= -\frac{1}{7}\begin{bmatrix} -7 \\ -14 \end{bmatrix}$$

$$= \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$\therefore x = \mathbf{1}, y = \mathbf{2}$

Answer: **B**

24 The equation of the graph is

$y = (x - 2)(x - 4)$

$\boldsymbol{y = x^2 - 6x + 8}$

Answer: **D**

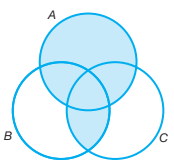
25 $A' \cap B = \{5, 8\}$

$(A' \cap B)' = \{1, 2, 3, 4, 6, 7, 9\}$

$n(A' \cap B)' = \mathbf{7}$

Answer: **B**

26



$A \cup (B \cap C)$

Answer: **C**

27

Place value	4^2	4^1	4^0
Digit	1	2	3

$123_4 = (1 \times 4^2) + (2 \times 4^1) + (3 \times 4^0)$

$= 16 + 8 + 3$

$= 27_{10}$

3	27	Remainder
3	9	0
3	3	0
3	1	0
	0	1

$123_4 = 1000_3$

Hence, $x = \mathbf{1000}$

Answer: **C**

28

$$\begin{array}{rccc} & {\scriptstyle 5} & {\scriptstyle 0}^{\scriptstyle 7} & {\scriptstyle 7} \\ & \not{6} & \not{7} & 5_7 \\ (-) & & 4 & 6_7 \\ \hline & 5 & 3 & 6_7 \end{array}$$

Answer: **A**

29 $MV = P\left(1 + \frac{r}{n}\right)^{nt}$

$= 10\,000\left(1 + \frac{0.05}{2}\right)^{2(5)}$

$= \mathbf{RM12\,800.85}$

Answer: **C**

30 The function of the trigonometric graph is $\boldsymbol{y = 3 \sin 2x}$.

Answer: **D**

31 Fire insurance premium is not entitled for income tax relief.

Answer: **D**

32 The shortest route is $\boldsymbol{C} \xrightarrow{500} \boldsymbol{D} \xrightarrow{650} \boldsymbol{A}$.

Answer: **A**

33 The graph has 5 vertices, 8 edges and a sum of degrees of 16.

Answer: **C**

34 Area = 99

$\frac{1}{2}(2y + y + 7)(2y - 1) = 99$

$(3y + 7)(2y - 1) = 198$

$6y^2 + 11y - 7 = 198$

$6y^2 + 11y - 205 = 0$

$(y - 5)(6y + 41) = 0$

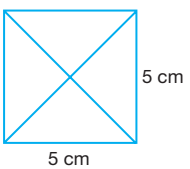
$y = 5$ or $y = -\frac{41}{6}$

$y = -\frac{41}{6}$ is not accepted.

Hence, $y = \mathbf{5}$

Answer: **A**

35 The plan of the combined solid is



Answer: **D**

36 A tree cannot have any cycle.

Answer: **C**

37 Let

E – Event that Ethan passes the test

C – Event that Chloe passes the test

P(only one of them passes the test)

$= P(E, C') + P(E', C)$

$= \left(\frac{4}{5} \times \frac{1}{3}\right) + \left(\frac{1}{5} \times \frac{2}{3}\right)$

$= \frac{\mathbf{2}}{\mathbf{5}}$

Answer: **D**

38 Interquartile range = $Q_3 - Q_1 = 24 - 18 = \mathbf{6}$ minutes

Answer: **A**

39 The contrapositive is "If $h < 8$, then $h < 5$".

Answer: **D**

40 The function that can be used to model the population of a city in 10 years time is the exponential function.

Answer: **C**

PAPER 2

Notes:
P represents *Pengetahuan* (Knowledge)
K represents *Kerja* (Working)
N represents *Nilai* (Value)

1 $\frac{3k-5}{2} = -\frac{3k-1}{k}$

$k(3k-5) = -2(3k-1)$ [K1]

$3k^2 - 5k = -6k + 2$

$3k^2 + k - 2 = 0$ [K1]

$(3k-2)(k+1) = 0$

$k = \frac{2}{3}$ or $k = -1$ [N1]

2 Let the prices of tickets for an adult and a child are x and y respectively.

$2x + 2y = 24$ ... (1)

$4x + 3y = 44$ ... (2) [K1]

(1) × 2 : $4x + 4y = 48$ ... (3)

(3) – (2): $y = 4$ [K1]

From (2): $4x + 3(4) = 44$

$4x = 32$

$x = 8$ [K1]

The total amount of money that Encik Ong has to pay = 2(8) + 4 = RM20 [N1]

3 (a) (i) If x is a multiple of 2, then x is a multiple of 8. [P1]

(ii) If x is not a multiple of 8, then x is not a multiple of 2. [P1]

(iii) If x is not a multiple of 2, then x is not a multiple of 8. [P1]

(b) If *PQRS* is a rhombus, then the diagonals of *PQRS* intersect at a right angle. [P1]

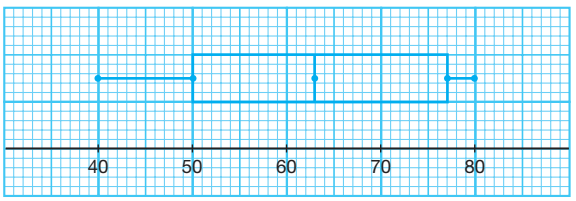
4

40	50	55	63	65	77	80
	↑		↑		↑	
	Q_1		m		Q_3	

[K1]

Minimum value = 40

Maximum value = 80



[K1][K1][N1]

5 (a) Carrying out financial plan [P1]

(b) Monthly saving = $\frac{10}{100} \times 9\,500 = \text{RM}950$ [K1]

Financial flow = 9 500 + 1 400 – 3 600 – 4 400 – 950 [K1]

= RM1 950 (positive financial flow)

[N1]

6 (a) (i) $n(V) = 5$ [P1]

(ii) $n(E) = 6$ [P1]

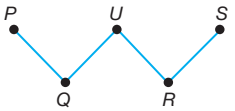
(b) For a tree, $n(E) = n(V) - 1$

$= 5 - 1$

$= 4$

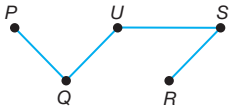
Extra 2 edges.

(i) The edges *PU* and *US* are removed.



[N1]

(ii) The edges *PU* and *UR* are removed.



[N1]

7 $3x + 4y = 134$

$2x + 6y = 156$

$\begin{bmatrix} 3 & 4 \\ 2 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 134 \\ 156 \end{bmatrix}$ [K1]

Let it be A

$A^{-1} = \frac{1}{18-8}\begin{bmatrix} 6 & -4 \\ -2 & 3 \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 6 & -4 \\ -2 & 3 \end{bmatrix}$ [K1]

$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 6 & -4 \\ -2 & 3 \end{bmatrix}\begin{bmatrix} 134 \\ 156 \end{bmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 180 \\ 200 \end{bmatrix}$

$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 18 \\ 20 \end{bmatrix}$ [K1]

$\therefore x = 18, y = 20$

Hence, the prices of a test kit and a box of gloves are RM18 and RM20 respectively. [N1]

8 (a) The amount of required insurance

$= \frac{70}{100} \times 300\,000$

$= \text{RM}210\,000$ [N1]

(b) (i) The amount of compensation

$= \frac{\text{RM}170\,000}{\text{RM}210\,000} \times \text{RM}30\,000 - \text{RM}5\,000$ [K1]

$= \text{RM}24\,285.71 - \text{RM}5\,000$

$= \text{RM}19\,285.71$ [N1]

(ii) Co-insurance penalty

$= \text{RM}30\,000 - \text{RM}24\,285.71$ [K1]

$= \text{RM}5\,714.29$ [N1]

9 Let

B represent the event that a blue rubber band is drawn,

M represent the event that a red rubber band is drawn,

K represent the event that a yellow rubber band is drawn.

P(both of the rubber bands drawn have the same colour)

= P(*B*, *B*) + P(*M*, *M*) + P(*K*, *K*)

$= \left(\frac{4}{15} \times \frac{3}{14}\right) + \left(\frac{5}{15} \times \frac{4}{14}\right) + \left(\frac{6}{15} \times \frac{5}{14}\right)$ [K3]

$= \frac{2}{35} + \frac{2}{21} + \frac{1}{7}$

$= \mathbf{\frac{31}{105}}$ [N1]

10 (a) $\bar{x} = \frac{\sum x}{n} = \frac{46\ 080}{12}$ [K1]

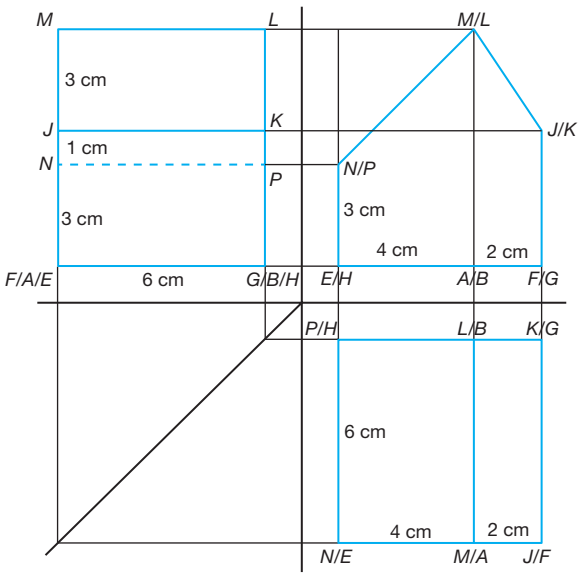
$= \text{RM}3\ 840$ [N1]

(b) $\sigma = \sqrt{\frac{\sum x^2}{n} - (\bar{x})^2} = \sqrt{\frac{215\ 848\ 269}{12} - (3\ 840)^2}$ [K1]

$= \text{RM}1\ 800.49$ [N1]

11

(c) [K3][N1] **(b)** [K2][N1]



(a) [K1][N1]

12 (a) (i) Speed in the first 20 minutes

$= \frac{18}{\frac{20}{60}}$ [K1]

$= 54 \text{ km h}^{-1}$ [N1]

(ii) Average speed = 43.2 km h^{-1}

$\frac{d}{\frac{50}{60}} = 43.2$ [K1]

$d = 43.2 \times \frac{50}{60}$

$= 36$ [N1]

(b) (i) The period of time where the bus travels with a uniform speed

$= 20 - 8$

$= 12 \text{ s}$ [P1]

(ii) Rate of change of speed in the last 4 seconds

$= -\frac{20}{4}$ [K1]

$= -5 \text{ m s}^{-2}$ [N1]

(iii) Distance in the first 20 s = 352 m

$\frac{1}{2}(u + 20)(8) + (12 \times 20) = 352$ [K1]

$4u + 80 + 240 = 352$

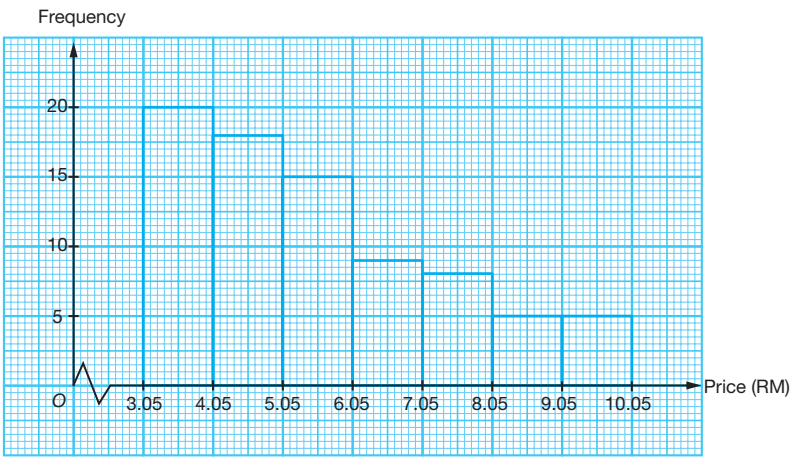
$4u = 32$

$u = 8$ [N1]

13 (a)

Price (RM)	Frequency	Lower boundary	Upper boundary
3.10 – 4.00	20	3.05	4.05
4.10 – 5.00	18	4.05	5.05
5.10 – 6.00	15	5.05	6.05
6.10 – 7.00	9	6.05	7.05
7.10 – 8.00	8	7.05	8.05
8.10 – 9.00	5	8.05	9.05
9.10 – 10.00	5	9.05	10.05

[K1]



[K1][N1]

(b) The data distribution is right-skewed. [P1]

(c)

Price (RM)	Frequency (f)	Midpoint (x)	fx	fx^2
3.10 – 4.00	20	3.55	71.00	252.05
4.10 – 5.00	18	4.55	81.90	372.645
5.10 – 6.00	15	5.55	83.25	462.0375
6.10 – 7.00	9	6.55	58.95	386.1225
7.10 – 8.00	8	7.55	60.40	456.02
8.10 – 9.00	5	8.55	42.75	365.5125
9.10 – 10.00	5	9.55	47.75	456.0125
	$\sum f = 80$		$\sum fx = 446$	$\sum fx^2 = 2\ 750.4$
		[K1]	[K1]	[K1]

Standard deviation $= \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$

$= \sqrt{\frac{2\ 750.4}{80} - \left(\frac{446}{80}\right)^2}$ [K1]

$= \sqrt{3.299375}$

= RM1.82 [N1]

14 (a) $5x + 6y \leqslant 50$ [P1]

For $5x + 6y = 50$,

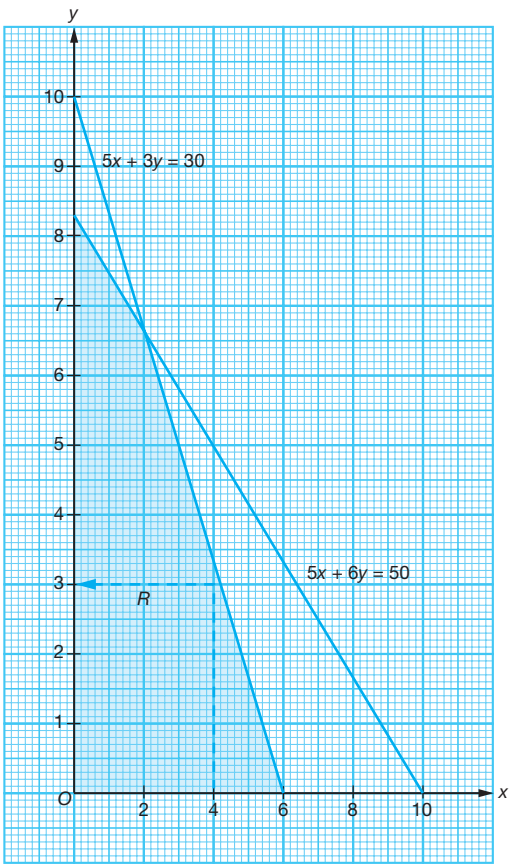
x	0	10
y	8.3	0

$5x + 3y \leqslant 30$ [P1]

For $5x + 3y = 30$,

x	0	6
y	10	0

(b)



[K1]
[K1]
[N2]

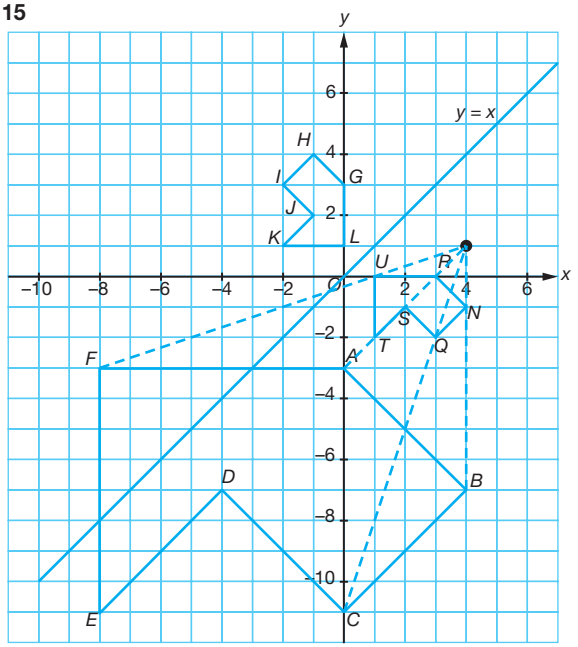
(c) (i) The maximum number of boxes of vitamin B produced = 3 [P1]

(ii) Profit = $250x + 200y$

Maximum profit = $250(4) + 200(3)$ [K1]

= RM1 600 [N1]

15



[K1] [K1]

(a) (i) **W** is a reflection in the straight line $y = x$. [P1] [P1]

(ii) **V** is an enlargement at centre (4, 1) with a scale factor of 4. [P1] [P1] [P1]

(b) Area of $GHIJKL = \left(\frac{1}{4}\right)^2 \times$ Area of $ABCDEF$

$= \frac{1}{16} \times 224$ [K1]

$= 14 \text{ cm}^2$ [N1]

16 (a)

[A] For the first RM1 000 (from table)	RM243.90	
[B] RM20.30 $\times \frac{90\,000 - 1\,000}{1\,000}$ (for the balance of each RM1 000) = RM20.30 × 89 = RM1 806.70	RM1 806.70	[K1] [K1]
[C] Basic premium = [A + B] = RM243.90 + RM1 806.70	RM2 050.60	[K1]
[D] NCD 55%: $\frac{55}{100} \times$ RM2 026.70 = RM1 114.69	RM1 127.83	[K1]
[E] Gross premium = [C] – [D]	RM922.77	[K1]

(b) (i) 10% → 1 310

100% → $1\,310 \times \frac{100}{10} = 13\,100$ [K1]

Hence, Encik Rashid's total income for that month is RM13 100. [N1]

$k = 13\,100 - 450$

$= 12\,650$ [N1]

(ii) Cash flow

$= 13\,100 - 1\,310 - 500 - 2\,000 - 1\,000 - 600 - 1\,200 - 500 - 3\,000 - 500$ [K1]

= RM2 490

Hence, Encik Rashid's cash flow for that month is positive RM2 490. [N1]

(c)

S	Buying a new smart phone with the 5G specification
M	Need to save RM$\left(\frac{9\,000}{5}\right)$ = RM1 800 a month [P1]
A	Can be achieved by saving at least RM1 800 a month [P1]
R	With positive cash flow of RM2 490 and only need to save RM1 800 a month is realistic [P1]
T	In 5 months time [P1]

Hence, Encik Rashid can achieve his goal. [P1]

17 (a) n(Swimming Club) = 58

$x + 6y + 10 = 58$

$x + 6y = 48$ ... (1) [K1]

n(Photography Club) = 60

$3y + y + 6y + 10 = 60$ [K1]

$10y = 50$

$y = 5$ [N1]

From (1): $x + 6(5) = 48$

$x = 18$ [N1]

n(members who join two clubs only)

$= 6y + y$

$= 6(5) + 5$

$= 35$ [N1]

(b) Swimmer P:

Mean $= \frac{120 + 125 + 128 + 127 + 130}{5}$

$= \frac{630}{5}$

$= 126$ s [N1]

Standard deviation

$= \sqrt{\frac{120^2 + 125^2 + 128^2 + 127^2 + 130^2}{5} - 126^2}$ [K1]

$= \sqrt{\frac{79\,438}{5} - 126^2}$

$= \sqrt{11.6}$

$= 3.41$ s [N1]

Swimmer Q:

Mean $= \frac{123 + 126 + 124 + 128 + 129}{5}$

$= \frac{630}{5}$

$= 126$ s [N1]

Standard deviation

$$= \sqrt{\frac{123^2 + 126^2 + 124^2 + 128^2 + 129^2}{5} - 126^2}$$

$$= \sqrt{\frac{79\ 406}{5} - 126^2}$$

$= \sqrt{5.20}$

= 2.28 s [N1]

Although the mean times of both swimmers are the same, the standard deviation of swimmer *Q* is smaller than the standard deviation of swimmer *P*. Hence, swimmer *Q* should be chosen because his performance is more consistent. [P1] [P1]

(c) Taxable income

= 54 000 – 9 000 – 4 200 – 2 500 = RM38 300 [K1]

Income tax calculation

= 600 + (38 300 – 35 000) × 0.08 = RM864 [K1]

Net income tax = 864 – 150 – (70 × 12)

= –RM126 [K1]

The Inland Revenue Board has to refund RM126 to Encik Shamsul. [P1]