Yakin

JAWAPAN

MATEMATIK TAMBAHAN

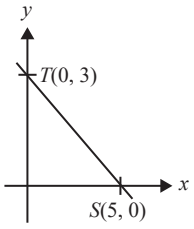
Dwibahasa

KERTAS 1

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	$\log_a x^2 y = \log_a x^2 + \log_a y$ $= 2\log_a x + \log_a y$ $\log_a \frac{y^2}{x^2} = \log_a y^2 - \log_a x^2$ $= 2\log_a y - 2\log_a x$ $2\log_a x + \log_a y = 6$ ..... (1) $2\log_a y - 2\log_a x = 5$ ..... (2) (1) + (2) : $3\log_a y = 11$ $\log_a y = \frac{11}{3}$ (1) : $2\log_a x + \frac{11}{3} = 6$ $2\log_a x = \frac{7}{3}$ $\log_a x = \frac{7}{6}$ (*a*) $\log_a y^2 x = \log_a y^2 + \log_a x$ $= 2\log_a y + \log_a x$ $= 2\left(\frac{11}{3}\right) + \frac{7}{6}$ $= \frac{17}{2}$ (*b*) $\log_a \frac{x}{y} = \log_a x - \log_a y$ $= \frac{7}{6} - \frac{11}{3}$ $= -\frac{5}{2}$	6	**6**

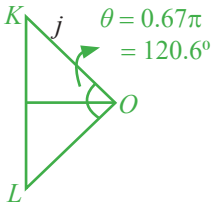
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
2	(*a*) $5^{3x+1}(5^{2x}) = 1$ $5^{3x+1+2x} = 5^0$ $3x + 1 + 2x = 0$ $5x = -1$ $x = -\frac{1}{5}$ (*b*) $\left(\frac{15p^4q^2}{5pq^7}\right)^3 = \left(\frac{3p^3}{q^5}\right)^3$ $= (3p^3q^{-5})^3$ $= 27p^9q^{-15}$	4	**4**
3	(*a*) $\tan(30° + x) = \frac{\tan 30° + \tan x}{1 - \tan 30° \tan x}$ $= \frac{\frac{\sqrt{3}}{3} + m}{1 - \frac{\sqrt{3}}{3}m}$ $= \frac{\sqrt{3} + 3m}{3 - \sqrt{3}m}$ (*b*) kos $(45° - x)$ = kos 45° kos x + sin 45° sin x *cos* $(45° - x)$ = *cos* 45° *cos* x + *sin* 45° *sin* x $= \frac{\sqrt{2}}{2}\left(\frac{1}{\sqrt{m^2+1}}\right) + \frac{\sqrt{2}}{2}\left(\frac{m}{\sqrt{m^2+1}}\right)$ $= \frac{\sqrt{2}}{2}\left(\frac{1+m}{\sqrt{m^2+1}}\right)$ $= \frac{\sqrt{2}}{\sqrt{2}\sqrt{2}}\left(\frac{1+m}{\sqrt{m^2+1}}\right)$ $= \frac{1}{\sqrt{2}}\left(\frac{1+m}{\sqrt{m^2+1}}\right)$ $= \frac{1+m}{\sqrt{2(m^2+1)}}$ // $\frac{m+1}{2}\sqrt{\frac{2}{m^2+1}}$	6	**6**
4	(*a*) $\int_2^6 f(x)\,dx = \int_4^6 f(x)\,dx + \int_2^4 f(x)\,dx$ $= 40 + 28$ $= 68$ (*b*) $\int_4^6 [3f(x) + k]\,dx = \int_2^4 f(x)\,dx$ $3\int_4^6 f(x)\,dx + \int_4^6 k\,dx = \int_2^4 f(x)\,dx$ $3(40) + k[x]_4^6 = 28$ $120 + k(6 - 4) = 28$ $120 + 2k = 28$ $2k = -92$ $k = -46$	5	5

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
5	(*a*) $d = 9 - 5$ $= 4$ (*b*) $a = 5, d = 4$ $T_n = a + (n-1)d$ $T_{20} = 5 + 19(4)$ $= 81$ (*c*) $S_{12} - S_4 = \frac{12}{2}[2(5) + 11(4)] - \frac{4}{2}[2(5) + 3(4)]$ $= 324 - 44$ $= 280$	6	**6**
6	(*a*) $p = 0.6, q = 0.4$ $P(x \geq 7) = P(x = 7) + P(x = 8) + P(x = 9) + P(x = 10)$ $= {}^{10}C_7(0.6)^7(0.4)^3 + {}^{10}C_8(0.6)^8(0.4)^2 + {}^{10}C_9(0.6)^9(0.4)^1 + {}^{10}C_{10}(0.6)^{10}(0.4)^0$ $= 0.2150 + 0.1209 + 0.0403 + 0.0060$ $= 0.3822$ (*b*) $P(X \leq 8) = 1 - P(X > 8)$ $= 1 - P(X = 9) - P(X - 10)$ $= 1 - {}^{10}C_9(0.6)^9(0.4)^1 - {}^{10}C_{10}(0.6)^{10}(0.4)^0$ $= 1 - 0.0403 - 0.0060$ $= 0.9537$	6	**6**
7	(*a*) ${}^4P_1 \times {}^8P_5 = 4 \times 6\,720$ $= 26\,880$ (*b*) ${}^7C_1 + {}^7C_2 + {}^7C_3 + {}^7C_4 + {}^7C_5$ $= 7 + 21 + 35 + 35 + 21$ $= 119$	4	**4**
8	(*a*) $\underset{\sim}{p} + \underset{\sim}{q} = \begin{pmatrix} 2 \\ 6 \end{pmatrix} + \begin{pmatrix} 3 \\ k \end{pmatrix}$ $= \begin{pmatrix} 2+3 \\ 6+k \end{pmatrix}$ $= \begin{pmatrix} 5 \\ 6+k \end{pmatrix}$ (*b*) $\lvert \underset{\sim}{p} + \underset{\sim}{q} \rvert = 5$ $\sqrt{5^2 + (6+k)^2} = 5$ $25 + 36 + 12k + k^2 = 5^2$ $k^2 + 12k + 36 = 0$ $(k+6)(k+6) = 0$ $k = -6$	5	**5**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
9	(*a*) $f^{-1}(x) = \frac{x-1}{x}$ Katakan $y = \frac{x-1}{x}$ *Let* $yx = x - 1$ $1 = x - yx$ $1 = x(1-y)$ $x = \frac{1}{1-y}$ $f(x) = \frac{1}{1-x}$; $x \neq 1$ (*b*) $g(x) = 3x - 2$ Katakan $y = 3x - 2$ *Let* $x = \frac{y+2}{3}$ $g^{-1}(x) = \frac{x+2}{3}$ $g^{-1}f(x) = g^{-1}\left(\frac{1}{1-x}\right)$ $= \frac{\left(\frac{1}{1-x}\right)+2}{3}$ $= \frac{\frac{1+2-2x}{1-x}}{3}$ $= \frac{\frac{3-2x}{1-x}}{3}$ $= \frac{3-2x}{3(1-x)}$; $x \neq 1$	6	**6**
10	(*a*) Koordinat $S(5, 0)$ dan $T(0, 3)$ *Coordinates* $S(5, 0)$ *and* $T(0, 3)$ $m_{st} = \frac{0-3}{5-0}$ $= -\frac{3}{5}$  		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) Titik tengah garis lurus, M *The midpoint of the straight line, M* $= \left(\frac{5}{2}, \frac{3}{2}\right)$ $\therefore y = \frac{5}{3}x + c$ $\frac{3}{2} = \frac{5}{3}\left(\frac{5}{2}\right) + c$ $c = \frac{3}{2} - \frac{25}{6}$ $= -\frac{8}{3}$ $\therefore y = \frac{5}{3}x - \frac{8}{3}$	5	**5**
11	(*a*) $s = \int v\, dt$ $= \int (15 + 2t - t^2)\, dt$ $= 15t + t^2 - \frac{t^3}{3} + c$ Pada $c = 0$, $s = 15t + t^2 - \frac{t^3}{3}$ *At* $c = 0$, $s = 15t + t^2 - \frac{t^3}{3}$ Apabila $t = 5$, *When* $t = 5$, $s = 15(5) + 5^2 - \frac{5^3}{3}$ $= 58\frac{1}{3}$ m (*b*) Apabila zarah bergerak ke arah kanan, $v > 0$. *When the particle moves to the right,* $v > 0$. $15 + 2t - t^2 > 0$ $(t - 5)(t + 3) > 0$ $t < -3$ atau / *or* $t > 5$ Oleh sebab $t \geq 0$, zarah bergerak ke kanan apabila $t > 5$. *Since* $t \geq 0$, *the particle moves to the right when* $t > 5$.	6	**6**
12	(*a*) $m = \frac{26 - 1}{6 - 1}$ $= \frac{25}{5}$ $= 5$ $\therefore \frac{y}{x} = 5\left(\frac{1}{x^2}\right) + c$ Pada (1, 1), *At* (1, 1), $1 = 5(1) + c$ $c = -4$ $\therefore \frac{y}{x} = 5\left(\frac{1}{x^2}\right) - 4$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Apabila $\frac{y}{x} = 4$, *When* $\frac{y}{x} = 4$, $4 = 5\left(\frac{1}{x^2}\right) - 4$ $8 = 5\left(\frac{1}{x^2}\right)$ $8x^2 = 5$ $x^2 = \frac{5}{8}$ $x = \sqrt{\frac{5}{8}}$ (*b*) $y = \frac{a}{x} + bx$ $\frac{y}{x} = \frac{a}{x^2} + b$ $\frac{y}{x} = \frac{5}{x^2} - 4$ $\therefore a = 5, b = -4$	5	**5**
13	(*a*) $h = 2.5r$; $V = \pi r^2 h$ $= \pi r^2(2.5r)$ $= 2.5\,\pi r^3$ $\frac{dV}{dr} = 7.5\,\pi r^2$ $= 456.3\pi$ $\frac{dV}{dt} = \frac{dV}{dr} \times \frac{dr}{dt}$ $2.3 = 456.3\pi \times \frac{dr}{dt}$ $\frac{dr}{dt} = 1.604 \times 10^{-3}$ cm s^{-1}	4	
	(*b*) $y = kx^3 + 6x^2 + 7x$ $\frac{dy}{dx} = 3kx^2 + 12x + 7$ $x = 3, \frac{dy}{dx} = 3k(3)^2 + 12(3) + 7$ $= 27k + 43$ $x = 5, \frac{dy}{dx} = 3k(5)^2 + 12(5) + 7$ $= 75k + 67$ $27k + 43 = 75k + 67$ $48k = -24$ $k = -\frac{1}{2}$	4	**8**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
14	(*a*)  $\sin\theta = \dfrac{j}{\left(\frac{KL}{2}\right)}$ $KL = \dfrac{2j}{\sin\theta}$ Perimeter tembereng *KL*/*Perimeter of segment KL* = 41.3 $S_{KL} + KL = 41.3$ $j(0.67\pi) + \dfrac{2j}{\sin 120.6°} = 41.3$ $4.428j = 41.3$ $j = 9.326$ cm Perimeter kawasan berlorek/*Perimeter of the shaded region* $= KL + S_{\text{major } KL}$ $= \dfrac{2(9.326)}{\sin 120.6°} + 9.326(2\pi - 0.67\pi)$ = 60.637 cm	4	
	(*b*) $\angle XOY = 3.142 - 0.531 - \left(53 \times \dfrac{3.142}{180}\right)$ = 1.686 rad Luas segmen/*Area of the segment* $= \dfrac{1}{2} r^2 (\theta - \sin\theta)$ $= \dfrac{1}{2} (15.7)^2 (1.686 - \sin 1.686)$ = 85.36 cm^2	4	**8**
15	(*a*) $x = y + 5$ ..... ① $\quad y^2 = 7x^2 - 9$ ..... ② Gantikan ① ke dalam ② *Substitute* ① *into* ② $y^2 = 7(y + 5)^2 - 9$ $y^2 = 7(y^2 + 10y + 25) - 9$ $y^2 = 7y^2 + 70y + 175 - 9$ $0 = 6y^2 + 70y + 166$ $y = \dfrac{-70 \pm \sqrt{70^2 - 4(6)(166)}}{2(6)}$ = –3.311 atau / *or* –8.355 Gantikan y = –3.311 ke dalam ① *Substitute* y = –3.311 *into* ① $x = -3.311 + 5$ = 1 689 Gantikan y = –8.355 ke dalam ① *Substitute* y = –8.355 *into* ① $x = -8.355 + 5$ = –3.355	4	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*

	(*b*) $2p + q - 3r = 7$ ..... ①
	$p - 5q - 2r = 9$ ..... ②
	$3p - 4q + 6r = 12$ ..... ③
	② × 2 : $2p - 10q - 4r = 18$ ..... ④
	① – ④ : $11q + r = -11$
	$r = -11 - 11q$ ..... ⑤
	① × 3 : $6p + 3q - 9r = 21$ ..... ⑥
	③ × 2 : $6p - 8q + 12r = 24$ ..... ⑦
	⑥ – ⑦ : $11q - 21r = -3$ ..... ⑧
	Gantikan ⑤ ke dalam ⑧
	Substitute ⑤ *into* ⑧
	$11q - 21(-11 - 11q) = -3$
	$11q + 231 + 231q = -3$
	$242q = -234$
	$q = -0.9669 \text{ // } -\frac{117}{121}$
	Gantikan $q = -0.9669 \text{ // } -\frac{117}{121}$ ke dalam ⑤
	Substitute $q = -0.9669 \text{ // } -\frac{117}{121}$ *into* ⑤
	$r = -11 - 11(-0.9669)$
	$= -0.3641 \text{ // } -\frac{4}{11}$
	Gantikan $q = -0.9669 \text{ // } -\frac{117}{121}$ dan $r = -0.3641 \text{ // } -\frac{4}{11}$ ke dalam ②
	Substitute $q = -0.9669 \text{ // } -\frac{117}{121}$ *and* $r = -0.3641 \text{ // } -\frac{4}{11}$ *into* ②
	$p - 5(-0.9669) - 2(-0.3641) = 9$
	$p + 5.5627 = 9$
	$p = 3.4373 \text{ // } \frac{416}{121}$
		4	**8**

KERTAS 2

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	$6^{x+y} = 36$ $6^{x+y} = 6^2$ $x + y = 2$ (*a*) $36^{\frac{x}{2}}.6^y = 12x^2 + 12xy$ $6^x.\ 6^y = 12x^2 + 12xy$ $6^{x+y} = 12x(x + y)$ $36 = 12x(2)$ $x = \frac{3}{2}$ $\frac{3}{2} + y = 2$ $y = \frac{1}{2}$	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $6^x y = \frac{x+y}{6^y} \cdot x$ $6^x \cdot 6^y = \frac{x+y}{y} \cdot x$ $6^{x+y} = \frac{2x}{y}$ $36 = \frac{2x}{y}$ $x = 18y$ ..... ① $x + y = 2$ ..... ② Gantikan ① ke dalam ② *Substitute* ① *into* ② $18y + y = 2$ $19y = 2$ $y = \frac{2}{19}$ $x = 18\left(\frac{2}{19}\right) = \frac{36}{19}$	3	**6**
2	(*a*) $\frac{AC}{\sin 50°} = \frac{7.1}{\sin 80°}$ $\quad \frac{CD}{\sin 60°} = \frac{6.4}{\sin 40°}$ $AC = 5.523$ cm $\quad CD = 8.623$ cm Panjang *ACD* *Length of ACD* = 5.523 cm + 8.623 cm = 14.146 cm	3	
	(*b*) $\frac{ED}{\sin 80°} = \frac{6.4}{\sin 40°}$ $ED = 9.805$ cm	1	
	(*c*) Luas segi tiga *ABC* *Area of triangle ABC* $= \frac{1}{2}(7.1)(5.523)\sin 50°$ = 15.0196 cm^2 Luas segi tiga *CDE* *Area of triangle CDE* $= \frac{1}{2}(6.4)(9.805)\sin 60°$ = 27.1724 cm^2 Jumlah luas *Total area* = 15.0196 cm^2 + 27.1724 cm^2 = 42.192 cm^2	4	**8**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
3	(*a*) $y = 3x^2(x + 3)$ $= 3x^3 + 9x^2$ $\frac{dy}{dx} = 9x^2 + 18x$ (*b*) $9x^2 + 18x = 0$ $9x(x + 2) = 0$ $x = 0 ; x = -2$ $y = 0 ; y = 3(-2)^2(-2 + 3)$ $y = 12$ $\therefore$ (0, 0) dan/*and* (–2, 12) (*c*) $\frac{d^2y}{dx^2} = 18x + 18$ $x = 0, \frac{d^2y}{dx^2} = 18 > 0$ (Minimum/*Maximum*) $x = -2, \frac{d^2y}{dx^2} = 18(-2) + 18 = -18 < 0$ (Maksimum/*Maximum*) $\therefore$ (0, 0) ialah titik minimum dan (–2, 12) ialah titik maksimum. (0, 0) *is a minimum point and* (–2, 12) *is a maximum point.*	2 2 3	7
4	(*a*) (i) $\log_a \frac{a^2x}{y^2} = \log_a a^2x - \log_a y^2$ $= \log_a a^2 + \log_a x - \log_a y^2$ $= 2 \log_a a + \log_a x - 2 \log_a y$ $= 2 + 3 - 2(4)$ $= -3$ (ii) $\log_a \frac{\sqrt{y}\,x}{a} = \log_a \sqrt{y} + \log_a x - \log_a a$ $= \frac{1}{2} \log_a y + \log_a x - \log_a a$ $= \frac{1}{2}(4) + 3 - 1$ $= 4$ (*b*) $\log_a 4 = 2$ $\log_a x = 3$ $\log_a y = 4$ $4 = a^2$ $\log_2 x = 3$ $\log_2 y = 4$ $a^2 = 2^2$ $x = 2^3$ $y = 2^4$ $a = 2$ $x = 8$ $y = 16$	4 3	**7**
5	(*a*) $5x + 3y = 4$ ..... ① $2y + 4z = 5$ ..... ② ① × 2 : $10x + 6y = 8$ ..... ③ ③ + ② : $10x + 8y + 4z = 13$ Tertunjuk. *It is shown.*	2	

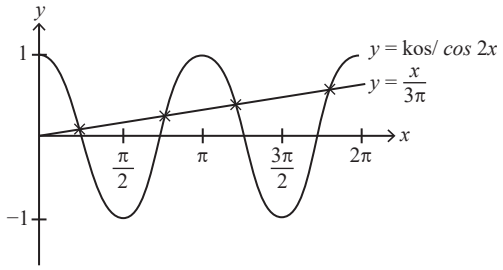
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $5x + 3y = 4$ ..... ① $2y + 4z = 5$ ..... ② Daripada ① *From* ① $5x + 3y = 4$ $y = \frac{4 - 5x}{3}$ Gantikan $y = \frac{4 - 5x}{3}$ dan $z = 2x - 1$ ke dalam ② *Substitute* $y = \frac{4 - 5x}{3}$ *and* $z = 2x - 1$ into ② $2\left(\frac{4 - 5x}{3}\right) + 4(2x - 1) = 5$ $\frac{8 - 10x}{3} + 8x - 4 = 5$ $8 - 10x + 24x - 12 = 15$ $14x = 19$ $x = \frac{19}{14}$ Gantikan $x = \frac{19}{14}$ ke dalam $z = 2x - 1$ *Substitute* $x = \frac{19}{14}$ *into* $z = 2x - 1$ $z = 2\left(\frac{19}{14}\right) - 1$ $= \frac{12}{7}$ Gantikan $z = \frac{12}{7}$ ke dalam ② *Substitute* $z = \frac{12}{7}$ *into* ② $2y + 4\left(\frac{12}{7}\right) = 5$ $y = -\frac{13}{14}$	5	7
6	(*a*) Bilangan cara untuk menyusun Adam dan Halim duduk bersebelahan *Number of ways to arrange Adam and Halim sit side by side* $= (7 - 1)! \times 2$ $= 6! \times 2$ $= 1\,440$ (*b*) Bilangan cara untuk menyusun 8 orang duduk di sebuah meja bulat *The number of ways to arrange* 8 *people sits at a round table* $= (8 - 1)!$ $= 7!$ $= 5\,040$	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Bilangan cara untuk menyusun Durga dan Benny duduk bersebelahan *The number of ways to arrange Durga and Benny sit side by side* $= (7 - 1)! \times 2$ $= 6! \times 2$ $= 1\,440$ Oleh itu, bilangan cara Durga dan Benny tidak duduk bersebelahan ialah *Therefore, the number of ways Durga and Benny do not sit side by side is* $= 5\,040 - 1\,440$ $= 3\,600$	4	**7**
7	(*a*) Luas sektor $= \frac{1}{2} j^2\theta$ *Area of sector* $= \frac{1}{2} r^2\theta$ $\frac{207\pi}{4} = \frac{1}{2}(9)^2\theta$ $\theta = 4.0143$ rad	2	
	(*b*) Panjang lengkok $AB = j\theta$ *Length of arc AB* $= r\theta$ $= 9(4.0143)$ $= 36.1287$ cm Perimeter sektor yang berlorek *Perimeter of the shaded region* $= 36.1287$ cm $+ 9$ cm $+ 9$ cm $= 54.1287$ cm	3	
	(*c*) $\theta = 2\pi - 4.0143$ $= 2.2689$ rad $= \frac{2.2689 \text{ rad}}{2\pi} \times 360°$ $= 130°$ Panjang perentas *AB* *Length of chord AB* $= \sqrt{9^2 + 9^2 - 2(9)(9) \text{ kos / } \cos 130}$ $= 16.314$ cm Panjang lengkok $AB = j\theta$ *Length of arc AB* $= r\theta$ $= 9\left(130° \times \frac{\pi}{180°}\right)$ $= 20.4204$ cm Perimeter tembereng *AB* *Perimeter of segment AB* $= 16.314$ cm $+ 20.4204$ cm $= 36.7344$ cm	3	8

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
8	(*a*) $y + x^2 = 16$ Pada/*At* $x = 0$, $y + 0 = 16$ $y = 16$ $\therefore D(0, 16)$ $y + x^2 = 16$ $y = -x^2 + 16$ $\frac{dy}{dx} = -2x$ $= -2(2)$ $= -4$ Persamaan tangen: *Equation of tangent:* $y - y_1 = \frac{dy}{dx}(x - x_1)$ $y - 12 = -4(x - 2)$ $y = -4x + 8 + 12$ $y = -4x + 20$ Apabila/*When* $x = 0$, $y = 20$ Apabila/*When* $y = 0$, $0 = -4x + 20$ $4x = 20$ $x = 5$ $\therefore C(5, 0)$ dan/*and* $A(0, 20)$	3	
	(*b*) $y + x^2 = 16$ Jika/*If* $16 - x^2 = 0$ $(4 - x)(4 + x) = 0$ $\therefore x = 4$; $x = -4$ Maka, luas rantau berlorek ialah *Hence, the area of shaded region is* $= \int_2^5 (20 - 4x)dx - \int_2^4 (16 - x^2)dx$ $= [20x - 2x^2]_2^5 - \left[16x - \frac{x^3}{3}\right]_2^4$ $= [[20(5) - 2(5)^2] - [20(2) - 2(2)^2]] - \left[\left[16(4) - \frac{4^3}{3}\right] - \left[16(2) - \frac{2^3}{3}\right]\right]$ $= [50 - 32] - \left[\frac{128}{3} - \frac{88}{3}\right]$ $= 18 - \frac{40}{3}$ $= \frac{14}{3}$ unit^2/*units*^{2}	4	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) Isi padu janaan *The generated volume* $= \int_{12}^{16} \pi x^2 \, dy$ $= \pi \int_{12}^{16} (16 - y) \, dy$ $= \pi \left[16y - \frac{y^2}{2} \right]_{12}^{16}$ $= \pi \left[\left[16(16) - \frac{16^2}{2} \right] - \left[16(12) - \frac{12^2}{2} \right] \right]$ $= \pi (128 - 120)$ $= 8\pi$ unit^3/*units*^{3}	3	**10**
9	(*a*) Sebelah kanan *Right-hand side* $= \text{kos}/cos\ 2x$ $= 2\,\text{kos}^2/cos^2\ x - 1$ $= \frac{2}{1 + \tan^2 x} - 1$ $= \frac{2 - 1 - \tan^2 x}{1 + \tan^2 x}$ $= \frac{1 - \tan^2 x}{1 + \tan^2 x}$ = Sebelah kiri/*Left-hand side* $\text{sek}^2/sec^2\ x = 1 + \tan^2 x$ $\frac{1}{\text{kos}^2/\ cos^2\ x} = 1 + \tan^2 x$ $\text{kos}^2/\ cos^2\ x = \frac{1}{1 + \tan^2 x}$	3	
	(*b*) & (*c*)		

x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$		$\frac{5\pi}{4}$	$\frac{3\pi}{2}$	$\frac{7\pi}{4}$	2
y	1	0	–1	0	1	0	–1	0	1



3

$3\pi(1 - \tan^2 x) = x(1 + \tan^2 x)$

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

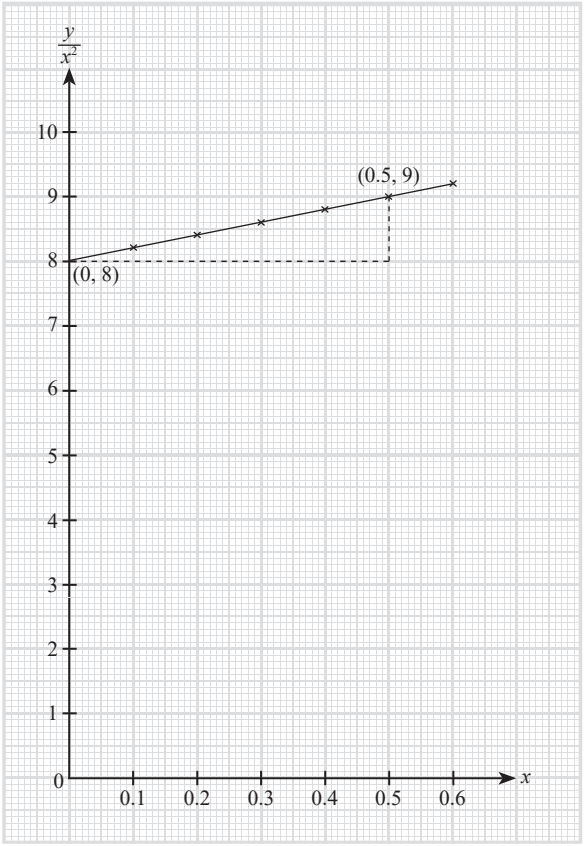
$\text{kos}/cos\ 2x = \frac{x}{3\pi}$

$y = \frac{x}{3\pi}$

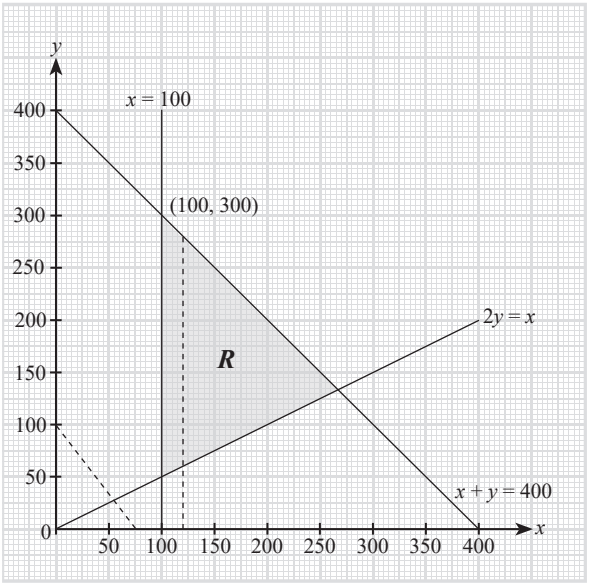
x	0	$\frac{\pi}{4}$	$\frac{3\pi}{4}$	$\frac{5\pi}{4}$	$\frac{7\pi}{4}$
y	0	0.083	0.25	0.417	0.583

∴ Bilangan penyelesaian/*Number of solutions* = 4

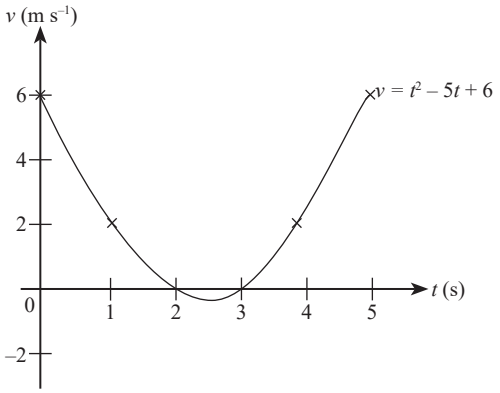
4 | **10**

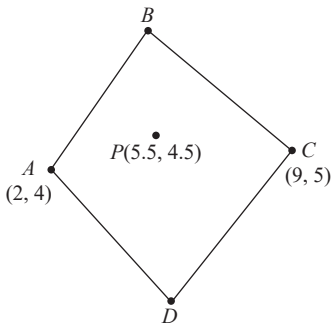
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
10	(*a*) $\begin{array}{\|c\|c\|c\|c\|c\|c\|c\|}\hline x & 0.1 & 0.2 & 0.3 & 0.4 & 0.5 & 0.6 \\ \hline \frac{y}{x^2} & 8.2 & 8.4 & 8.6 & 8.8 & 9.0 & 9.2 \\ \hline\end{array}$  (*b*) $y = px^3 + qx^2$ $\div 2 : \frac{y}{x^2} = px + q$ Pintasan-*y*/*y-intercept* = 8 Kecerunan/*Gradient*, $p = \frac{9-8}{0.5-0}$ $= \frac{1}{0.5}$ $= 2$ $p = 2, q = 8$ (*c*) $y = px^3 + qx^2$ $= 2x^3 + 8x^2$ Apabila/*When* $x = 0.73$, $y = 2(0.73)^3 + 8(0.73)^2$ $= 5.041$	3 5 2	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
11	(*a*) (i) $\overrightarrow{CF} = \frac{3}{4}\overrightarrow{CB}$ $\quad \overrightarrow{CA} = \overrightarrow{CB} + \overrightarrow{BA}$ $\overrightarrow{CB} = \frac{4}{3}\underset{\sim}{b}$ $\quad = \frac{4}{3}\underset{\sim}{b} + (-\underset{\sim}{a})$ $= \frac{4}{3}\underset{\sim}{b} - \underset{\sim}{a}$ (ii) $\overrightarrow{AE} = \frac{2}{7}\overrightarrow{AC}$ $= \frac{2}{7}\left(\underset{\sim}{a} - \frac{4}{3}\underset{\sim}{b}\right)$ $= \frac{2}{7}\underset{\sim}{a} - \frac{8}{21}\underset{\sim}{b}$ $\overrightarrow{EA} = \frac{8}{21}\underset{\sim}{b} - \frac{2}{7}\underset{\sim}{a}$ $\overrightarrow{EB} = \overrightarrow{EA} + \overrightarrow{AB}$ $= \frac{8}{21}\underset{\sim}{b} - \frac{2}{7}\underset{\sim}{a} + \underset{\sim}{a}$ $= \frac{5}{7}\underset{\sim}{a} + \frac{8}{21}\underset{\sim}{b}$	4	
	(*b*) $\overrightarrow{DC} = \overrightarrow{DE} + \overrightarrow{EC}$ $h\underset{\sim}{a} + k\underset{\sim}{b} = \frac{3}{5}h\underset{\sim}{a} - \frac{3}{2}k\underset{\sim}{b} + \frac{5}{7}\left(\underset{\sim}{a} - \frac{4}{3}\underset{\sim}{b}\right)$ $h\underset{\sim}{a} + k\underset{\sim}{b} = \left(\frac{3}{5}h + \frac{5}{7}\right)\underset{\sim}{a} + \left(-\frac{3}{2}k - \frac{20}{21}\right)\underset{\sim}{b}$ $h = \frac{3}{5}h + \frac{5}{7}$ $\quad k = -\frac{3}{2}k - \frac{20}{21}$ $\frac{2}{5}h = \frac{5}{7}$ $\quad \frac{5}{2}k = -\frac{20}{21}$ $h = \frac{25}{14}$ $\quad k = -\frac{8}{21}$	4	
	(*c*) $\overrightarrow{CA} = \frac{4}{3}\underset{\sim}{b} - \underset{\sim}{a}$ $\lvert\overrightarrow{CA}\rvert^2 = \left[\left(\frac{4}{3}\right)(9)\right]^2 + [(-1)(5)]^2$ $\lvert\overrightarrow{CA}\rvert = \sqrt{169}$ $= 13$ unit/*units*	2	**10**
12	(*a*) I : $x + y \leq 400$ II : $x \geq 100$ III : $2y \geq x$	3	

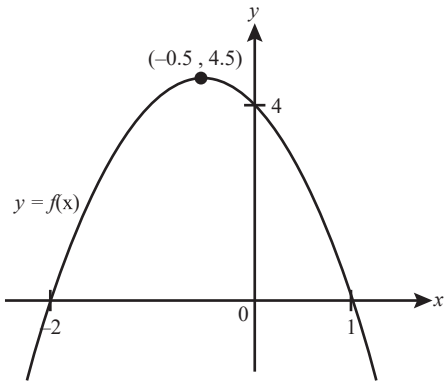
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*)  (*c*) (i) Apabila/*When* $x = 120$, $60 \le y \le 280$ (ii) $70x + 50y = k$ Katakan/*Let* $k = 5\,000$ $70x + 50y = 5\,000$ $7x + 5y = 500$ Jumlah maksimum yuran bulanan *Maximum total monthly fees* $= 70(100) + 50(300)$ = RM22 000	4 3	**10**
13	(*a*) $x = 114$ (*b*) Biarkan/*Let* Q_0 = Harga pada tahun 2021 *Price in the year* 2021 Q_1 = Harga pada tahun 2022 *Price in the year* 2022 Nombor indeks/*Index number*, $I = \frac{Q_1}{Q_0} \times 100$ $110 = \frac{91.50}{Q_0} \times 100$ Q_0 = RM83.18 (*c*) $I_{2023/2022} = \frac{I_{2023/2021}}{I_{2022/2021}} \times 100$ $= \frac{129}{121} \times 100$ $= 106.61$	1 2 3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*d*) (i) Indeks gubahan/*Composite index*, $I = \frac{\sum I_i w_i}{\sum w_i}$ $111.3 = \frac{150y + 110(4) + 114(3) + 121(1)}{y + 4 + 3 + 1}$ $111.3 = \frac{105y + 903}{y + 8}$ $111.3y + 890.4 = 105y + 903$ $6.3y = 12.6$ $y = 2$ (ii) $I = \frac{Q_{2022}}{Q_{2021}} \times 100$ $111.3 = \frac{Q_{2022}}{92.50} \times 100$ $Q_{2022} = \text{RM}102.95$	4	**10**
14	(*a*) Halaju minimum/*Minimum velocity*, $\frac{dv}{dt} = 0$ $2t - 5 = 0$ $t = 2.5$ Oleh sebab $\frac{d^2v}{dt^2} = 2(> 0)$, v adalah minimum apabila $t = 2.5$ *Since* $\frac{d^2v}{dt^2} = 2(> 0)$, *v is minimum when* $t = 2.5$ Maka, halaju minimum zarah *Hence, minimum velocity of the particle* $= (2.5)^2 - 5(2.5) + 6$ $= -0.25 \text{ m s}^{-1}$	3	
	(*b*) $t = 0, \quad t^2 - 5t + 6 = 0$ $(t - 3)(t - 2) = 0$ $\therefore t = 3, t = 2$ Jarak antara titik *A* dan *B* *Distance between points A and B* $= \int_2^3 (t^2 - 5t + 6)\, dt$ $= \left[\frac{t^3}{3} - \frac{5t^2}{2} + 6t\right]_2^3$ $= \left[\frac{3^3}{3} - \frac{5(3)^2}{2} + 6(3)\right] - \left[\frac{2^3}{3} - \frac{5(2)^2}{2} + 6(2)\right]$ $= \left\lvert \frac{9}{2} - \frac{14}{3} \right\rvert$ $= \left\lvert -\frac{1}{6} \right\rvert$ $= 0.167 \text{ m}$	3	

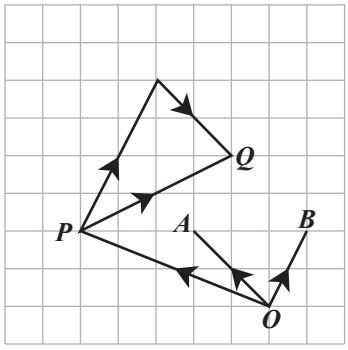
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) | ***t*** | 0 | 1 | 2 | 2.5 | 3 | 4 | 5 | | ***v*** | 6 | 2 | 0 | –0.25 | 0 | 2 | 6 |  (*d*) $t > 2.5$	3 1	**10**
15	(*a*) $m_{AC} = \frac{5-4}{9-2}$ $= \frac{1}{7}$ $m_2 = -7$ Titik tengah *AC* *Midpoint AC* $= \left(\frac{9+2}{2}, \frac{5+4}{2}\right)$ $= (5.5, 4.5)$ Persamaan pembahagi dua sama serenjang bagi *AC* *Equation of the perpendicular bisector of AC* $\frac{y-4.5}{x-5.5} = -7$ $y = -7(x - 5.5) + 4.5$ $y = -7x + 43$ (*b*) *BD* ialah pembahagi dua sama serenjang bagi *AC*. *BD is the perpendicular bisector of AC.* Persamaan *BD* ialah/*The equation of BD is* $y = -7x + 43$; $m = -7$ $\frac{y-4}{x-5} = -7$ $y = -7(x - 5) + 4$ $= -7x + 39$	2 3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*)  $PB^2 = PC^2$ $(x - 5.5)^2 + (y - 4.5)^2 = (9 - 5.5)^2 + (5 - 4.5)^2$ $x^2 - 11x + 30.25 + y^2 - 9y + 20.25 = 12.25 + 0.25$ $x^2 + y^2 - 11x - 9y + 38 = 0$ —— ① $AB^2 = BC^2$ $(x - 2)^2 + (y - 4)^2 = (9 - x)^2 + (5 - y)^2$ $x^2 - 4x + 4 + y^2 - 8y + 16 = 81 - 18x + x^2 + 25 - 10y + y^2$ $14x + 2y - 86 = 0$ $2y = 86 - 14x$ $y = 43 - 7x$ —— ② Gantikan ② ke dalam ① *Substitute* ② *into* ① $x^2 + (43 - 7x)^2 - 11x - 9(43 - 7x) + 38 = 0$ $x^2 + 1\,849 - 602x + 49x^2 - 11x - 387 + 63x + 38 = 0$ $50x^2 - 550x + 1\,500 = 0$ $50(x^2 - 11x + 30) = 0$ $(x - 6)(x - 5) = 0$ $x = 6$ atau/*or* $x = 5$ Apabila/*When* $x = 6$, $y = 43 - 7(6)$ $= 1$ Apabila/*When* $x = 5$, $y = 43 - 7(5)$ $= 8$ $\therefore$ $B(5, 8)$ dan/*and* $D(6,1)$	5	**10**

KERTAS 1

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) (i) Selanjar *Continuous* (ii) Diskret *Discrete* (iii) Diskret *Discrete* (*b*) $P(Z < -m) = \frac{1 - 0.7114}{2} = 0.1443$ $m = 1.061$	3 3	**6**
2	(*a*) $(6 - 1)!$ $= 120$ cara/*ways* (*b*) $(5 - 1)! \times 2!$ $= 48$ cara/*ways*	4	**4**
3	(*a*) (i) $f(x) = -2x^2 - 2x + 4$ $= -2(x^2 + x - 2)$ $= -2\left[\left(x + \frac{1}{2}\right)^2 - \left(\frac{1}{2}\right)^2 - 2\right]$ $= -2\left(x + \frac{1}{2}\right)^2 + \frac{9}{2}$ (ii)  (*b*) (i) Lebar graf berkurang. *Width of graph decreases.* (ii) Graf dengan bentuk yang sama bergerak secara mengufuk 1 unit ke kanan.//Persamaan paksi simetri adalah $x = \frac{1}{2}$. *Graph with the same shape moves* 1 *unit horizontally to the right.//The equation of the axis of symmetry is* $x = \frac{1}{2}$. (iii) Graf bergerak secara menegak 3 unit ke bawah.//Nilai minimum ialah $\frac{3}{2}$. *Graph moves vertically* 3 *units downwards.//The minimum value is* $\frac{3}{2}$.	7	**7**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	$y = x^3$ ..... ① $y + \delta y = (x + \delta x)^3$ ..... ② ② – ① : $\delta y = (x + \delta x)^3 - x^3$ $= (x + 8x)[x^2 + 2x\delta x + (\delta x)^2] - x^3$ $= x^3 + 2x^2\delta x + x(\delta x)^2 + x^2\delta x + 2x(\delta x)^2 + (\delta x)^3 - x^3$ $= 3x^2\delta x + 3x(\delta x)^2 + (\delta x)^3$ $\frac{\delta y}{\delta x} = 3x^2 + 3x(\delta x) + (\delta x)^2$ $\frac{dy}{dx} = \lim_{\delta x \to 0} [3x^2 + 3x(\delta x) + (\delta x)^2]$ $= 3x^2$ $\delta y = 3(3)^2 \times (-0.02)$ $= -0.54$	5	**5**
5	**Rajah** *Diagram* / **Fungsi Songsang** *Inverse Function* / **Sebab** *Reason* **5**(*a*) — Ada *Yes* — Garis mengufuk memotong satu titik sahaja pada graf. *Horizontal line cuts the graph at only one point.* **5**(*b*) — Ada *Yes* — Garis mengufuk memotong satu titik sahaja pada graf. *Horizontal line cuts the graph at only one point.* **5**(*c*) — Tiada *No* — Garis mengufuk memotong lebih daripada satu titik pada graf. *Horizontal line cuts the graph at more than one point.*	3	**3**
6	sek/*sec* A(tan A + kot/*cot* A) $= \frac{1}{\text{kos/}cos\ A}\left(\frac{\sin A}{\text{kos/}cos\ A} + \frac{\text{kos/}cos\ A}{\sin A}\right)$ $= \frac{1}{\text{kos/}cos\ A}\left(\frac{\sin^2 A + \text{kos/}cos^2\ A}{\sin A\ \text{kos/}cos\ A}\right)$ $= \frac{1}{\text{kos/}cos\ A}\left(\frac{1}{\sin A\ \text{kos/}cos\ A}\right)$ $= \frac{1}{\sin A\ (1 - \sin^2 A)}$ $= \frac{1}{\sin A\ \sin^3 A}$	4	**4**
7	(*a*) $\frac{7\sqrt{5}}{\sqrt{5} - 14} \times \frac{\sqrt{5} + 14}{\sqrt{5} + 14}$ $= \frac{35 + 98\sqrt{5}}{5 - 14^2}$ $= \frac{35 + 98\sqrt{5}}{-191}$	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $9(27^x) = 3^y$ $3^2(3^{3x}) = 3^y$ $3^{2+3x} = 3^y$ $y = 3x + 2$ ..... ① $\log_2 y - \log_2 (x-1) = 1$ $\log_2 \frac{y}{x-1} = 1$ $\frac{y}{x-1} = 2$ $y = 2x - 2$ ..... ② ① – ② : $0 = x + 4$ $0 = x + 4$ $x = -4$ $y = 3(-4) + 2$ $= -10$ $x = -4, y = -10$	4	**7**
8	(*a*) $a + 2d = x$ ..... ① $a + 6d = y$ ..... ② ② – ① : $4d = y - x$ $d = \frac{y-x}{4}$ $a = x - 2\left(\frac{y-x}{4}\right)$ $= \frac{3}{2}x - \frac{1}{2}y$ (*b*) $n = 2029 - 2022 + 1 = 8$ $T_{2030}(T_8) = 10\,000 \times 1.04^{8-1}$ $= \text{RM}13\,159.32$ $n = 2039 - 2029 + 1 = 11$ $T_{2040}(T_{11}) = 13\,159.32 \times 1.05^{11-1}$ $= \text{RM}21\,435.15$	3 4	**7**
9	$y = kx^3$ $\log_2 y = 3\log_2 x + \log_2 k$ $\log_2 k = -1$ $k = \frac{1}{2}$ $\frac{h-(-1)}{2-0} = 3$ $h = 5$	4	**4**
10	(*a*) (i) 		

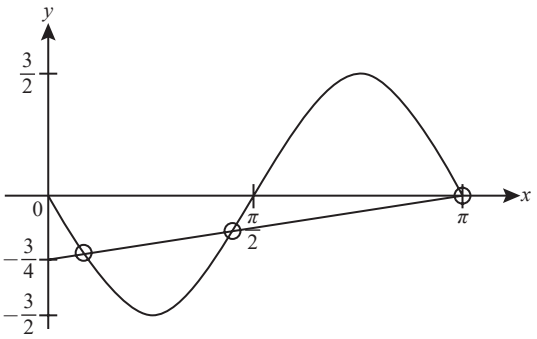
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(ii) $\lvert\overrightarrow{PQ}\rvert = \sqrt{4^2 + (-2)^2}$ $= \sqrt{20}$ // $2\sqrt{5}$ // 4.47	3	
	(*b*) $v = \sqrt{6^2 + 12^2}$ $= 6\sqrt{5}$ km j^{-1}/km h^{-1} // 13.42 km j^{-1}/km h^{-1} $\alpha = \tan^{-1}\left(\frac{6}{12}\right) = 26.57°$ $\theta = 270° + 26.57° = 296.57°$	3	**6**
11	(*a*) $2j + j\theta = 30$ ..... ① $\frac{1}{2}j^2\theta = 14$ ..... ②	2	
	(*b*) $\theta = \frac{30 - 2j}{j}$ $\frac{1}{2}j^2\left(\frac{30 - 2j}{j}\right) = 14$ $j^2 - 15j + 14 = 0$ $(j - 14)(j - 1) = 0$ $j = 14, 1$ $j = 14$, $\theta = \frac{30 - 2(14)}{14} = \frac{1}{7}$ rad $j = 1$, $\theta = \frac{30 - 2(1)}{(1)} = 28$ rad $\theta = 0.1429$ rad ($\theta = 28$ rad tidak diterima kerana melebihi 2π) ($\theta = 28$ rad *is not accepted because more than* 2π) $j = 14$ cm ($j = 1$ cm tidak diterima kerana θ yang setara adalah 28 rad) ($j = 1$ cm *is not accepted because the equivalent is* 28 rad) $j = 14$ cm , $\theta = 0.1429$	2	**4**
12	(*a*) Bukan, kerana $2x + y = zx$ bukan persamaan linear. *No, because* $2x + y = zx$ *is not a linear equation.*	1	
	(*b*) $x + y + z = 2$ ..... ① $y - 3z = 1$ ..... ② $2x + y + 5z = 0$ ..... ③ $\Rightarrow$ ②, $y = 1 + 3z$ ..... ④ Gantikan/*Substitute* ④ ke dalam/*into* ① $x + (1 + 3z) + z = 2$ $x + 4z = 1$ $x = 1 - 4z$ ..... ⑤ Gantikan/*Substitute* ④ dan ⑤ ke dalam/*into* ③ $2(1 - 4z) + (1 + 3z) + 5z = 0$ $2 - 8z + 3z + 1 + 5z = 0$ $3 = 0$ Sistem persamaan linear ini tiada penyelesaian kerana $3 \neq 0$. *This system of linear equations has no solution because* $3 \neq 0$.	4	**5**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
13	(*a*) $\frac{x-x_1}{x_2-x_1}=\frac{m}{n}$ $x(m+n)=nx_1+mx_2$ $x=\frac{nx_1+mx_2}{m+n}$ $\frac{y-y_1}{y_2-y_1}=\frac{m}{n}$ $y(m+n)=ny_1+my_2$ $y=\frac{ny_1+my_2}{m+n}$ $P(x,y)=\left(\frac{nx_1+mx_2}{m+n},\frac{ny_1+my_2}{m+n}\right)$ $\therefore$ Tertunjuk/*Shown*	4	
	(*b*) $RH_1=\left(\frac{1(6)+2(-6)}{1+2},\frac{1(4)+2(-2)}{1+2}\right)$ $=(-2,0)$ $RH_2=\left(\frac{2(6)+1(-6)}{2+1},\frac{2(4)+1(-2)}{2+1}\right)$ $=(2,2)$	4	**8**
14	(*a*) (i) $4x-4=0$ $x=1$ $(1,-4)$ (ii) $\frac{d^2y}{dx^2}=4$ Titik minimum/*Minimum point*	5	
	(*b*) $y=\int(4x-4)\,dx$ $=2x^2-4x+c$ $-4=2(1)^2-4(1)+c$ $c=-2$ $y=2x^2-4x-2$	3	**8**
15	(*a*) (i) $f^2(x)=\frac{\left(\frac{x-1}{x}\right)-1}{\left(\frac{x-1}{x}\right)}$ $=\frac{1}{1-x},\ x\neq 1$ $f^3(x)=x$	3	
	(ii) $f^{36}(x)=x$ $f^{36}(2)=2$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) (i) gf (ii) $f(x) = 2x - 1$ $f^{-1}(x) = \frac{x+1}{2}$ (iii) $g(x) = \frac{2 - 2\left(\frac{x+1}{2}\right)}{2\left(\frac{x+1}{2}\right) - 1}$ $= \frac{1-x}{x}$; $x \neq 0$	4	**8**

KERTAS 2

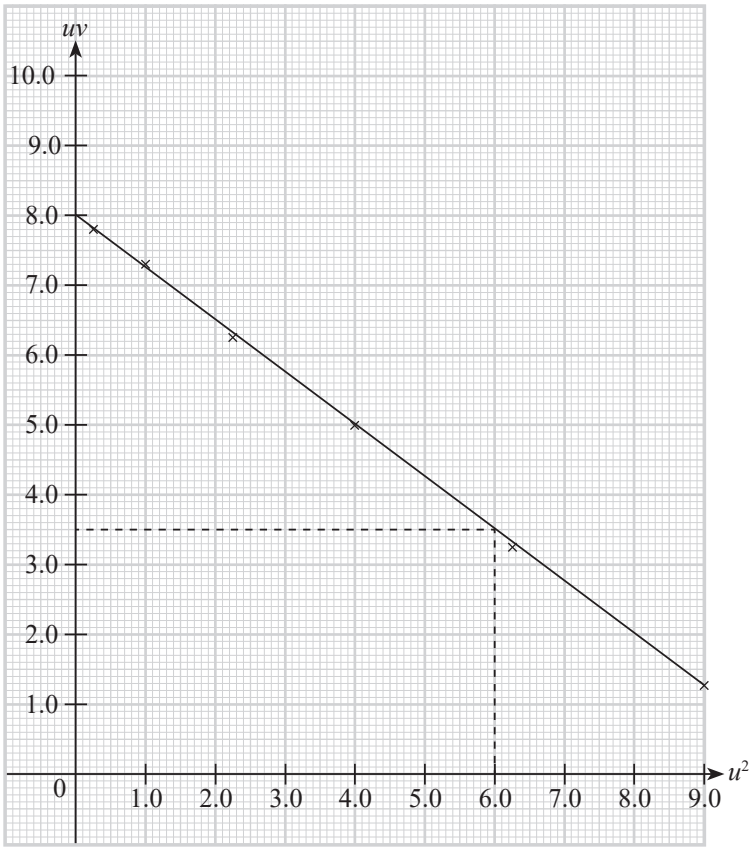
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) $3x^2 + 2x - 6 = 0$ $\alpha + \beta = -\frac{2}{3}$ $\quad \alpha\beta = -2$ $\frac{\alpha}{\beta} + \frac{\beta}{\alpha} = \frac{\alpha^2 + \beta^2}{\alpha\beta}$ $= \frac{(\alpha+\beta)^2 - 2\alpha\beta}{\alpha\beta}$ $= \frac{\left(-\frac{2}{3}\right)^2 - 2(-2)}{-2}$ $= -\frac{20}{9}$ $\frac{\alpha}{\beta} \times \frac{\beta}{\alpha} = 1$ $x^2 - \left(-\frac{20}{9}\right)x + (1) = 0$ $9x^2 + 20x + 9 = 0$	3	
	(*b*) $x^2 + (3k-1)x + 2k + 10 = 0$ di mana / *where* $a = 1$, $b = 3k - 1$, $c = 2k + 10$ $(3k-1)^2 - 4(1)(2k+10) \geq 0$ $9k^2 - 6k + 1 - 8k - 40 \geq 0$ $9k^2 - 14k - 39 \geq 0$ $k \geq 3$, $k \leq \frac{-13}{9}$	3	**6**

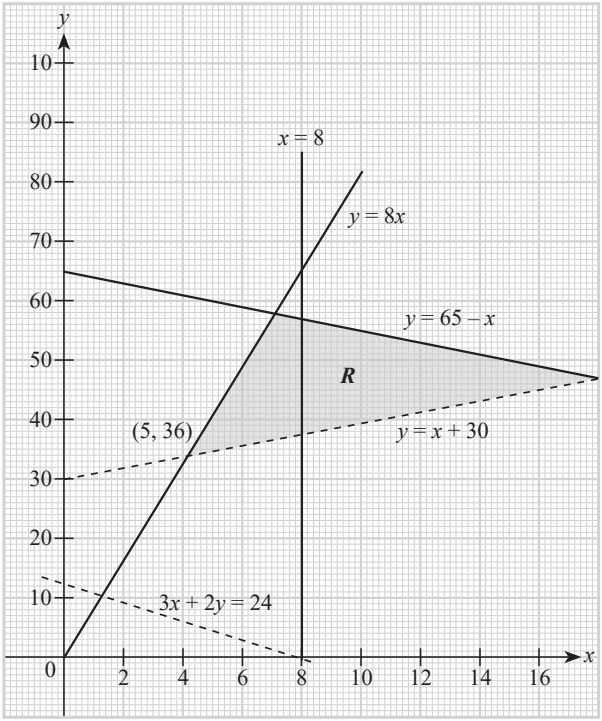
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
2	(*a*) $a = 0.888...$ ..... ① $10a = 8.888...$ ..... ② ② – ① : $9a = 8$ $a = \frac{8}{9}$ 0.888... ialah nombor nisbah kerana dapat ditulis dalam bentuk nisbah, $\frac{p}{q}$. 0.888... *is a rational nombor because can be written in the ratio form,* $\frac{p}{q}$.	3	
	(*b*) $m\sqrt{20} = m\sqrt{7} + \sqrt{3}$ $m\sqrt{12} - m\sqrt{7} = \sqrt{3}$ $m\left(\sqrt{12} - \sqrt{7}\right) = \sqrt{3}$ $m = \sqrt{3}$ $m = \frac{\sqrt{3}}{\sqrt{12} - \sqrt{7}} \times \frac{\sqrt{12} + \sqrt{7}}{\sqrt{12} + \sqrt{7}}$ $= \frac{6 + \sqrt{21}}{5}$ $\frac{p + \sqrt{q}}{5} = \frac{6 + \sqrt{21}}{5}$ $p = 6, q = 21$	3	**6**
3	(*a*) (i) $\frac{10!}{2! \times 2! \times 2!} = 453\,600$ (ii) $\frac{5! \times 6!}{2! \times 2! \times 2!} = 10\,800$	3	
	(*b*) (i) ${}^{10}C_5 = 252$ (ii) ${}^{6}C_2 \times {}^{4}C_3 = 60$	3	**6**
4	(*a*) $1 - \tan x \sin 2x$ $= 1 - \left(\frac{\sin x}{\text{kos}/\textit{cos}\ x}\right)(2 \sin x\ \text{kos}/\textit{cos}\ x)$ $= 1 - 2\sin^2 x$ $= \text{kos}/\textit{cos}\ 2x$ (LHS)	2	
	(*b*) (i) 		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(ii) $2 \sin 2x = 1 - \frac{x}{\pi}$ $-\frac{3}{4}(2 \sin 2x) = -\frac{3}{4}\left(1 - \frac{x}{\pi}\right)$ $-\frac{3}{2} \sin 2x = -\frac{3}{4} + \frac{3x}{4\pi}$ $y = -\frac{3}{4} + \frac{3x}{4\pi}$ Bilangan penyelesaian = 3 *Number of solutions*	6	**8**
5	$4x + 4(x + 5) + 4y = 154$ ..... ① $2(x \times y) + 2[x \times (x + 5)] + 2[y \times (x + 5)] = 845$ ..... ② ① $\Rightarrow 8x + 4y = 134$ $y = 33.5 - 2x$ ..... ③ ① $\Rightarrow 2xy + 2x^2 + 10x + 2xy + 10y = 845$ $2x^2 + 4xy + 10x + 10y = 845$ ..... ④ Ganti/*Substitute* ③ ke dalam/*into* ④ $2x^2 + 4x(33.5 - 2x) + 10x + 10(33.5 - 2x) = 845$ $2x^2 + 134x - 8x^2 + 10x + 335 - 20x - 845 = 0$ $-6x^2 + 124x - 510 = 0$ $3x^2 - 62x + 255 = 0$ $(3x - 17)(x - 15) = 0$ $x = 5.667, 15$ $x = 5.667$; $y = 33.5 - 2(5.667) = 22.166$ $(x > y)$ $x = 15$; $y = 33.5 - 2(15) = 3.5$ $\therefore x = 15$ cm ; $y = 3.5$ cm $V = 15 \times (15 + 5) \times 3.5 = 1\,050$ cm^3 1 L tepung susu formula dapat dibungkus di dalam bekas tersebut kerana 1 L < 1 050 cm^3. 1 L *of formula milk powder can be packed in the container because* 1 L < 1 050 cm^3.	8	**8**
6	(*a*) $\sqrt{h^2 + 8^2} // \sqrt{50^2 + k^2}$ $\sqrt{h^2 + 8^2} = \sqrt{50^2 + k^2}$ $k = \sqrt{h^2 - 2\,436}$ (*b*) $\frac{y - 10}{x - (-100)} = \frac{5 - 10}{-60 - (-100)}$ $y - 10 = -\frac{1}{8}(x + 100)$ $y = -\frac{1}{8}x - \frac{5}{2}$ $k = \sqrt{(50)^2 - 2\,436}$ $= -8, 8$ $x = 50$, $y = -8$	3	

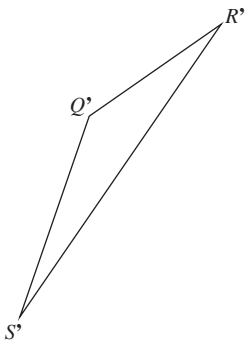
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$y \neq -\frac{1}{8}(50) - \frac{5}{2}$ $-8 \neq -\frac{35}{4}$ Kedudukan pusat sukan tidak segaris dengan fakulti kejuruteraan dan fakulti sains apabila nilai $h = 50$. *The position of the sports center is not in line with the engineering faculty and the science faculty when the value of $h = 50$.*	5	**8**
7	(*a*) $\int_0^1 (x^2 + k)\,dx = \frac{4}{3}$ $\left[\frac{x^3}{3} + kx\right]_0^1 = \frac{4}{3}$ $\left[\frac{(1)^3}{3} + k(1)\right] - \left[\frac{(0)^3}{3} + k(0)\right] = \frac{4}{3}$ $\frac{1}{3} + k = \frac{4}{3}$ $k = 1$	3	
	(*b*) Isi padu kisaran/*Volume of revolution* $= \pi(1)^2(2) - \pi\left[\frac{y^2}{2} - y\right]_1^2$ $= 2\pi - \pi\left[\left(\frac{2^2}{2} - 2\right) - \left(\frac{1^2}{2} - 1\right)\right]$ $= 2\pi - \frac{1}{2}\pi$ $= \frac{3}{2}\pi$	5	**8**
8	(*a*) $\overrightarrow{KM} = \overrightarrow{KO} + \overrightarrow{OM}$ $= (5\underset{\sim}{i} - 3\underset{\sim}{j}) + (4\underset{\sim}{i} - 3\underset{\sim}{j})$ $= 9\underset{\sim}{i} - 6\underset{\sim}{j}$ $\overrightarrow{LN} = \overrightarrow{LO} + \overrightarrow{ON}$ $= (4\underset{\sim}{i} + 2\underset{\sim}{j}) + 4\underset{\sim}{j}$ $= 4\underset{\sim}{i} + 6\underset{\sim}{j}$	3	
	(*b*) (i) $\overrightarrow{NP} = \left(\frac{1}{1+\lambda}\right)\overrightarrow{NL}$ $\overrightarrow{OP} = \overrightarrow{ON} + \overrightarrow{NP}$ $= 4\underset{\sim}{j} + \left(\frac{1}{1+\lambda}\right)(-4\underset{\sim}{i} - 6\underset{\sim}{j})$ (ii) $\overrightarrow{PM} = \left(\frac{\mu}{1+\mu}\right)\overrightarrow{KM}$ $= \left(\frac{\mu}{1+\mu}\right)(9\underset{\sim}{i} - 6\underset{\sim}{j})$	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) $LP = PN$, maka $\lambda = 1$ $\overrightarrow{OP} = -2\underset{\sim}{i} + \underset{\sim}{j}$ $\overrightarrow{PM} = \overrightarrow{PO} + \overrightarrow{OM}$ $\left(\frac{\mu}{1+\mu}\right)(9\underset{\sim}{i} - 6\underset{\sim}{j}) = (2\underset{\sim}{i} - \underset{\sim}{j}) + (4\underset{\sim}{i} - 3\underset{\sim}{j})$ $\left(\frac{\mu}{1+\mu}\right)(9\underset{\sim}{i} - 6\underset{\sim}{j}) = 6\underset{\sim}{i} - 4\underset{\sim}{j}$ $9\mu\underset{\sim}{i} - 6\mu\underset{\sim}{j} = (1+\mu)(6\underset{\sim}{i} - 4\underset{\sim}{j})$ $9\mu\underset{\sim}{i} - 6\mu\underset{\sim}{j} = 6\underset{\sim}{i} - 4\underset{\sim}{j} + 6\mu\underset{\sim}{i} - 4\mu\underset{\sim}{j}$ $9\mu\underset{\sim}{i} - 6\mu\underset{\sim}{j} = (6+6\mu)\underset{\sim}{i} + (-4-4\mu)\underset{\sim}{j}$ $9\mu = 6 + 6\mu$ $3\mu = 6$ $\mu = 2$	4	**10**
9	(*a*) (i) $\min/mean = \frac{4}{5} \times 10 = 8$ $\sigma = \sqrt{10\left(\frac{4}{5}\right)\left(\frac{1}{5}\right)} = 1.2649$ (ii) $P(X \geq 3) = 1 - P(X < 3)$ $= 1 - P(X = 0) - P(X = 1) - P(X = 2)$ $= 1 - {}^{10}C_0\left(\frac{4}{5}\right)^0\left(\frac{1}{5}\right)^{10} - {}^{10}C_1\left(\frac{4}{5}\right)^1\left(\frac{1}{5}\right)^9 - {}^{10}C_2\left(\frac{4}{5}\right)^2\left(\frac{1}{5}\right)^8$ $= 0.9999$	5	
	(*b*) (i) $P(X \leq 965) = P\left(Z \leq \frac{965 - 985}{10}\right)$ $= P(Z \leq -2)$ $= 0.0228$ (ii) $P(X \geq k) = \frac{16\,000}{20\,000}$ $P\left(Z \leq \frac{k - 985}{10}\right) = 0.8$ $\frac{k - 985}{10} = -0.842$ $k = 976.58$	5	**10**
10	(*a*) u^2 | uv 0.25 | 7.80 1.00 | 7.30 2.25 | 6.30 4.00 | 5.00 6.25 | 3.25 9.00 | 1.26		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	 (*b*) (i) $u = \sqrt{6} \rightarrow u^2 = 6$ $uv = 3.5$ $v = \frac{3.5}{\sqrt{6}}$ $= 1.43$ (ii) $m = \frac{8-2}{8-0} = 0.75$ $c = 8.0$ $Y = 0.75X + 8$ $uv = 0.75u^2 + 8$ $v = 0.75u + \frac{8}{u}$	5 5	**10**
11	(*a*) $\sin \angle AOX = \frac{5}{8}$ $\angle AOX = 0.675$ rad (Tertunjuk/*Shown*) (*b*) $\angle AOB = 1.350$ rad $\angle OAX = \angle OBX = \frac{3.142 - 1.350}{2} = 0.896$ $\angle CBX = \angle DAX$ $= 3.142 - 0.896$ $= 2.246$ rad	2	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Perimeter $= 2[13(1.350) + 2(5)(2.246)]$ $= 80.02$ cm	4	
	(*c*) Luas segi tiga *OAB*/*Area of triangle OAB* $= 2 \times \frac{1}{2}(5)\left(\sqrt{8^2 - 5^2}\right)$ $= 31.225$ Luas sektor *OFE* *Area of sector OFE* $= \frac{1}{2}(13)^2(1.350)$ $= 114.075$ cm^2 Luas sektor *EAX* = Luas sektor *FBX* *Area of sector EAX = Area of sector FBX* $= \frac{1}{2}(5)^2(2.246)$ $= 28.075$ cm^2 Luas kawasan berlorek *Area of shaded region* $= 2[114.075 - 31.225 - 2(28.075)]$ $= 53.40$ cm^2	4	**10**
12	(*a*) I: $x + y \leq 65$ II: $y \leq 8x$ III: $y - x > 30$	3	
	(*b*) 	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) (i) Apabila/*When* $x = 8$, $39 \le y \le 57$ atau/*or* $38 < y \le 57$ (ii) $120x + 80y = k$ Katakan/*Let* $k = 960$ $120x + 80y = 960$ $3x + 2y = 24$ Kos minimum/*Minimum cost* $= 120(5) + 80(36)$ = RM3 480	4	**10**
13	(*a*) $\frac{x}{3.60} \times 100 = 125$ x = RM4.50 $\frac{6.60}{y} \times 100 = 110$ y = RM6.00 $z = \frac{4.60}{4.00} \times 100$ $= 115$	3	
	(*b*) $\bar{I}_{2020/2018} = \frac{(120 \times 5) + (125 \times 3) + (110 \times 2) + (115 \times 4)}{5 + 3 + 2 + 4}$ $= 118.21$ Peratus peningkatan bagi kos ialah 18.21%. *The increase in percentage for the cost is* 18.21%.	3	
	(c) $\left(I_{2021/2020}\right)_A = 108.33$, $\left(I_{2021/2020}\right)_B = 104$, $\left(I_{2021/2020}\right)_C = 118.18$, $\left(I_{2021/2020}\right)_D = 113.04$ $\bar{I}_{2021/2020} = \frac{(108.33 \times 5) + (104 \times 3) + (118.18 \times 2) + (113.04 \times 4)}{5 + 3 + 2 + 4}$ $= 110.16$ $\frac{\bar{Q}_{2021}}{40} \times 100 = 110.16$ $\bar{Q}_{2021}$ = RM 44.06	4	**10**
14	(*a*) (i) $8.3^2 = 5.1^2 + 11.9^2 - 2(5.1)(11.9)\ \text{kos}/\cos \angle SQR$ $\angle SQR = 35.57°$	4	
	(ii) $\frac{11.9}{\sin 65°} = \frac{PS}{\sin 79.43°}$ PS = 12.907 cm		
	(*b*) $s = \frac{5.1 + 8.3 + 11.9}{2} = 12.65$ Luas ΔQRS /*Area of* ΔQRS $= \sqrt{12.65(12.65 - 5.1)(12.65 - 8.3)(12.65 - 11.9)}$ $= 17.652\ \text{cm}^2$ Luas ΔPQS /*Area of* $\Delta PQS = \frac{12.907}{5.1} \times 17.652$ $= 44.67\ \text{cm}^2$	4	

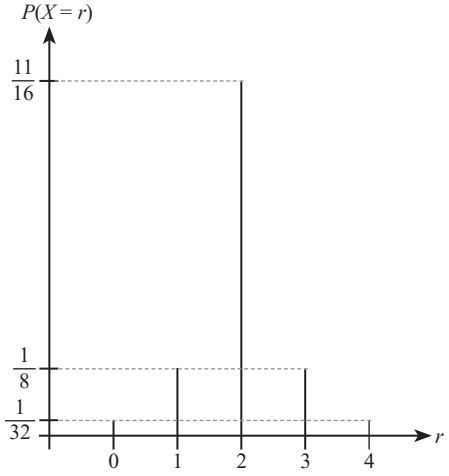
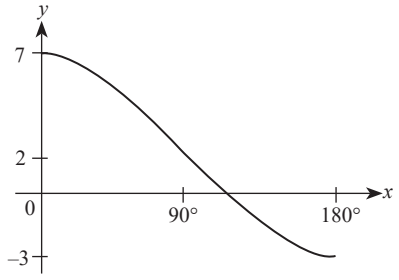
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*)  $\angle S'Q'R' = 180° - 35.57° = 144.43°$	2	**10**
15	(*a*) $\frac{d}{dt}(t^2 - 6t + 5) = 0$ $2t - 6 = 0$ $t = 3$ s $v = (3)^2 - 6(3) + 5$ $= -4$ m s^{-1}	3	
	(*b*) $t^2 - 6t + 5 < 0$ $(t - 1)(t - 5) < 0$ $1 < t < 5$	2	
	(*c*) $a < 0$ $2t - 6 < 0$ $t < 3$ s Jumlah jarak/*Total distance* $= \int_0^1 (t^2 - 6t + 5)\,dt + \left\lvert \int_1^3 (t^2 - 6t + 5)\,dt \right\rvert$ $= \left[\frac{t^3}{3} - 3t^2 + 5t\right]_0^1 + \left\lvert \left[\frac{t^3}{3} - 3t^2 + 5t\right]_1^3 \right\rvert$ $= 7\frac{2}{3}$ m	5	**10**

KERTAS 1

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) $T(x, y) \rightarrow (x + y, x - 2y)$ $T(2, 1) = (2 + 1, 2 - 2)$ $= (3, 0)$ $T(3, 0) = (3 + 0, 3 - 0)$ $= (3, 3)$	2	
	(*b*) $T(x, y) = (1, 7)$ $x + y = 1$ $x = 1 - y$ $x - 2y = 7$ $1 - y - 2y = 7$ $-3y = 6$ $y = -2$ $x = 1 - (-2)$ $= 3$ $\therefore D(3, -2)$	2	**4**
2	(*a*) $\lvert x^2 - 3x - 7\rvert \leq 3$ $-3 \leq x^2 - 3x - 7 \leq 3$ $x^2 - 3x - 7 \leq 3$ $x^2 - 3x - 10 \leq 0$ $-2 \leq x \leq 5$ $x^2 - 3x - 7 \geq -3$ $x^2 - 3x - 4 \geq 0$ $x \leq -1, x \geq 4$	3	
	(*b*) $\frac{1}{2}x^2 + qx + q = 0$ $q^2 - 4\left(\frac{1}{2}\right)(q) < 0$ $q^2 - 2q < 0$ $q(q - 2) < 0$ $0 < q < 2$ (Terbukti/*Shown*)	3	**6**
3	(*a*) $n = \frac{3 - 1}{0 - 4} = -\frac{1}{2}$ $y = kx^n$ $\log_{10} y = \log_{10} k + n \log_{10} x$ $\log_{10} k = 3$ $k = 1\,000$	3	
	(*b*) $\frac{\log_{10} y - 3}{\log_{10} y - 0} = -\frac{1}{2}$ $2 \log_{10} y - 6 = -\log_{10} y$ $3 \log_{10} y = 6$ $\log_{10} y = 2$ $y = 10^2$ $= 100$	2	**5**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	(*a*) $a + 17d = 2(a + 8d)$ $d = a$ $\frac{S_{18}}{S_9} = \frac{\frac{18}{2}(2a + 17d)}{\frac{9}{2}(2a + 8d)}$ $= \frac{9(2a + 17d)}{9(2a + 4d)}$ $= \frac{19a}{5a}$ $= \frac{19}{5}$	3	
	(*b*) $S_{10} = \frac{10}{2}(T_{21} + T_{30}) = 675$ $\frac{10}{2}[a + 20d + a + 29d] = 675$ $2a + 49d = 135$ ……① $T_{10} = 21$ $a + 9d = 21$ (×2) $2a + 18d = 42$ ……② ① – ② : $31d = 93$ $d = 3$ $a + 9d = 21$ $a + 9(3) = 21$ $a = -6$ $S_{10} = \frac{10}{2}2(-6) + 9(3) = 75$	3	**6**
5	(*a*) ${}^6C_4 \times {}^5C_3 \times 7!$ $= 756\,000$	2	
	(*b*) ${}^6C_4 \times {}^5C_3 \times 4! \times 4!$ $= 86\,400$	2	
	(*c*) ${}^6C_4 \times {}^5C_3 \times 3! \times 4! \times {}^5C_3$ $= 21\,600$	2	**6**
6	Biarkan/*Let* $\log_a b = x$ $b = a^x$ $\log b = x \log a$ $x = \frac{\log b}{\log a}$ $\log_a b = \frac{\log b}{\log a}$ (Terbukti/*Shown*) $\log_2 5 \times \log_{11} 4 \times \log_5 11$ $= \frac{\log_{10} 5}{\log_{10} 2} \times \frac{\log_{10} 4}{\log_{10} 11} \times \frac{\log_{10} 11}{\log_{10} 5}$ $= 2$	6	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
7	$\frac{1}{2}(AT)(10) = 60$ $AT = 12$ cm $\tan \angle AOT = \frac{12}{10}$ $\angle AOT = 50.19°$ $= 50.19 \times \frac{\pi}{180°}$ $= 0.876$ rad Luas sektor / *Area of sector AOB* $= \frac{1}{2}(10)^2(0.876)$ $= 43.80$ cm^2	6	**6**
8	$y = \frac{k}{x^2} + h$ $3 = \frac{k}{1^2} + h$ $k + h = 3$ ..... ① $\frac{\int_1^2 (kx^{-2} + h)\,dx}{\int_2^4 (kx^{-2} + h)\,dx} = \frac{3}{4}$ $4\left[-\frac{k}{x} + hx\right]_1^2 = 3\left[-\frac{k}{x} + hx\right]_2^4$ $4\left[\left(-\frac{k}{2} + h(2)\right) - \left(-\frac{k}{1} + h(1)\right)\right] = 3\left[\left(-\frac{k}{4} + h(4)\right) - \left(-\frac{k}{2} + h(2)\right)\right]$ $2k + 4h = \frac{3k}{4} + 6h$ $h = \frac{5k}{8}$ ..... ② Gantikan ② dalam ① *Substitute ② into ①* $k + \frac{5k}{8} = 3$ $k = \frac{24}{13}$ $\frac{24}{13} + h = 3$ $h = \frac{15}{13}$	6	**6**
9	(*a*) $P(X < 58)$ $= P\left(Z < \frac{58 - 54}{7}\right)$ $= P(Z < 0.571)$ $= 0.716$	1	**1**

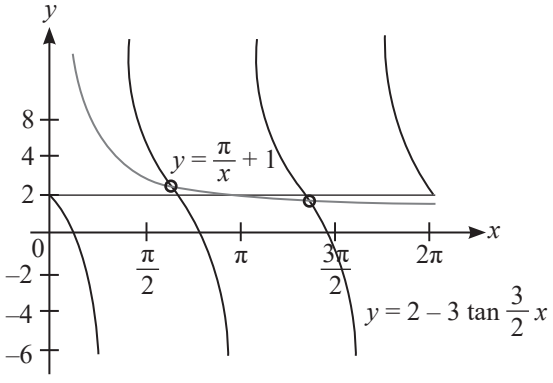
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $P(X-2) = 1 - \frac{2}{32} - \frac{2}{8}$ $= \frac{11}{16}$  	3	**4**
10	(*a*) $a = 2$ $b = 4$ $c = \frac{1}{2}$ (*b*)  	3 3	**6**
11	(*a*) Luas/*Area* $= \frac{1}{2}\begin{vmatrix} 0 & -3 & 6 & 0 \\ 0 & -4 & 2 & 0 \end{vmatrix} - 24$ $= \frac{1}{2}\lvert 0 + (-6) + 0 - [0 + (-24) + 0] \rvert$ $= \frac{1}{2}\lvert 18 \rvert$ $= 9$ unit^2/*units*^{2} (*b*) $x = \frac{2(-3) + 3(6)}{5}$ $= \frac{12}{5}$ $y = \frac{3(2) + 2(-4)}{5}$ $= -\frac{2}{5}$ $\therefore C\left(\frac{12}{5}, -\frac{2}{5}\right)$	2 2	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) $PA = 2PB$ $\sqrt{(x+3)^2 + (y+4)^2} = 2\sqrt{(x-6)^2 + (y-2)^2}$ $x^2 + 6x + 9 + y^2 + 8y + 16 = 4x(x^2 - 12x + 36 + y^2 - 4y + 4)$ $3x^2 + 3y^2 - 54x - 24y + 135 = 0$ $x^2 + y^2 - 18x - 8y + 45 = 0$	2	**6**
12	$h - k + 1 = 0$, $h = k - 1$ ..... ① $3h + k = 0$ ..... ② Gantikan ① dalam ② *Substitute* ① *into* ② $3(k-1) + k = 0$ $3k - 3 + k = 0$ $4k = 3$ $k = \frac{3}{4}$ ..... Gantikan dalam / *Substitute into* ① $h = \frac{3}{4} - 1$ $= -\frac{1}{4}$	3	**3**
13	(*a*) $3kx + 2y - 6z = 2$ ..... ① $qx + 2y - 8z = 7$ ..... ② $3x - 2z = 12$ ..... ③ ② – ① : $(q - 3k)x - 2z = 5$ ..... ④ ③ – ④ : $3 - (q - 3k) = 7$ $-q + 3k = 4$ $-q = 4 - 3k$ $q = 3k - 4$ (*b*) $\sqrt{k+1} + \sqrt{k-4} = \sqrt{2k+9}$ $[(\sqrt{k+1}) + (\sqrt{k-4})]^2 = (\sqrt{2k+9})^2$ $(k+1) + (k-4) + 2\sqrt{k+1}\sqrt{k-4} = 2k + 9$ $2k - 3 + 2\sqrt{(k+1)(k-4)} = 2k + 9$ $2\sqrt{(x+1)(x-4)} = 12$ $4(k+1)(k-4) = 144$ $(k+1)(k-4) = 36$ $k^2 - 3k - 4 = 36$ $k^2 - 3k - 40 = 0$ $(k-8)(k+5) = 0$ $k = 8, k = -5$ $\therefore k = 8$	5 3	**8**
14	(*a*) (i) $y = \frac{1}{x} + 2\sqrt{x}$ $= x^{-1} + 2x^{\frac{1}{2}}$ $\frac{dy}{dx} = -\frac{1}{x^2} + 2\left(\frac{1}{2}\right)x^{-\frac{1}{2}}$ $= -\frac{1}{x^2} + \frac{1}{\sqrt{x}}$		

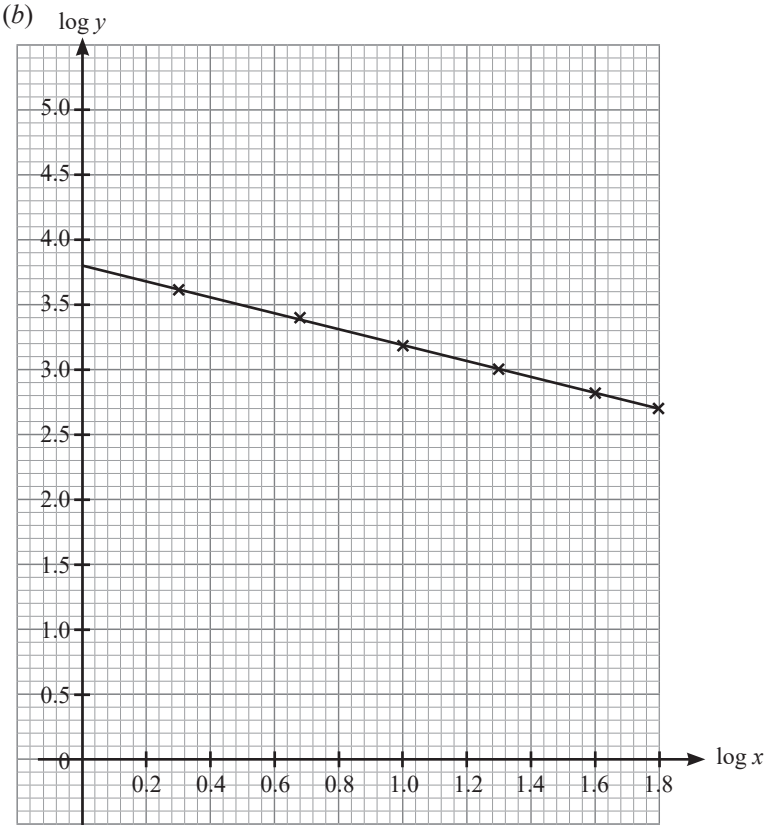
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(ii) $\frac{dy}{dx} = -x^{-2} + x^{-\frac{1}{2}}$ $\frac{d^2y}{dx^2} = 2x^{-3} - \frac{1}{2}x^{-\frac{3}{2}}$ $= \frac{2}{x^3} - \frac{1}{2x^{\frac{3}{2}}}$	4	
	(*b*) $-\frac{1}{x^2} + \frac{1}{x^{\frac{1}{2}}} = 0$ $\frac{-1 + x^{\frac{3}{2}}}{x^2} = 0$ $x^{\frac{3}{2}} = 1$ $x = (1)^{\frac{2}{3}}$ $x = 1$ Gantikan $x = 1$ dalam $y = \frac{1}{x} + 2\sqrt{x}$ *Subsitute* $x = 1$ *into* $y = \frac{1}{x} + 2\sqrt{x}$ $y = \frac{1}{1} + 2 = 3$ Titik pusingan / *Turning Point* = (1, 3) Gantikan / *Subsitute* $x = 1$ dalam / *into* $\frac{d^2y}{dx^2}$ $\frac{d^2y}{dx^2} = \frac{2}{1} - \frac{1}{2} = \frac{3}{4}$ $\frac{d^2y}{dx^2} > 0$ (1, 3) ialah titik minimum/(1, 3) *is a minimum point.*	4	**8**
15	(*a*) $y = \frac{1}{2}[(x+4)^2 + (x-2)^2]$ $= \frac{1}{2}(x^2 + 8x + 16 + x^2 - 4x + 4)$ $= \frac{1}{2}(2x^2 + 4x + 20)$ $= x^2 + 2x + 10$ $= (x+1)^2 - 1 + 10$ $= (x+1)^2 + 9$ Titik minimum ialah (–1, 9)/*The minimum point is* (–1, 9)	5	
	(*b*) $3x^2 - 4x + 5 = 0$ $\alpha + \beta = \frac{4}{3}$ $\alpha\beta = \frac{5}{3}$ $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ $= \left(\frac{4}{3}\right)^2 - 2\left(\frac{5}{3}\right)$ $= \frac{16}{9} - \frac{10}{3}$ $= \frac{16 - 30}{9}$ $= -\frac{14}{9}$	3	**8**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) $y = 8x^{-2}$ $\frac{dy}{dx} = -\frac{16}{x^3}$ $y = 1$ $x^2 = 8$ $x = \sqrt{8}$ $\frac{\delta y}{dx} = \frac{dy}{dx}$ $\frac{h}{\delta x} = -\frac{16}{8\sqrt{8}}$ $= -\frac{16}{16\sqrt{2}}$ $\delta x = -\sqrt{2}h$ (*b*) $y = (x+1)^2$ $y = x^2 + 2x + 1$ $\delta y + y = (x + \delta x)^2 + 2(x + \delta x) + 1$ $\delta y + x^2 + 2x + 1 = x^2 + 2\delta x(x) + (\delta x)^2 + 2x + 2\delta x + 1$ $\delta y = 2\delta x(x) + (\delta x)^2 + 2\delta x$ $\frac{\delta y}{\delta x} = 2x + \delta x + 2$ $\frac{dy}{dx} = \lim_{\delta x \to 0} \frac{\delta y}{\delta x}$ $= \lim_{\delta x \to 0} (2x + \delta x + 2) = 2x + 2$	3 3	**6**
2	(*a*) $b^2 - 4ac < 0$ $(-4)^2 - 4(-1)c < 0$ $16 + 4c < 0$ $c < -4$ (*b*) $y = x^2 + (k-1)x - k$ $y = 0$, $b^2 - 4ac = 0$ $(k-1)^2 - 4(1)(-k) = 0$ $k^2 - 2k + 1 + 4k = 0$ $k^2 + 2k + 1 = 0$ $(k+1)^2 = 0$ $k = -1$	3 3	**6**
3	$6 + 66 + 666 + 6666 + ...$ $\frac{2}{3}[9 + 99 + 999 + ...]$ $S_n = \frac{2}{3}[(10-1) + (10^2 - 1) + ... (10^n - 1)]$ $= \frac{2}{3}[10^1 + 10^2 + 10^3 + ... + 10^n] + \frac{2}{3}[-1 - 1 - 1 ..... - 1]$ $= \frac{2}{3}(10)\left(\frac{10^n - 1}{10 - 1}\right) - \frac{2}{3}n$ $= \frac{20}{27}(10^n - 1) - \frac{2}{3}n$	7	**7**

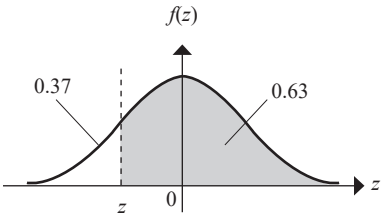
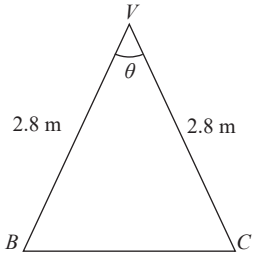
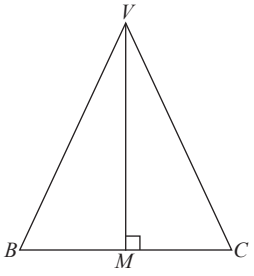
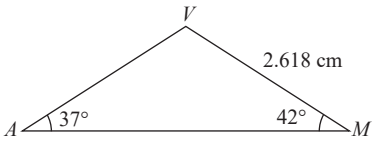
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	(*a*) $s = \theta r$ $6.2 = \theta \times 5$ $\theta = 1.24$ rad $\angle BAD = \frac{1}{2}(1.24) = 0.62$ $\sin 0.62 = \frac{BD}{5}$ $BD = 5 \sin 0.62$ $= 2.905$ cm $s = \theta r$ $= (2.905)(\pi)$ $= 9.126$ cm Perimeter $= 9.126 + 6.2$ $= 15.326$ cm	4	
	(*b*) Luas semi bulatan *BCF*/*Area of semicircle BCF* $= \frac{1}{2}\pi r^2$ $= \frac{1}{2}\pi(2.905)^2$ $= 13.256$ cm Luas segmen *BCE*/*Area of segment BCE* $= \frac{1}{2}r^2(\theta - \sin\theta)$ $= \frac{1}{2}(5)^2(1.24 - \sin 1.24)$ $= 3.678$ cm Luas kawasan berlorek/*Area of shaded region* $= 13.256 - 3.678$ $= 9.578$ cm	3	**7**
5	(*a*) $\overrightarrow{AB} = \underset{\sim}{b} - \underset{\sim}{a}$ $\overrightarrow{AD} = \frac{1}{2}\underset{\sim}{b} - \frac{1}{2}\underset{\sim}{a}$ $\overrightarrow{OD} = \overrightarrow{OA} + \overrightarrow{AD}$ $= \underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b} - \frac{1}{2}\underset{\sim}{a}$ $= \frac{1}{2}\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b}$ $\overrightarrow{OM} = \overrightarrow{POD}$ $= p\left(\frac{1}{2}\underset{\sim}{a} + \frac{1}{2}\underset{\sim}{b}\right)$ $= \frac{1}{2}p\underset{\sim}{a} + \frac{1}{2}p\underset{\sim}{b}$ $\overrightarrow{BC} = \frac{2}{3}\underset{\sim}{a} - \underset{\sim}{b}$ $\overrightarrow{BM} = q\overrightarrow{BC}$ $= q\left(\frac{2}{3}\underset{\sim}{a} - \underset{\sim}{b}\right)$ $\overrightarrow{OM} = \overrightarrow{OB} + \overrightarrow{BM}$ $= \underset{\sim}{b} + q\left(\frac{2}{3}\underset{\sim}{a} - \underset{\sim}{b}\right)$ $= (1 - q)\,\underset{\sim}{b} + \frac{2}{3}q\underset{\sim}{a}$	5	

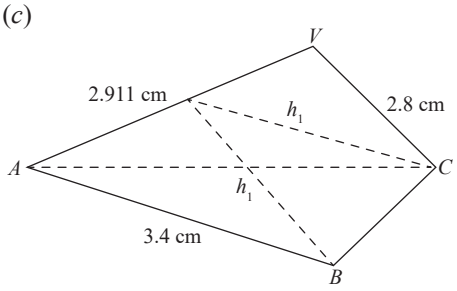
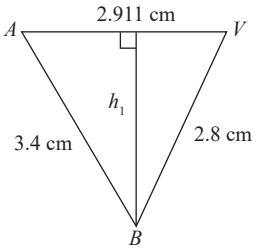
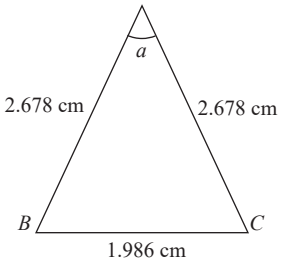
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $\frac{1}{2}p = \frac{2}{3}q$ $p = \frac{4}{3}q$ ..... ① $\frac{1}{2}p = 1 - q$ ..... ② Gantikan ① dalam ② *Subsitute* ① *into* ② $\frac{1}{2}\left(\frac{4}{3}q\right) = 1 - q$ $\frac{5}{3}q = 1$ $q = \frac{3}{5}$ $p = \frac{4}{3}\left(\frac{3}{5}\right)$ $= \frac{4}{5}$	3	**8**
6	$f(x) = \frac{x}{x+1}$ $f^2(x) = \frac{\frac{x}{x+1}}{\frac{x}{x+1}+1}$ $= \frac{x}{2x+1}$ $f^3(x) = f[f^2(x)]$ $= f\left(\frac{x}{2x+1}\right)$ $= \frac{x}{3x+1}, x \neq -\frac{1}{3}$ $f^n(x) = \frac{x}{nx+1}, x \neq -\frac{1}{n}$	7	**7**
7	(*a*) & (*b*)  x | $\frac{\pi}{2}$ | π | 2π y | 3 | 2 | $\frac{3}{2}$ 2 penyelesaian/*solutions*	4	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$\frac{\pi}{x} + 3\tan\frac{3}{2}x = 1$ $\frac{\pi}{x} + 1 + 3\tan\frac{3}{2}x = 2$ $\frac{\pi}{x} + 1 = 2 - 3\tan\frac{3}{2}x$ $y = \frac{\pi}{x} + 1$	4	**8**
8	(*a*) $\frac{y-8}{y-9} = \frac{8-2}{9+3}$ $\frac{y-8}{y-9} = \frac{6}{12}$ $2y - 16 = y - 9$ $y = 7$ Pintasan-*y*/ *y-intercept* = 7	1	
	(*b*) Titik tengah *AB* / *Midpoint of AB* $= \left(\frac{-3+9}{2}, \frac{2+8}{2}\right) = (3, 5)$	1	
	(*c*) $m_1 m_2 = -1$, $\frac{1}{2}m_2 = -1$ $m_2 = -2$ $y - 5 = -2(x - 3)$ $y = -2x + 11$	2	
	(*d*) (i) $E(0, 11)$ (ii) Luas *ABE* / *Area ABE* $= \frac{1}{2}\begin{vmatrix} -3 & 9 & 0 & -3 \\ 2 & 8 & 11 & 2 \end{vmatrix}$ $= \frac{1}{2}\lvert -24 + 99 + 0 - 18 - 0 + 33 \rvert$ $= \frac{1}{2}\lvert 90 \rvert$ $= 45$ unit^2 / *units*^{2} Luas *ECD* / *Area ECD* $= \frac{1}{2}\begin{vmatrix} 0 & 3 & 0 & -3 \\ 7 & 5 & 11 & 7 \end{vmatrix}$ $= \frac{1}{2}\lvert 0 + 33 + 0 - 21 - 0 + 33 \rvert$ $= \frac{45}{2}$ unit^2 / *units*^{2} $\frac{\text{Luas } ABE \text{ / } Area\ ABE}{\text{Luas } ECD \text{ / } Area\ ECD} = \frac{45}{\left(\frac{45}{2}\right)}$ Luas *ABE* = 2 kali luas *ECD* *Area ABE* = 2 *times area ECD*	4	**8**

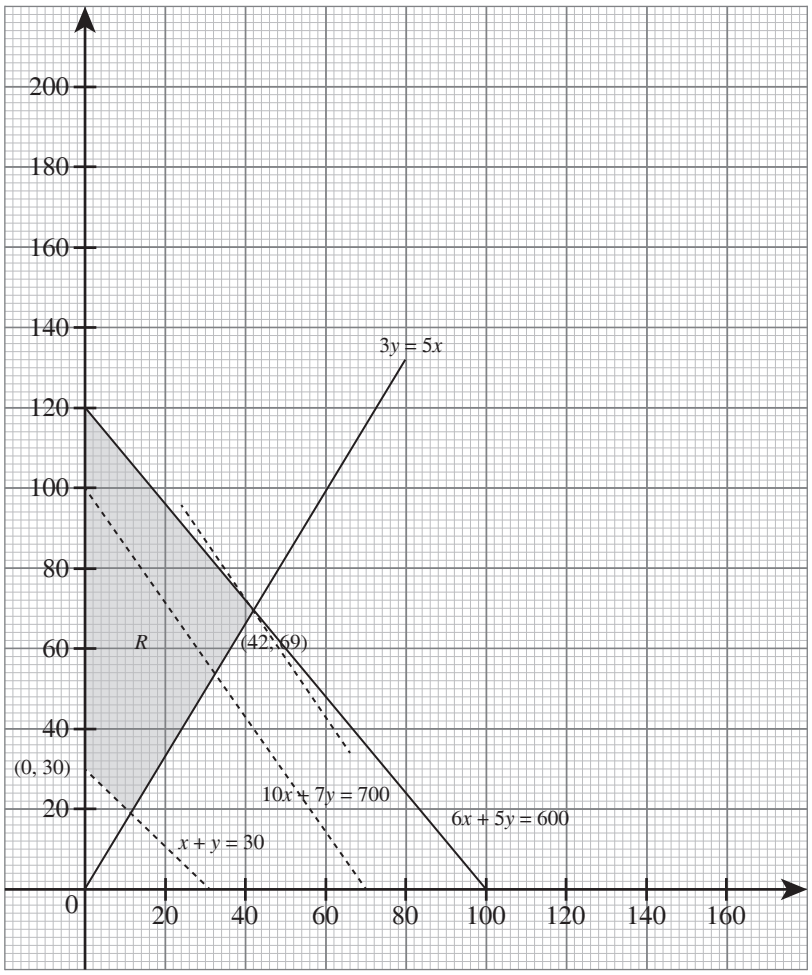
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
9	(*a*) | log x | 0.301 | 0.699 | 1.000 | 1.301 | 1.602 | 1.778 | | log y | 3.615 | 3.400 | 3.203 | 2.993 | 2.775 | 2.667 |	2	
	(*b*)  	4	
	(*c*) $y = k\,x^n$ $\log y = \log k + \log x^n$ $\log y = \log k + n \log x$ n = kecerunan / *gradient* $= \dfrac{2.993 - 2.667}{1.301 - 1.778}$ $= -0.683$ $\log k$ = pintasan-y/ *y-intercept* $= 3.8$ $k = 6\,310$	2	**8**
10	(*a*) Isi padu / *Volume A* $= \int_{-1}^{1} \pi y^2\,dx$ $= \int_{-1}^{1} \pi(x + 1)\,dx$ $= \pi\left[\dfrac{x^2}{2} + x\right]_{-1}^{1}$ $= \pi\left(\dfrac{3}{2}\right) - \pi\left(-\dfrac{1}{2}\right)$ $= 2\pi$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Isi padu / *Volume* $B = \frac{1}{3}(2\pi)$ $\pi\left[\frac{x^2}{2}+x\right]_1^k = \frac{2}{3}\pi$ $\left(\frac{k^2}{2}+k\right)-\left(\frac{3}{2}\right)=\frac{2}{3}$ $3k^2+6k-9=4$ $3k^2+6k-13=0$ $k=\frac{-6\pm\sqrt{36-4(3)(-13)}}{3}$ $=\frac{-6\pm\sqrt{192}}{6}$ $k>0, k=\frac{-6\pm\sqrt{192}}{6}$ $=\frac{-3+4\sqrt{3}}{3}$ (*b*) (i) $\frac{1}{2}(6)=3$ (ii) $[3x]_0^4-6$ $=12-0-6$ $=6$	6 2	**8**
11	(*a*) (i) $X = B(n, p)$ $np = 40, \quad npq = 15$ $40q = 15$ $q = 0.375$ $p = 1 - 0.375$ $= 0.625$ (ii) X = ciku yang elok /*cikus that are good* $p=\frac{3}{5}=0.6, \quad q=\frac{2}{5}=0.4, \quad n=8,$ $P(X\geq 2)$ $= 1 - P(X=0) - P(X=1)$ $= 1 - {}^8C_0(0.6)^8(0.4)^0 - {}^8C_1(0.6)^7(0.4)^1$ $= 1 - 0.0168 - 0.0896$ $= 0.8936$ (*b*) X = markah / *marks*, $X = N(45, 12^2)$ (i) $P(40 < X < 60)$ $= P\left(\frac{40-45}{12} < Z < \frac{60-45}{12}\right)$ $= (-0.417 < Z < 1.25)$ $= 1 - A(0.417) - A(1.25)$ $= 1 - 0.3384 - 0.1056$ $= 0.556$ Bilangan murid *Number of students* $= 40(0.556)$ $= 22.24$ $= 22$	4	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(ii) $P(Z > z) = 0.63$  $P(Z > z) = 0.37$ $z = 0.332$ $= -0.332$ $X = 41.02$ Markah lulus / *Passing grade* $= 41$	4	**8**
12	(*a*)  $\frac{1}{2}(2.8)^2 \sin\theta = 2.6$ $\theta = 41.55°$ $BC = 2(2.8)\sin\left(\frac{41.55}{2}\right)$ $= 1.986$ m (*b*)   $\frac{VA}{\sin 42} = \frac{2.618}{\sin 37}$ $VA = 2.911$ m $\frac{1}{2}(VM)(1.986) = 2.6$ $VM = 2.618$ m	2 3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*)   $s = \frac{3.4 + 2.911 + 2.8}{2}$ $= 4.5555$ m Luas *VAB* / *Area VAB* $= \sqrt{(4.5555)(1.1555)(1.6445)(1.7555)}$ $= 3.898$ m^2 $\frac{1}{2}(2.911)(h_1) = 3.898$ $h_1 = 2.678$ m $h_1 = h_2 = 2.678$ m  $1.986^2 = 2.678^2 + 2.678^2 - 2(2.678)^2$ kos/cos α kos/cos α = 0.7250 α = 43.53°	5	**10**
13	(*a*) (i) $y = 130$ (ii) $\frac{3.90}{x} \times 100 = 130$ $x =$ RM3.00 $z = \frac{4.80}{3.20} \times 100$ $= 150$ (*b*) $I = \frac{108(6) + 130(5) + 170(3) + 150(1)}{6 + 5 + 3 + 1}$ $= 130.5$ (*c*) (i) $160 = \frac{130.5 \times I}{100}$ $I = 122.6$ (ii) $112.6 = \frac{Q_1}{2.40} \times 100$ $Q_1 =$ RM2.94	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Bahagian maksimum bahan pencuci yang boleh dihasilkan *Maximum number of detergent that can be produced* $= \frac{\text{RM195 000}}{\text{RM2.94}}$ = 66 327 botol/*bottles*	5	**10**
14	(*a*) $v = 3t^2 - 15t + 12$ $3t^2 - 15t + 12 > 0$ $t^2 - 5t + 4 > 0$ $(t - 1)(t - 4) > 0$ $0 \le t < 1$ saat / *second* $t > 4$ s	4	
	(*b*) $a = 6t - 15$ $6t - 15 > 0$ $t > \frac{5}{2}$ s	3	
	(*c*) $v = 0$ $t = 1$ s $\quad t = 4$ s $s = \int(3t^2 - 15t + 12)\, dt$ $= t^3 - \frac{15}{2}t^2 + 12t + c$ $t = 0, \quad s = 0, \quad c = 0$ Jarak antara *A* dan *B* *Distance between A and B* $= \left\|(1 - \frac{15}{2} + 12) - (64 - 120 + 48)\right\|$ $= \|5.5 - (-8)\|$ $= \|13.5\|$ = 13.5 m	3	**10**
15	(*a*) I: $x + y > 30$ II: $6x + 5y \le 600$ III: $5x \le 3y$	3	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*)  	3	
	(*c*) Katakan/*Let k* = 700 Apabila/*when* (0, 30) Jualan / *Sales* = 10(0) + 7(30) = RM210 Apabila/*When* (42, 69) Jualan / *Sales* = 10(42) + 7(69) = RM903 Julat jualan, *J* / *Range of sales*, *J*: $210 < J \leq 903$	4	**10**

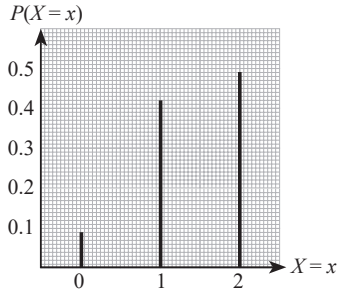
KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) (i) $\{1, 2, 3, 4, 5\}$ (ii) 2, 4, 8	1 1	
	(*b*) **(i)** $f(0) = h$ $\lvert 5 - 0\rvert = h$ $h = 5$ $f\left(\frac{5}{8}\right) = 0$ $\left\lvert 5 - \frac{5}{8}k\right\rvert = 0$ $5 - \frac{5}{8}k = 0$ $-\frac{5}{8}k = -5$ $k = 8$ **(ii)** $0 \leqslant f(x) \leqslant 13$ **(iii)** $f(x)$ mempunyai fungsi songsang kerana fungsi ini mempunyai hubungan satu kepada satu. *$f(x)$ has an inverse function because it is one-to-one relation.*	 1 1 1 1 1	**7**
2	(*a*) $\mathbf{1 - 6x = 0}$ $x = \frac{1}{6}$	1	
	(*b*) **Anggap** / *Let* $y = f^{-1}(x)$ $f(y) = x$ $\frac{p}{1 - 6y} = x$ $p = x(1 - 6y)$ $p = x - 6xy$ $6xy = x - p$ $y = \frac{x - p}{6x}$ $y = \frac{1}{6} - \frac{p}{6x}$ $f^{-1}(x) = \frac{1}{6} - \frac{p}{6x}$ Maka / *Then*, $-\frac{p}{6} = -\frac{2}{q}$ $\frac{p}{6} = \frac{2}{q}$ $p = \frac{12}{q}$	 1 1 1	**4**
3	$y = 3(x - b)^2 + a$ $y = 3(x - b)(x - b) + a$ $y = 3(x^2 - bx - bx + b^2) + a$ $y = 3(x^2 - 2bx + 3b^2) + a$ $y = 3x^2 - 6bx + 3b^2 + a$	 1	

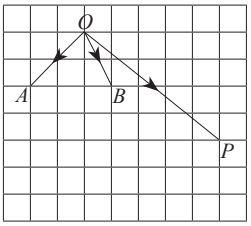
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	Guna / *Use* $b^2 - 4ac > 0$ $(-6b)^2 - 4(3)(3b^2 + a) > 0$ $36b^2 - 36b^2 - 12a > 0$ $-12a > 0$ $a < \frac{0}{-12}$ $a < 0$; tertunjuk / *shown*	1 1	**3**
4	(*a*) $(x-3)^2 = x - 5$ $x^2 - 6x + 9 - x + 5 = 0$ $x^2 - 7x + 14 = 0$ $b^2 - 4ac = (-7)^2 - 4(1)(14)$ $= -7 < 0$ $\therefore b^2 - 4ac < 0$ (Tiada punca nyata / *No real roots*)	 1 1	
	(*b*) $x(x-m) = 3 - k$ $x^2 - mx + k - 3 = 0$ Punca / *Roots*: α, $\alpha + 8$ HTP / *SOR*: $\alpha + (\alpha + 8) = -\left(-\frac{m}{1}\right)$ $2\alpha + 8 = m$ $\alpha = \frac{m-8}{2}$ HDP / *POR*: $\alpha(\alpha + 8) = \frac{k-3}{1}$ $\alpha^2 + 8\alpha = k - 3$ $\left(\frac{m-8}{2}\right)^2 + 8\left(\frac{m-8}{2}\right) - k + 3 = 0$ $\frac{m^2 - 16m + 64}{4} + 4m - 32 - k + 3 = 0$ $m^2 - 4k - 52 = 0$ $m = \pm\sqrt{52 + 4k}$	 1 1 1 1	**6**
5	(*a*) $x \log_{27} p = \log_3 p$ $\log_{27} p^x = \log_3 p$ $\frac{\log_3 p^x}{\log_3 27} = \log_3 p$ $\frac{\log_3 p^x}{\log_3 3^3} = \log_3 p$ $\frac{\log_3 p^x}{3\log_3 3} = \log_3 p \ldots$ $\frac{\log_3 p^x}{3\log_3 3} = \log_3 p$ $\log_3 p^x = 3\log_3 p$ $p^x = p^3$ $x = 3$	 1 1 1	
	(*b*) $3^{2h-4m} = 5 + 3^{3(2h)}$ $\frac{3^{2h}}{3^{4m}} = 5 + (3^{2h})^3$ $\frac{k}{p} = 5 + k^3 \ldots$ $\frac{k}{5 + k^3} = p$	1 1 1	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
6	$y = an^x$ $\log_2 y = \log_2 an^x$ $\log_2 y = \log_2 a + \log_2 n^x$ $\log_2 y = (\log_2 n)x + \log_2 a$ $Y = \quad m \quad X + c$ Kecerunan / *Gradient*: $\log_2 n = \dfrac{10 - 4}{3 - 1}$ $\log_2 n = 3$ $n = 2^3$ $n = 8$ Pada / *At* (1, 4); $4 = 3(1) + c$ $c = 1$ $\log_2 a = 1$ $a = 2$	 1 1 1 1 1	**5**
7	(*a*) Bilangan digit / *Number of digits* = 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 $= 10$ ${}^{10}P_4 = 5\,040$	1	
	(*b*) ${}^4C_2 \times {}^2P_2 \times {}^3P_1$ $= {}^4C_2 \times {}^2P_2 \times {}^3P_1 \times 6 \times 6$ $= 1\,296$	1 1 1	**4**
8	(*a*) $\delta y = [2(x + \delta x) - (x + \delta x)^2] - (2x - x^2)$ $\delta y = 2x + 2\delta x - (x + \delta x)(x + \delta x) - 2x + x^2$ $\delta y = 2x + 2\delta x - [x^2 + x\delta x + x\delta x + (\delta x)^2] - 2x + x^2$ $\delta y = 2x + 2\delta x - [x^2 + 2x\delta x + (\delta x)^2] - 2x + x^2$ $\delta y = 2x + 2\delta x - x^2 - 2x\delta x - (\delta x)^2 - 2x + x^2$ $\delta y = 2\delta x - 2x\delta x - (\delta x)^2$ $\dfrac{\delta y}{\delta x} = 2 - 2x - \delta x$ $\dfrac{dy}{dx} = \lim\limits_{\delta x \to 0} 2 - 2x - \delta x$ $\dfrac{dy}{dx} = 2 - 2x$	1 1 1	
	(*b*) **(i)** Katakan / *Let* $u = 12\,000t$, Katakan / *Let* $v = 1 + t^3$ $\dfrac{du}{dt} = 12\,000$ $\quad \dfrac{dv}{dt} = 3t^2$ $\dfrac{dP}{dt} = \dfrac{v\dfrac{du}{dt} - u\dfrac{dv}{dt}}{v^2}$ $\dfrac{dP}{dt} = \dfrac{(1 + t^3)(12\,000) - 12\,000t(3t^2)}{(1 + t^3)^2}$ $\dfrac{dP}{dt} = \dfrac{12\,000 + 12\,000t^3 - 36\,000t^3}{(1 + t^3)^2}$ $\dfrac{dP}{dt} = \dfrac{12\,000 + 24\,000t^3}{(1 + t^3)^2}$ $0 = \dfrac{12\,000 + 24\,000t^3}{(1 + t^3)^2}$ $0 = 12\,000 - 24\,000t^3$	 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$24\,000t^3 = 12\,000$ $t^3 = \frac{12\,000}{24\,000}$ $t^3 = 0.5$ $t = 0.7937$ jam / *hours* $t \approx 48$ minit / *minutes* **(ii)** $P = \frac{12\,000(0.7937)}{1 + 0.7937^3}$ $P = 6\,349.6 \approx 6\,350$	1 1	**7**
9	(*a*) $X = \{0, 1, 2\}$	1	
	(*b*) $P(X = 0) = {}^2C_0(0.7)^0(0.3)^{2-0} = 0.09$ $P(X = 1) = {}^2C_1(0.7)^1(0.3)^{2-1} = 0.42$ $P(X = 2) = {}^2C_2(0.7)^2(0.3)^{2-2} = 0.49$  	2 2	**5**
10	$P(m < Z < 0) = 2P(0 < Z < k)$ $0.5 - 0.14 = 2[0.5 - P(Z > k)]$ $0.18 = 0.5 - P(Z > k)$ $P(Z > k) = 0.5 - 0.18$ $P(Z < k) = 0.32$ $k = 0.468$ $P(Z < m) = P(Z > -m)$ $= 0.14$ $\therefore m = -1.081$	1 1 1 1	**4**
11	(*a*) $\int_p^1 \frac{1}{2}[f(x) - x]\,dx = 20$ $\frac{1}{2}\int_p^1 f(x)\,dx - \frac{1}{2}\int_p^1 x\,dx = 20$ $\frac{1}{2}(36) - \frac{1}{2}\left[\frac{x^2}{2}\right]_p^1 = 20$ $18 - \frac{1}{2}\left[\frac{1^2}{2} - \frac{p^2}{2}\right] = 20$ $-\frac{1}{2}\left[\frac{1}{2} - \frac{p^2}{2}\right] = 2$ $\frac{1}{2} - \frac{p^2}{2} = -4$ $-\frac{p^2}{2} = -\frac{9}{2}$ $p^2 = 9$ $p = \pm 3$ Oleh sebab / *Since* $p < 0$, $p = -3$	1 1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $\int -\frac{r}{(2-qx)^4}\,dx = -r\int (2-qx)^{-4}\,dx$ $= -r\frac{(2-qx)^{-3}}{(-3)(-q)} + c$ $= -\frac{r}{3q}(2-qx)^{-3} + c$ $-\frac{r}{3q} = -3$ $\frac{r}{3q} = 3$ $\frac{r}{q} = 9$ Maka / *Thus*, $r : q = 9 : 1$	1 1 1	**7**
12	(*a*) $\sin A = \frac{a}{c}$, $\kos A = \frac{b}{c}$, $\tan A = \frac{a}{b}$ Diketahui bahawa / *It is known that*, $a^2 + b^2 = c^2$ Bahagi kedua-dua belah dengan b^2 / *Divide both sides by* b^2: $\frac{a^2}{b^2} + \frac{b^2}{b^2} = \frac{c^2}{b^2}$ $\frac{a^2}{b^2} + 1 = \frac{c^2}{b^2}$ $\left(\frac{a}{b}\right)^2 + 1 = \left(\frac{c}{b}\right)^2$ $\therefore \tan^2 A + 1 = \text{sek}^2 A$	1 1 1	
	(*b*) $(1 + \tan A)^2 = (1 + \tan A)(1 + \tan A)$ $= 1 + 2\tan A + \tan^2 A$ $= 1 + \tan^2 A + 2\tan A$ $= \text{sek}^2 A + 2\frac{\sin A}{\kos A}$ $= \text{sek}^2 A + 2\frac{\sin A}{\kos A} \cdot \frac{\kos A}{\kos A}$ $= \text{sek}^2 A + 2\frac{\sin A \kos A}{\kos^2 A}$ $= \text{sek}^2 A + 2\sin A \kos A\left(\frac{1}{\kos^2 A}\right)$ $= \text{sek}^2 A + \sin 2A\ \text{sek}^2 A$ $= \text{sek}^2 A(1 + \sin 2A)$	1 1 1	**6**

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
13	(*a*) **(i)** 	2	
	(ii) $\overrightarrow{OP} = 3\begin{pmatrix}-1\\-4\end{pmatrix} - \begin{pmatrix}2\\4\end{pmatrix}$	1	
	$\overrightarrow{OP} = \begin{pmatrix}-5\\-16\end{pmatrix}$		
	$\lvert\overrightarrow{OP}\rvert = \sqrt{(-5)^2 + (-16)^2}$	1	
	$\lvert\overrightarrow{OP}\rvert = \sqrt{281}$	1	
	(*b*) $\lambda\left(-\frac{1}{4}h\underline{p} - 2\underline{q}\right) = (1-k)\underline{p} + 2h\underline{q}$	1	
	$-\frac{1}{4}h\lambda\underline{p} - 2\lambda\underline{q} = (1-k)\underline{p} + 2h\underline{q}$		
	$-\frac{1}{4}h\lambda = 1-k \quad , \quad -2\lambda = 2h$ $\lambda = -h$	1	
	$-\frac{1}{4}h(-h) = 1-k$		
	$h^2 = 4(1-k)$		
	$h = 2\sqrt{1-k}$	1	**7**
14	(*a*) $P(0, -20)$ dan / *and* $R(0, 20)$	1 1	
	(*b*) (i) $\frac{1}{2}(20)^2(\pi) = 200\pi$	1	
	(ii) Diameter semi bulatan OQR / *Diameter of semicircle OQR* $= \sqrt{20^2 + 20^2} = 20\sqrt{2}$		
	Jejari semi bulatan OQR / *Radius of semicircle OQR* $= 10\sqrt{2}$	1	
	Luas semi bulatan OQR / *Area of semicircle OQR* $= \frac{1}{2}\left(10\sqrt{2}\right)^2(\pi)$ $= 100\pi$	1	
	Luas segi tiga OQR / *Area of triangle OQR* $= \frac{1}{2}(20)(20)$ $= 200$		
	Luas satu tembereng / *Area of one segment* $= \frac{100\pi - 200}{2}$ $= 50\pi - 100$	1	
	Luas kawasan berlorek / *Area of the shaded region* $= 200\pi - (200 + 50\pi - 100)$ $= 150\pi - 100$	1	
	$= 50(3\pi - 2)$	1	**8**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
15	(*a*) $\frac{T_3}{T_2} = \frac{\frac{m^5}{27}}{\frac{m^3}{3}} = 1$	1	
	$\frac{m^2}{9} = 1$ $m^2 = 9$ $m = 3, m = -3$	1	
	(*b*) (i) T_2: $ar^{2-1} = \frac{m^3}{3}$		
	$ar = \frac{m^3}{3}$		
	T_3: $ar^{3-1} = \frac{m^5}{27}$		
	$ar^2 = \frac{m^5}{27}$		
	$\frac{ar^2}{ar} = \frac{\frac{m^5}{27}}{\frac{m^3}{3}}$	1	
	$r = \left(\frac{m^5}{27}\right) \times \left(\frac{3}{m^3}\right)$		
	$r = \frac{m^2}{9}$		
	$r = \frac{(4)^2}{9}$	1	
	$r = \frac{16}{9}$	1	
	$ar = \frac{64}{3}$		
	$a\left(\frac{16}{9}\right) = \frac{64}{3}$		
	$a = \frac{64}{3} \div \frac{16}{9}$		
	$a = \frac{64}{3} \times \frac{9}{16}$		
	$a = 12$	1	
	(ii) $S_{2\to5} = S_5 - S_1$		
	$= \frac{12\left[\left(\frac{16}{9}\right)^5 - 1\right]}{\left(\frac{16}{9}\right) - 1} - 12$	1	
	$= \frac{565\,444}{2\,187} - 12$		
	$= \frac{539\,200}{2\,187}$ atau / *or* $S_{2\to5} = 246.5478$	1	**8**

KERTAS 2

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	Diberi (6, –4) dan kecerunan $\frac{1}{2}$. *Given* (6, –4) *and gradient* $\frac{1}{2}$. $-4 = m(6) + \frac{1}{2}$ $6m = -\frac{9}{2}$ $m = -\frac{3}{4}$ Maka / *Thus*, $y = -\frac{3}{4}x + \frac{1}{2}$ .....① Ganti ① ke dalam / *Substitute* ① *into* $x^2 + xy - 6 = 0$: $x^2 + x\left(-\frac{3}{4}x + \frac{1}{2}\right) - 6 = 0$ $x^2 - \frac{3}{4}x^2 + \frac{1}{2}x - 6 = 0$ $\frac{1}{4}x^2 + \frac{1}{2}x - 6 = 0$ $\frac{1}{4}(x + 6)(x - 4) = 0$ $x = -6, x = 4$ Pada / *At* $x = -6$, $y = -\frac{3}{4}(-6) + \frac{1}{2}$ $= 5$ Pada / *At* $x = 4$, $y = -\frac{3}{4}(4) + \frac{1}{2}$ $= -\frac{5}{2}$ Maka, $A(-6, 5)$ dan $B\left(4, -\frac{5}{2}\right)$. *Thus*, $A(-6, 5)$ *and* $B\left(4, -\frac{5}{2}\right)$.	1 1 1 1 2	6
2	(*a*) $\sqrt{320} - \sqrt{45} = \sqrt{64}\cdot\sqrt{5} - \sqrt{9}\cdot\sqrt{5}$ $= 8\sqrt{5} - 3\sqrt{5}$ $= 5\sqrt{5}$ Maka / *Thus*, $a = 5$	1 1	
	(*b*) $2^2 = 3^2 + (2 + \sqrt{3})^2 - 2(3)(2 + \sqrt{3}) \kos \theta$ $2^2 - 3^2 - (2 + \sqrt{3})^2 = -2(3)(2 + \sqrt{3}) \kos \theta$ $4 - 9 - (4 + 2\sqrt{3} + 2\sqrt{3} + 3) = -(12 + 6\sqrt{3}) \kos \theta$ $-12 - 4\sqrt{3} = -(12 + 6\sqrt{3}) \kos \theta$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$(12 + 6\sqrt{3}) \kos \theta = 12 + 4\sqrt{3}$ $\kos \theta = \dfrac{12 + 4\sqrt{3}}{12 + 6\sqrt{3}}$ Menisbahkan penyebut / *Rationalising the denominator*: $\kos \theta = \dfrac{12 + 4\sqrt{3}}{12 + 6\sqrt{3}} \cdot \dfrac{12 - 6\sqrt{3}}{12 - 6\sqrt{3}}$ $= \dfrac{144 - 72\sqrt{3} + 48\sqrt{3} - 24(3)}{144 - 72\sqrt{3} + 72\sqrt{3} - 36(3)}$ $= \dfrac{72 - 24\sqrt{3}}{36}$ $= \dfrac{6 - 2\sqrt{3}}{3}$	1 1 1	**6**
3	(*a*) $\dfrac{dy}{dx} = 3ax^2 + b$ Pada / *At* $x = 3$, Kecerunan lengkung / *Gradient of curve*: $-15 = \dfrac{dy}{dx}$ $-15 = 3a(3)^2 + b$ $-15 = 27a + b$ ... ① Pada / *At* $(-2, -11)$ $-11 = a(-2)^3 + b(-2) + 5$ $-16 = -8a - 2b$ $-8 = -4a - b$ ... ② ① + ②: $-15 = 27a + b$ $+ \quad -8 = -4a - b$ $-23 = 23a$ $a = -1$ $-15 = 27(-1) + b$ $b = 12$	1 1 1 1 1	
	(*b*) $\dfrac{dy}{dx} = 3(-1)x^2 + 12$ $0 = -3x^2 + 12$ $3x^2 = 12$ $x^2 = 4$ $x = \pm 2$ Nilai maksimum / *Maximum value* = 2 $y = -1(2)^3 + 12(2) + 5$ $y = 21$ Titik maksimum / *Maximum point* = (2, 21)	 1 1	**7**

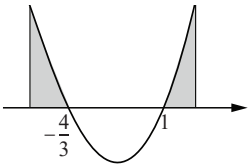
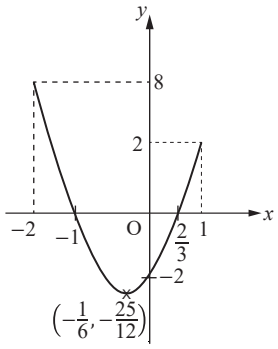
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	(*a*) (i) $\overrightarrow{QT} = \overrightarrow{QO} + \overrightarrow{OT}$ $= -8\underline{a} + 2\underline{b}$ (ii) $\overrightarrow{PS} = \overrightarrow{PO} + \overrightarrow{OS}$ $= -4\underline{a} + 5\underline{b}$	1 1	
	(*b*) (i) $\overrightarrow{OR} = \overrightarrow{OQ} + \overrightarrow{QR}$ $= 8\underline{a} + m(-8\underline{a} + 2\underline{b})$ $= (8 - 8m)\underline{a} + 2m\underline{b}$ (ii) $\overrightarrow{OR} = \overrightarrow{OS} + \overrightarrow{SR}$ $\overrightarrow{OR} = \overrightarrow{OS} - \overrightarrow{RS}$ $= 5\underline{b} - n(-4\underline{a} + 5\underline{b})$ $= 4n + (5 - 5n)\underline{b}$	1 1 1	
	(*c*) Diketahui / *It is known that* $8 - 8m = 4n$, $2m = 5 - 5n$ $8m = 20 - 20n$ $8 - (20 - 20n) = 4n$ $2m = 5 - 5\left(\frac{3}{4}\right)$ $-12 + 20n = 4nm$ $16n = 12$ $m = \frac{5}{8}$ $n = \frac{3}{4}$	1 1 1	**8**
5	(*a*) $\theta = \frac{1}{5}\pi$ Perimeter $= 2r + r\left(\frac{1}{5}\pi\right)$, Luas / *Area* $= \frac{1}{2}r^2\left(\frac{1}{5}\pi\right)$ $2r + r\left(\frac{1}{5}\pi\right) = \frac{1}{2}r^2\left(\frac{1}{5}\pi\right)$ $\left(2 + \frac{1}{5}\pi\right)r = \left(\frac{1}{10}\pi\right)r^2$ $r = \frac{\left(2 + \frac{1}{5}\pi\right)}{\left(\frac{1}{10}\pi\right)}$ $r = 8.365$ cm	1 1 1 1	
	(*b*) Isi padu sepotong kek / *Volume per slice of cake* $= \pi(8.365)^2(12) \div 10$ $= 263.79\ \text{cm}^3$ Jisim sepotong kek / *Mass per slice of cake* $= 263.79 \div 0.916$ $= 287.98$ g Harga sepotong kek / *Price per slice of cake* $= \frac{287.98\text{ g}}{100\text{ g}} \times \text{RM}4.90$ = RM14.11 sepotong / *per slice* Bilangan sepotong kek / *Number of slice of cake* $= \frac{\text{RM}180}{\text{RM}14.11}$ $= 112.76$ $\approx$ 12 potong / *slices*	1 1 1 1	**8**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
6	(*a*) $T_1 = \frac{1}{2}(b)(h)$ $= \frac{bh}{2}$ $T_2 = \frac{1}{2}(b)(h+1)$ $= \frac{b(h+1)}{2}$ $= \frac{bh+b}{2}$ $T_3 = \frac{1}{2}(b)(h+2)$ $= \frac{b(h+2)}{2}$ $= \frac{bh+2b}{2}$ $T_3 - T_2 = T_2 - T_1$ $\frac{bh+2b}{2} - \frac{bh+b}{2} = \frac{bh+b}{2} - \frac{bh}{2}$ $\frac{b}{2} = \frac{b}{2}$ Beza sepunya / *Common difference* $= \frac{b}{2}$	1 1 1	
	(*b*) $S_9 = \frac{9}{2}\left[2\left(\frac{bh}{2}\right) + \left(9-1\right)\left(\frac{b}{2}\right)\right]$ $S_9 = \frac{9}{2}bh + 18b$	1 1	
	(*c*) $T_1 = \frac{1}{3}(b^2)(h)$ $= \frac{b^2h}{3}$ $T_2 = \frac{1}{3}(b^2)(h+1)$ $= \frac{b^2(h+1)}{3}$ $= \frac{b^2h+b^2}{3}$ $T_3 = \frac{1}{3}(b^2)(h+2)$ $= \frac{b^2(h+2)}{3}$ $= \frac{b^2h+2b^2}{3}$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$a = \frac{b^2h}{3}$, $d = \frac{b^2}{3}$	1	
	$S_{16} = \frac{16}{2}\left[2\left(\frac{b^2h}{3}\right) + (16-1)\left(\frac{b^2}{3}\right)\right]$	1	
	$= \frac{16}{3}b^2h + 40b^2$	1	**8**
7	(*a*) (i) ${}^{10}C_4 = 210$	1	
	(ii) $({}^3C_2 \times {}^7C_1 \times {}^3C_1) + ({}^3C_3 \times {}^3C_1)$ $= 66$	2 1	
	(*b*) ${}^5C_1 \times {}^2C_1$ atau / *or* ${}^2P_2 \times {}^3P_1$ ${}^5C_1 \times {}^2C_1 \times {}^2P_2 \times {}^3P_1 \times {}^9P_3$ $= 30\,240$	1 1 1	**7**

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
8	(*a*) HTP / *SOR*: $p + q = -\frac{1}{\frac{9p}{2}}$ HDP / *POR*: $pq = \frac{2q}{\frac{9p}{2}}$	1	
	$p + q = -\frac{2}{9p}$ $pq = \frac{4q}{9p}$ $9p(p+q) = -2$ $9p^2q = 4q$ $9p^2 + 9pq = -2$ $9p^2 = 4$ $p^2 = \frac{4}{9}$ $p = \pm\frac{2}{3}$	1	
	Apabila / *When* $p = \frac{2}{3}$, $9\left(\frac{2}{3}\right)^2 + 9\left(\frac{2}{3}\right)q = -2$ $\frac{18}{3}q = -6$ $q = -1$		
	Apabila / *When* $p = -\frac{2}{3}$, $9\left(-\frac{2}{3}\right)^2 + 9\left(-\frac{2}{3}\right)q = -2$ $-\frac{18}{3}q = -6$ $q = -1$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) (i) $3x^2 + x - 2 > 2$ $3x^2 + x - 4 > 0$ $(3x + 4)(x - 1) > 0$  $x < -\frac{4}{3}, x > 1$	1 1	
	(ii) $f(x) = 3\left(x^2 + \frac{x}{3} - \frac{2}{3}\right)$ $= 3\left[x^2 + \frac{x}{3} + \left(\frac{1}{3}{2}\right)^2 - \left(\frac{1}{3}{2}\right)^2 - \frac{2}{3}\right]$ $= 3\left[\left(x + \frac{1}{6}\right)^2 - \frac{25}{36}\right]$ $= 3\left(x + \frac{1}{6}\right)^2 - \frac{25}{12}$ Titik minimum / *Minimum point* $= \left(-\frac{1}{6}, -\frac{25}{12}\right)$ $3x^2 + x - 2 = 0$ $(3x - 2)(x + 1) = 0$ $x = \frac{2}{3}, x = -1$ Pintasan-x / *x-intercepts* $= \left(\frac{2}{3}, 0\right)$ dan / *and* $(-1, 0)$ Pada / *At* $x = -2$, $y = 3(-2)^2 + (-2) - 2$ $= 8$ Pada / *At* $x = 1$, $y = 3(1)^2 + (1) - 2$ $= 2$  Pintasan-x dan pintasan-y / *x-intercept and y-intercept*: $(-1,0), \left(\frac{2}{3}, 0\right), (0, -2)$ Titik minimum / *Minimum point* $= \left(-\frac{1}{6}, -\frac{25}{12}\right)$ Titik / *Points* $(-2, 8)$ dan / *and* $(1, 2)$	1 1 1	

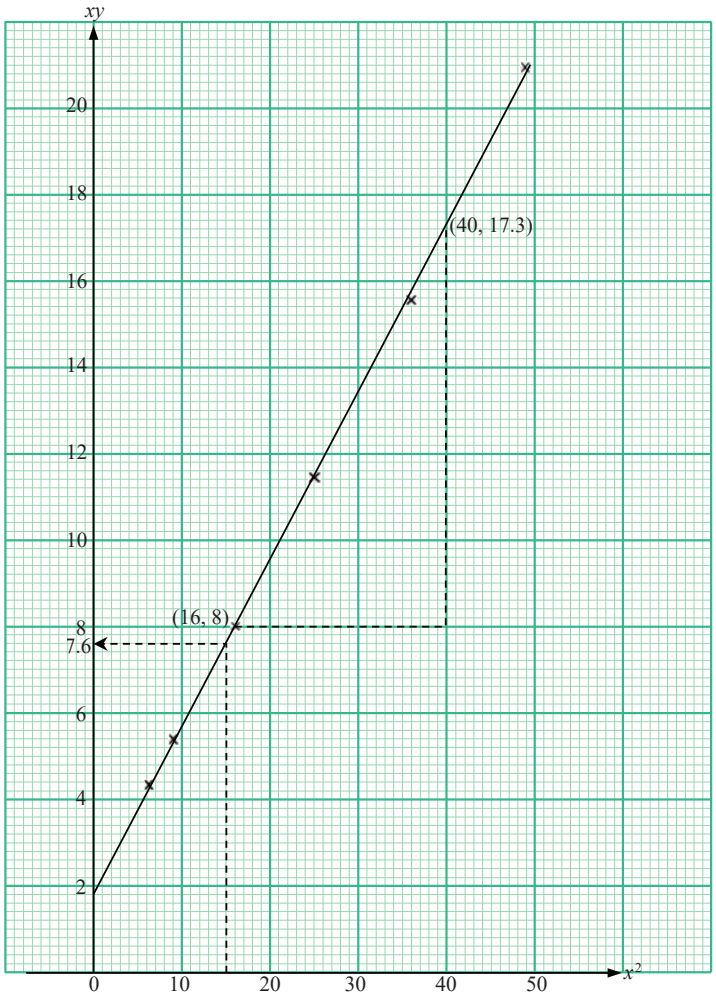
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) $-2 + p = -2 - \frac{2}{3}$ dan / *and* $3q = 3(1)$ $= -\frac{8}{3}$ $= 3$ HTP / *SOR* $= -\frac{8}{3} + 3$ HDP / *POR* $= -\frac{8}{3}(3)$ $= \frac{1}{3}$ $= -8$ $\therefore x^2 - \frac{1}{3}x - 8 = 0$	1 1	**10**
9	(*a*)		

x^2	6.25	9	16	25	36	49
xy	4.38	5.4	8	11.5	15.6	21

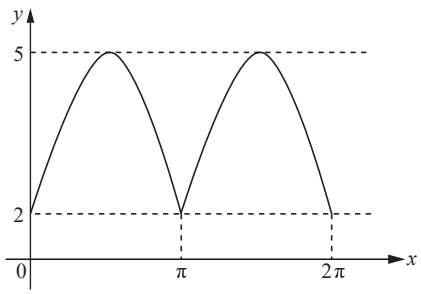
2

- Semua titik diplot dengan betul.
  All points are plotted correctly. 1

- Garis penyuaian terbaik.
  The line of best fit. 1



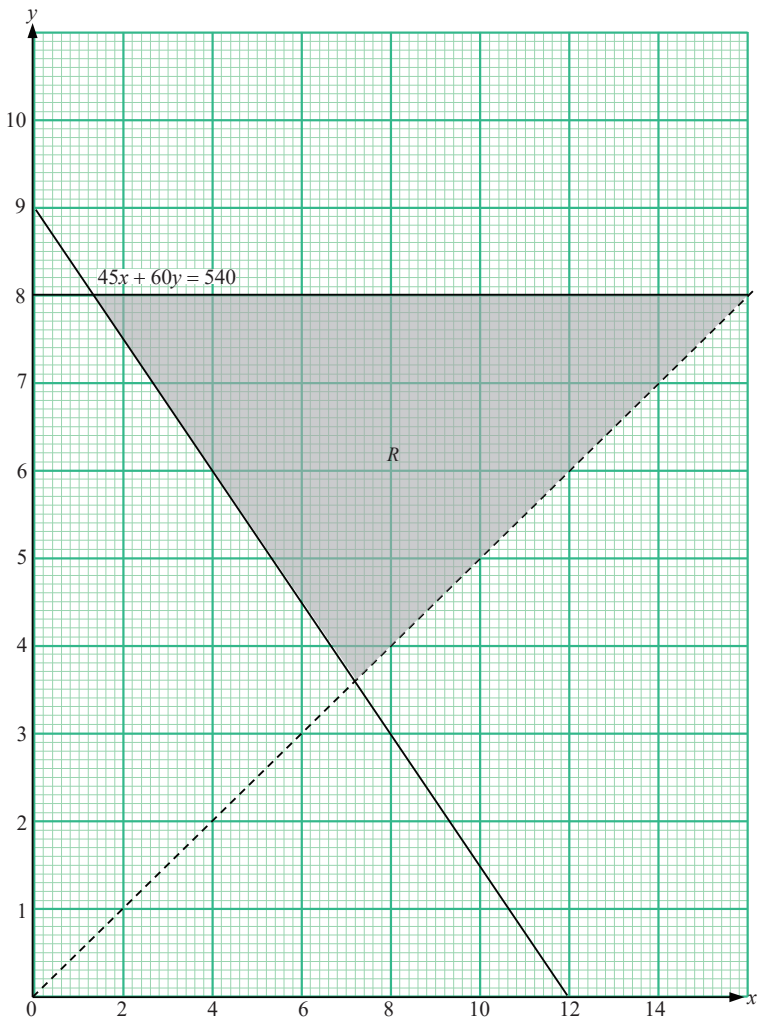
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) (i) $xy = \frac{b}{a}x^2 + a$	1	
	Apabila / *When* $x^2 = 15$, $xy = 7.6$ $y = \frac{7.6}{\sqrt{15}}$	1	
	$y = 1.962$	1	
	(ii) $a = 1.9$	1	
	m: $\frac{b}{a} = \frac{17.3 - 8}{40 - 16}$ $\frac{b}{1.9} = \frac{17.3 - 8}{40 - 16}$ $\frac{b}{1.9} = \frac{31}{80}$	1	
	$b = 0.7363$	1	**10**
10	(*a*) $\int \frac{dy}{dx}\,dx = \int 2x\,dx$ $y = \frac{2x^2}{2} + c$	1	
	Pada / *At* (3, 12), $12 = \frac{2(3)^2}{2} + c$ $c = 3$	1	
	$\therefore y = x^2 + 3$	1	
	(*b*) Luas trapezium = $\frac{1}{2}(3)(3 + 12)$ *Area of trapezium*	1	
	Luas di bawah graf = $\int_0^3 x^2 + 3\,dx$ *Area under the graph*		
	$\frac{1}{2}(3)(3 + 12) - \int_0^3 x^2 + 3\,dx$	1	
	$= \frac{45}{2} - \left[\frac{x^3}{3} + 3x\right]_0^3$		
	$= \frac{45}{2} - \left[\left(\frac{3^3}{3} + 3(3)\right) - \left(\frac{0^3}{3} + 3(0)\right)\right]$	1	
	$= \frac{9}{2}$	1	
	(*c*) $\pi \int_3^t y - 3\,dy = \pi\left[\frac{y^2}{2} - 3y\right]_3^t$	1	
	$= \pi\left[\left(\frac{t^2}{2} - 3t\right) - \left(\frac{3^2}{2} - 3(3)\right)\right]$	1	
	$= \pi\left(\frac{t^2}{2} - 3t + \frac{9}{2}\right)$	1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
11	(*a*) $3 \sin x + 2 = \text{kos } 2x$ $3 \sin x + 2 = 1 - 2 \sin^2 x$ $2 \sin^2 x + 3 \sin x + 1 = 0$ $(2 \sin x + 1)(\sin x + 1) = 0$ $\sin x = -\frac{1}{2}$, $\sin x = -1$ Sudut asas / *Basic angle* = 30°, 90° $x = (270° - 30°), 270°, (360° - 30°)$ $\therefore x = 240°, 270°, 330°$	1 1 1 1	
	(*b*)  – Bentuk / *Shape of* sin *x* – |sin *x*| – Translasi / *Translation* $\begin{pmatrix}0\\2\end{pmatrix}$ – Nilai maksimum / *Maximum value* = 5	 1 1 1 1	
	(*c*) $t < 2, t > 5$	2	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
12	(*a*) $\angle ADC = 115°$ $AC^2 = 7^2 + 10^2 - 2(7)(10) \text{ kos } 115°$ $AC^2 = 208.1666$ $AC = 14.4280$	1 1 1	
	(*b*) $\frac{\sin \angle ACB}{12.32} = \frac{\sin 75°}{14.4280}$ $\sin \angle ACB = 0.8248$ $\angle ACB = 55.5681°$ $\angle CAB = 180° - 75° - 55.5681°$ $= 49.4319°$	1 1 1 1	
	(*c*) $\frac{1}{2}(12.32)(14.4280) \sin 49.4319°$ dan / *and* $\frac{1}{2}(7)(10) \sin 115°$ $\frac{1}{2}(12.32)(14.4280) \sin 49.4319° + \frac{1}{2}(7)(10) \sin 115°$ $= 67.51° + 31.72°$ $= 99.23°$	1 1 1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
13	(*a*) (i) $\frac{6.30}{P_{2013}} \times 100 = 120$ $P_{2013} = \text{RM}5.25$	1 1	
	(ii) $\frac{P_{2016}}{3.50} \times 100 = 140$ $P_{2016} = \text{RM}4.90$	1	
	(*b*) $\frac{120(2) + 110(3) + 3x + 140(2)}{10} = 122.2$ $\frac{850 + 3x}{10} = 122.2$ $x = 124$	2 1	
	(*c*) $I_{\frac{2018}{2016}} = \frac{120(2) + 100(3) + 95(3) + 100(2)}{10}$ $= 102.5$	1	
	<table><tr><td>P_0 \ P_1</td><td>2013</td><td>2016</td><td>2018</td></tr><tr><td>2013</td><td></td><td>122.2</td><td>x</td></tr><tr><td>2016</td><td></td><td>100</td><td>102.5</td></tr><tr><td>2018</td><td></td><td></td><td></td></tr></table>		
	$\frac{122.3}{100} = \frac{x}{102.5}$ $x = 125.87$	1	
	(*d*) $\frac{P_{2018}}{20} \times 100 = 125.87$ $P_{2018} = \text{RM}25.17$	1 1	**10**
14	(*a*) $45x + 60y \geqslant 540$ $x < 2y$ $y \leqslant 8$	1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) – Semua garis lurus dilukis dengan betul. *All straight lines are drawn correctly.* – Kawasan berlorek yang betul. *Correct shaded region.*  	1 2	
	(*c*) (i) $4 < y \leqslant 8$ (ii) Titik maksimum / *Maximum point* = (15, 8) Bilangan maksimum bilangan kopi = 23 × 18 *Maximum number of coffee drink* = 414	1 1 1 1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
15	(*a*) $v = \int kt - 10 \, dt$		
	$v = \frac{kt^2}{2} - 10t + c$	1	
	Pada / *At* $t = 0$, $v = -8$ $-8 = \frac{k(0)^2}{2} - 10(0) + c$ $c = -8$ $v = \frac{kt^2}{2} - 10t - 8$	1	
	Pada / *At* $t = 5$, $v = 17$ $17 = \frac{k(5)^2}{2} - 10(5) - 8$ $k = 6$	1	
	(*b*) $0 = 6t - 10$ $t = \frac{5}{3}$	1	
	$v = 3\left(\frac{5}{3}\right)^2 - 10\left(\frac{5}{3}\right) - 8$	1	
	$= -\frac{49}{3}$	1	
	(*c*) $2 = 6t - 10$ dan / *and* $0 = 3t^2 - 10t - 8$ $t = 2$ $0 = (3t + 2)(t - 4)$ $t = 4$	1	
	$\int_2^4 \lvert 3t^2 - 10t - 8 \rvert \, dt$	1	
	$= \left\lvert \frac{3t^3}{3} - \frac{10t^2}{2} - 8t \right\rvert_2^4$ $= \left\lvert \left(\frac{3(4)^3}{3} - \frac{10(4)^2}{2} - 8(4)\right) - \left(\frac{3(2)^3}{3} - \frac{10(2)^2}{2} - 8(2)\right) \right\rvert$	1	
	$= \lvert -20 \rvert$ $= 20$	1	**10**

KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	(*a*) $p(0) = -4$ $m(0) - k = -4$ $-k = -4$ $k = 4$ $p(-2) = -8$ $m(-2) - k = -8$ $-2m - 4 = -8$ $-2m = -4$ $m = 2$	1 1	
	(*b*) Katakan / *Let* $2x - 4 = y$ $x = \frac{y+4}{2}$ $p(x) = y$ $p^{-1}(y) = x$ $p^{-1}(y) = \frac{y+4}{2}$ $\therefore p^{-1}(x) = \frac{x+4}{2}$ atau / *or* $p^{-1}(x) = \frac{1}{2}x + 2$	1 1	**4**
2	(*a*) $x^2 = ky$ $\log_{10} x^2 = \log_{10} ky$ $2 \log_{10} x = \log_{10} k + \log_{10} y$ $\log_{10} y = 2 \log_{10} x - \log_{10} k$	1 1	
	(*b*) $\frac{4-(-2)}{p-0} = 2$ $4 + 2 = 2p$ $6 = 2p$ $3 = p$ $-\log_{10} k = -2$ $\log_{10} k = 2$ $k = 10^2$ $k = 100$	1 1 1	**5**
3	(*a*) $\underline{\mathbf{A}} \times \underline{(\ {}^6P_4\ )} \times \underline{{}^4P_1}$ $\underline{\mathbf{I}} \times \underline{(\ {}^6P_4\ )} \times \underline{{}^4P_1}$ ${}^2P_1 \times {}^6P_4 \times {}^4P_1 = 2\,880$	2	
	(*b*) $\underline{\mathbf{2}} \times \underline{(\ \ {}^7P_5\ \ )}$ $\underline{\mathbf{3}} \times \underline{(\ \ {}^7P_5\ \ )}$ $\underline{\mathbf{4}} \times \underline{(\ \ {}^7P_5\ \ )}$ ${}^3P_1 \times {}^7P_5 = 7\,560$	2	**4**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	(*a*) $m + 0.25 + 2m + 2m + 0.30 = 1$ $5m + 0.55 = 1$ $5m = 0.45$ $m = 0.09$	1 1	
	(*b*) $^4C_4p^4q^0 = 0.3$ $(1)(p^4)(1) = 0.3$ $p^4 = 0.3$ $p = \sqrt[4]{0.3}$ $p = 0.7401$ Min / *Mean* $= (4)(0.7401)$ $= 2.9604$	1 1 1 1	**6**
5	$\kos 2\theta = \sin\theta$ $\kos^2\theta - \sin^2\theta = \sin\theta$ $(1 - \sin^2\theta) - \sin^2\theta - \sin\theta = 0$ $-2\sin^2\theta - \sin\theta + 1 = 0$ $2\sin^2\theta + \sin\theta - 1 = 0$ $(2\sin\theta - 1)(\sin\theta + 1) = 0$ $2\sin\theta - 1 = 0$, $\sin\theta + 1 = 0$ $\sin\theta = \frac{1}{2}$ (**I** dan / *and* **II**) $\sin\theta = -1$ (**III** dan / *and* **IV**) Sudut asas / *Basic angle*: 30° Sudut asas / *Basic angle*: 90° $\therefore \theta = 30°, 150°, 270°$	 1 1 1 1 1	**5**
6	(*a*) $\frac{dx}{dy} = (2x - 1)^2$; $A(-1, 3)$ $= [2(-1) - 1]^2$ $= (-3)^2$ $= 9$ $m_1m_2 = -1$ $9 \times m_2 = -1$ $m_2 = -\frac{1}{9}$ Persamaan normal di $A(-1, 3)$ / *Equation of normal at* $A(-1, 3)$: $y - y_1 = m(x - x_1)$ $y - 3 = -\frac{1}{9}[x - (-1)]$ $y - 3 = -\frac{1}{9}(x + 1)$ $y = -\frac{1}{9}x - \frac{1}{9} + 3$ $y = -\frac{1}{9}x + \frac{26}{9}$ atau / *or* $9y + x = 26$	 1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) $\int dy = \int (2x-1)^2\, dx$ $y = \frac{(2x-1)^3}{(3)(2)} + c$ $y = \frac{(2x-1)^3}{6} + c$; $A(-1, 3)$ $3 = \frac{[2(-1)-1]^3}{6} + c$ $3 = -\frac{9}{2} + c$ $\frac{15}{2} = c$ $\therefore y = \frac{(2x-1)^3}{6} + \frac{15}{2}$ atau / *or* $6y = (2x-1)^3 + 45$	1 1 1	**6**
7	$2^{x+1} \cdot 5^{x+2} = 10^{2x-1}$ $(2^x)(2^1)(5^x)(5^2) = \frac{10^{2x}}{10^1}$ $(10^x)(50) = \frac{10^{2x}}{10}$ $500 = \frac{10^{2x}}{10^x}$ $500 = 10^x$ $\log_{10} 500 = x$ $2.6990 = x$	1 1 1 1	4
8	(*a*) $Q(x, y) = \left(\frac{(3)(-1)+(1)(8)}{1+3}, \frac{(3)(4)+(1)(2)}{1+3}\right)$ $= \left(\frac{5}{4}, \frac{7}{2}\right)$	1 1	
	(*b*) $m_{AB} = \frac{4-2}{-1-8}$ $= -\frac{2}{9}$ $m_1 m_2 = -1$ $-\frac{2}{9} m_2 = -1$ $m_2 = \frac{9}{2}$ Persamaan garis lurus / *Equation of the straight line*: $y - y_1 = m(x - x_1)$ $y - \frac{7}{2} = \frac{9}{2}\left(x - \frac{5}{4}\right)$ $y = \frac{9}{2}x - \frac{45}{8} + \frac{7}{2}$ $y = \frac{9}{2}x - \frac{17}{8}$ atau / *or* $8y = 36x - 17$	1 1 1	

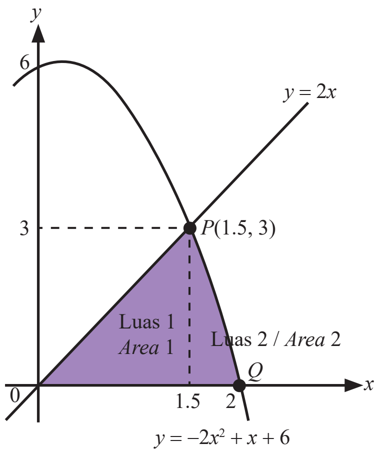
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(c) $AP = PB$ $\sqrt{[x-(-1)]^2+(y-4)^2} = \sqrt{(x-8)^2+(y-2)^2}$ $(x+1)^2+(y-4)^2 = (x-8)^2+(y-2)^2$ $x^2+2x+1+y^2-8y+16 = x^2-16x+64+y^2-4y+4$ $18x-4y-51=0$	1 1 1	**8**
9	$2x^2-6x+5=0$ Punca / *Roots*: α, β HTP / *SOR*: $\alpha+\beta = -\left(-\frac{6}{2}\right)$ $\alpha+\beta=3$ HDP / *POR*: $\alpha\beta = \frac{5}{2}$ Punca baru / *New roots*: α^2, β^2 HTP baru / *New SOR*: $\alpha^2+\beta^2 = (\alpha+\beta)^2-2\alpha\beta$ $= (3)^2-2\left(\frac{5}{2}\right)$ $=4$ HDP baru / *New POR*: $\alpha^2\beta^2 = (\alpha\beta)^2$ $= \left(\frac{5}{2}\right)^2$ $= \frac{25}{4}$ Persamaan baru / *New equation*: $x^2-(\text{HTP})x+\text{HDP}=0$ $x^2-4x+\frac{25}{4}=0$ atau / *or* $4x^2-16x+25=0$	 1 1 1 1	**5**
10	**(a)** $T_7 = a+(n-1)d$ $= 6+(7-1)(0.5)$ $= 9$ cm	 1 1	
	(b) $T_n > 95$ $6+(n-1)(0.5) > 95$ $0.5n-0.5>89$ $0.5n>89.5$ $n>179$ $\therefore\ n = 180$ hari / *days*	 1 1 1	**5**
11	**(a)** $\overrightarrow{OA} = -\underline{i}+4\underline{j}$ $\overrightarrow{OB} = 6\underline{i}+8\underline{j}$ $\overrightarrow{OC} = m\underline{i}+n\underline{j}$ $\overrightarrow{AB}-2\overrightarrow{BC} = 3\underline{i}-6\underline{j}$ $(\overrightarrow{AO}+\overrightarrow{OB})-2(\overrightarrow{BO}+\overrightarrow{OC}) = 3\underline{i}-6\underline{j}$ $(-\overrightarrow{OA}+\overrightarrow{OB})-2(-\overrightarrow{OB}+\overrightarrow{OC}) = 3\underline{i}-6\underline{j}$ $(\underline{i}-4\underline{j}+6\underline{i}+8\underline{j})-2(-6\underline{i}-8\underline{j}+m\underline{i}+n\underline{j}) = 3\underline{i}-6\underline{j}$ $7\underline{i}+4\underline{j}+12\underline{i}+16\underline{j}-2m\underline{i}-2n\underline{j} = 3\underline{i}-6\underline{j}$ $(19-2m)\underline{i}+(20-2n)\underline{j} = 3\underline{i}-6\underline{j}$	 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$\underline{i}$: $19 - 2m = 3$ $-2m = -16$ $m = 8$ $\underline{j}$: $20 - 2n = -6$ $-2n = -26$ $n = 13$	 1 1	
	(*b*) Luas / *Area* $= \frac{1}{2}\begin{vmatrix} -1 & 6 & 8 & -1 \\ 4 & 8 & 13 & 4 \end{vmatrix}$ $= \frac{1}{2}\lvert(-8 + 78 + 32) - (24 + 64 - 13)\rvert$ $= \frac{1}{2}\lvert 102 - 75\rvert$ $= \frac{1}{2}(27)$ $= 13\frac{1}{2}$ unit^2	 1 1	**6**
12	**(*a*)** $\int_4^1 f(x)\,dx = -\int_1^4 f(x)\,dx$ $= -10$	 1	
	(*b*) $2\int_4^1 g(x)\,dx - 3\int_1^4 f(x)\,dx = 2(-5) - 3(10)$ $= -10 - 30$ $= -40$	1 1	
	(*c*) $\int_1^4 [k - g(x)]\,dx = \int_0^2 4x\,dx$ $\int_1^4 k\,dx - \int_1^4 g(x)\,dx = \left[\frac{4x^2}{2}\right]_0^2$ $[kx]_1^4 - 5 = [2x^2]_0^2$ $[k(4) - k(1)] - 5 = [2(2)^2] - [2(0)^2]$ $4k - k - 5 = 8$ $3k = 13$ $k = \frac{13}{3}$	 2 1	**6**

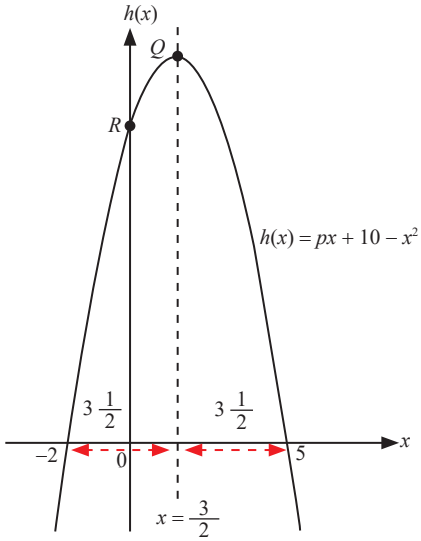
Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
13	**(*a*)** $3x^2 - 2x - 5 = 0$ $(3x - 5)(x + 1) = 0$ $3x - 5 = 0$, $x + 1 = 0$ $x = \frac{5}{3}$ $x = -1$ $\therefore A\left(\frac{5}{3}, 0\right)$ dan / *and* $B(-1, 0)$	 2 2	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) (i) $f(x) = 3x^2 - 2x - 5$ $= 3\left(x^2 - \frac{2}{3}x - \frac{5}{3}\right)$ $= 3\left[x^2 - \frac{2}{3}x + \left(\frac{-\frac{2}{3}}{2}\right)^2 - \left(\frac{-\frac{2}{3}}{2}\right)^2 - \frac{5}{3}\right]$ $= 3\left[x^2 - \frac{2}{3}x + \left(-\frac{1}{3}\right)^2 - \left(-\frac{1}{3}\right)^2 - \frac{5}{3}\right]$ $= 3\left[\left(x - \frac{1}{3}\right)^2 - \frac{1}{9} - \frac{5}{3}\right]$ $= 3\left[\left(x - \frac{1}{3}\right)^2 - \frac{16}{9}\right]$ $= 3\left(x - \frac{1}{3}\right)^2 - \frac{16}{3}$ (ii) $a = 3 > 0$ $\therefore f(x)$ mempunyai titik pusingan minimum pada titik $\left(\frac{1}{3}, -\frac{16}{3}\right)$ *$f(x)$ has a minimum turning point at* $\left(\frac{1}{3}, -\frac{16}{3}\right)$.	1 1 2	**8**
14	**(*a*)** $\theta = \frac{(360° - 240°)}{180°} \times \pi$ $= 2.095$ rad	1 1	
	(*b*) $s = r\theta$ $20 = r(2.095)$ $\frac{20}{2.095} = r$ $9.5465 \text{ cm} = r$	1 1	
	(*c*) Luas sektor *DOC* / *Area of sector DOC* $= \frac{1}{2} r^2\theta$ $= \frac{1}{2}(9.4565 + 3)^2(2.095)$ $= 162.5347 \text{ cm}^2$ Luas segi tiga *BOA* / *Area of triangle BOA* $= \frac{1}{2} ab \sin C$ $= \frac{1}{2}(9.4565)(9.4565) \sin 120°$ $= 38.7223 \text{ cm}^2$ Luas kawasan berlorek / *Area of the shaded region* $= 162.5347 \text{ cm}^2 - 38.7223 \text{ cm}^2$ $= 123.8124 \text{ cm}^2$	1 1 1 1	**8**

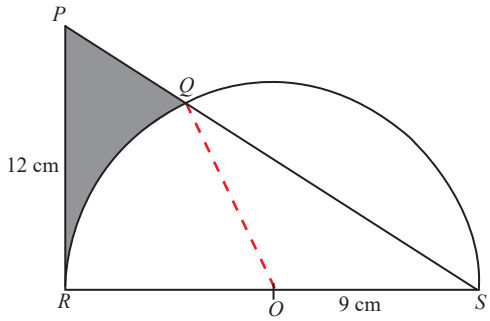
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
15	(*a*) Q adalah pintasan-x / Q *is x-intercept* $\rightarrow y = 0$		
	$-2x^2 + x + 6 = 0$		
	$2x^2 - x - 6 = 0$	1	
	$(2x + 3)(x - 2) = 0$		
	$x - 2 = 0 \quad , \quad 2x + 3 = 0$		
	$x = 2 \quad\quad = -\frac{3}{2}$ (Abaikan / *Ignore*)	1	
	$\therefore Q(2, 0)$	1	
	(*b*) 		
	Luas / *Area* 1 = Luas segi tiga / *Area of triangle*		
	$= \frac{1}{2} \times 1.5 \times 3$		
	$= 2\frac{1}{4}$ unit^2	1	
	Luas / *Area* 2 $= \int_{1.5}^{2} (-2x^2 + x + 6)\, dx$	1	
	$= \left[-\frac{2x^3}{3} + \frac{x^2}{2} + 6x \right]_{1.5}^{2}$	1	
	$= \left[-\frac{2(2)^3}{3} + \frac{(2)^2}{2} + 6(2) \right] - \left[-\frac{2(1.5)^3}{3} + \frac{(1.5)^2}{2} + 6(1.5) \right]$		
	$= 8\frac{2}{3} - 7\frac{7}{8}$		
	$= \frac{19}{24}$ unit^2		
	Luas kawasan berlorek = Luas 1 + Luas 2		
	Area of the shaded region = *Area* 1 + *Area* 2		
	$= 2\frac{1}{4} + \frac{19}{24}$	1	
	$= 3\frac{1}{24}$ unit^2	1	**8**

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
1	$2x + 3y - z = 3$ ... ① $x + y + z = -1$ ... ② $-x - 2y + 3z = 4$ ... ③ ② + ③: $(x + y + z) + (-x - 2y + 3z) = -1 + 4$ $x + y + z - x - 2y + 3z = 3$ $-y + 4z = 3$ $4z - 3 = y$ ... ④	1	
	① − 2 × ②: $(2x + 3y - z) - 2(x + y + z) = 3 - 2(-1)$ $2x + 3y - z - 2x - 2y - 2z = 3 + 2$ $y - 3z = 5$ $y = 5 + 3z$ ... ⑤	1	
	④ = ⑤: $4z - 3 = 5 + 3z$ $4z - 3z = 5 + 3$ $z = 8$	1	
	Daripada / *From* ⑤: $y = 5 + 3z$ $= 5 + 3(8)$ $= 29$	1	
	Daripada / *From* ②: $x + y + z = -1$ $x + 29 + 8 = -1$ $x = -1 - 29 - 8$ $x = -38$	1	**5**
2	(*a*) $h(0) = p(0) + 10 - (0)^2$ $= 10$ $R(0, 10)$	1	
	(*b*) 		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	$\frac{x+5}{2} = \frac{3}{2}$ $2x + 10 = 6$ $2x = -4$ $x = -2$ $\therefore h(x) < 0$ apabila $x < -2$ atau $x > 5$ $h(x) < 0$ *when* $x < -2$ *or* $x > 5$	1 1	
	(*c*) $h(x) = -x^2 + px + 10$ $= -(x^2 - px - 10)$ $= -\left[x^2 - px + \left(-\frac{p}{2}\right)^2 - \left(-\frac{p}{2}\right)^2 - 10\right]$ $= -\left[\left(x - \frac{p}{2}\right)^2 - \frac{p^2}{4} - 10\right]$ $= -\left(x - \frac{p}{2}\right)^2 + \frac{p^2}{4} + 10$ $x - \frac{p}{2} = 0$ $x = \frac{p}{2}$ $\frac{3}{2} = \frac{p}{2}$ $p = 3$	1 1 1 1 1	
	(*d*) $\frac{p^2}{4} + 10 = \frac{(3)^2}{4} + 10$ $= 12\frac{1}{4}$ $\therefore Q\left(1\frac{1}{2}, 12\frac{1}{4}\right)$	1 1	**9**
3	(*a*) $\frac{\sqrt{5}}{\sqrt{3}+2} = \frac{\sqrt{5}}{\sqrt{3}+2} \times \frac{-\sqrt{3}+2}{-\sqrt{3}+2}$ $= \frac{-\sqrt{15}+2\sqrt{5}}{-3+4}$ $= -\sqrt{15} + 2\sqrt{5}$	1 1 1	
	(*b*) $3^{x+2} - 3^x + 45(3^{x-2}) = (3^x)(3^2) - 3^x + 45(3^x)\left(\frac{1}{3^2}\right)$ $= (3^x)\left[3^2 - 1 + 45\left(\frac{1}{3^2}\right)\right]$ $= (3^x)(9 - 1 + 5)$ $= 13(3^x)$ $3^{x+2} - 3^x + 45(3^{x-2})$ boleh ditulis dalam bentuk $13(3^x)$, maka ianya boleh dibahagikan dengan 13. Ditunjukkan. $3^{x+2} - 3^x + 45(3^{x-2})$ *can be written in the form* $13(3^x)$, *thus it is divisible by* 13. *Shown*.	1 1 1	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
4	(*a*) (i) $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$ $\overrightarrow{AC} = 10\underline{a} - 6\underline{b}$ (ii) $\overrightarrow{FA} = \overrightarrow{FC} + \overrightarrow{CA}$ $\overrightarrow{FA} = \frac{1}{3}\overrightarrow{BC} + \overrightarrow{CA}$ $\overrightarrow{FA} = \frac{1}{3}(-6\underline{b}) + (-10\underline{a} + 6\underline{b})$ $\overrightarrow{FA} = -2\underline{b} - 10\underline{a} + 6\underline{b}$ $\overrightarrow{FA} = -10\underline{a} + 4\underline{b}$	1 1 1 1	
	(*b*) $\overrightarrow{AE} = \overrightarrow{AB} + \overrightarrow{BE}$ $= 10\underline{a} + m\overrightarrow{BD}$ $= 10\underline{a} + m(\overrightarrow{BA} + \overrightarrow{AD})$ $= 10\underline{a} + m\left(-10\underline{a} + \frac{1}{2}\overrightarrow{AC}\right)$ $= 10\underline{a} + m\left[-10\underline{a} + \frac{1}{2}(10\underline{a} - 6\underline{b})\right]$ $= 10\underline{a} + m(-10\underline{a} + 5\underline{a} - 3\underline{b})$ $= 10\underline{a} + m(-5\underline{a} - 3\underline{b})$ $= (10 - 5m)\underline{a} - 3m\underline{b}$	 1 1	
	(*c*) $\overrightarrow{AE} = \lambda\overrightarrow{AF}$ $(10 - 5m)\underline{a} - 3m\underline{b} = \lambda(10\underline{a} - 4\underline{b})$ Bandingkan kedua-dua belah / *Compare both sides*: $\underline{a}$: $10 - 5m = 10\lambda$ ... ① $\underline{b}$: $-3m = -4\lambda$ $\frac{3m}{4} = \lambda$ ... ② Ganti / *Substitute* ② ke dalam / *into* ①: $10 - 5m = 10\left(\frac{3m}{4}\right)$ $10 = \frac{15m}{2} + 5m$ $10 = \frac{25m}{2}$ $\frac{4}{5} = m$	1 1 1	9

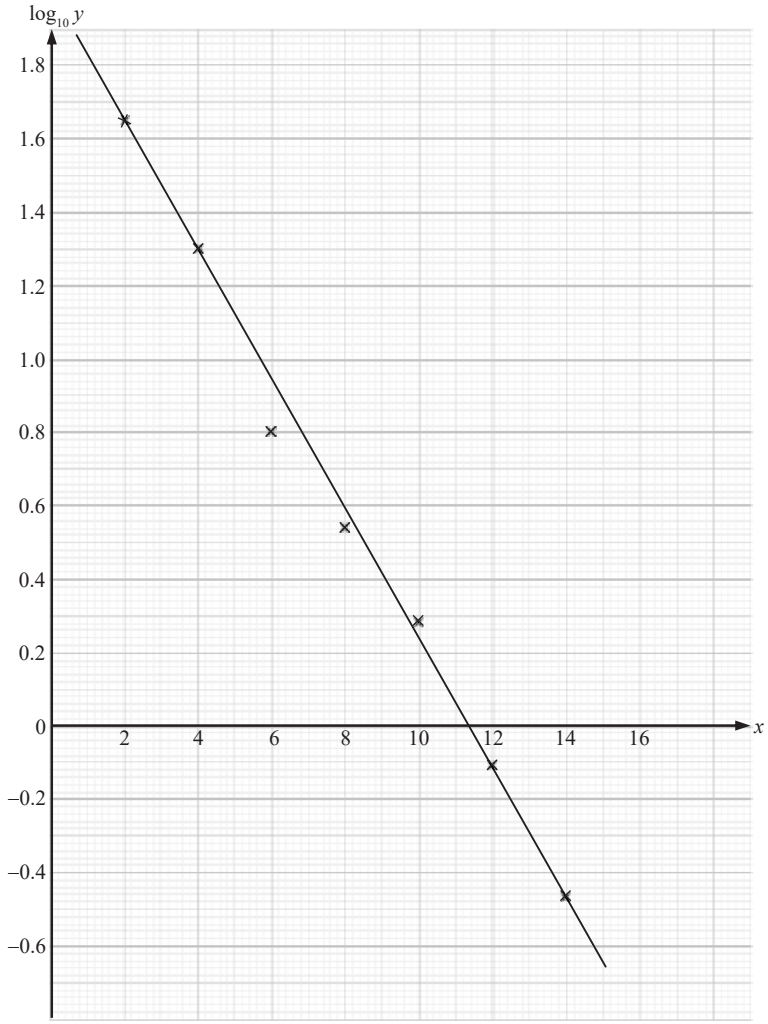
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
5	 $\angle PSR = \tan^{-1}\left(\frac{12}{18}\right)$ $= 33.69°$ $= 0.5881$ rad $\angle QOS = 180° - 33.69° - 33.69°$ $= 112.62°$ $\angle QOR = 180° - 112.62°$ $= 67.38°$ $= 1.1762$ rad *Lengkok RQ* / *Arc of RQ* $= (9)(1.1762)$ $= 10.5858$ cm $SQ^2 = 9^2 + 9^2 - 2(9)(9)$ kos / *cos* $112.62°$ $SQ = \sqrt{224.3080}$ $= 14.9769$ cm $PS^2 = 12^2 + 18^2$ $PS = \sqrt{468}$ $= 21.6333$ cm Perimeter $= 12 + (21.6333 - 14.9769) + 10.5858$ $= 29.2422$ cm	1 1 1 1 1 1 1	**7**
6	(*a*) $r = \frac{\frac{1}{2}}{\frac{1}{4}}$ $= 2$ $T_n = 512$ $\left(\frac{1}{4}\right)(2)^{n-1} = 512$ $(2)^{n-1} = 2\,048$ $(2)^{n-1} = 2^{11}$ $n - 1 = 11$ $n = 12$	1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*) Janjang geometri / *Geometric progression*: $a, ar, ar^2, ar^3, \ldots$ $8S_3 = S_{4\to 6}$ $8(a + ar + ar^2) = ar^3 + ar^4 + ar^5$ $8(a + ar + ar^2) = ar^3(1 + r + r^2)$ $\frac{8a(1 + r + r^2)}{a(1 + r + r^2)} = r^3$ $8 = r^3$ $\sqrt[3]{8} = r^3$ $r = 2$	 1 1 1	**6**
7	(*a*) $\frac{1}{2}\begin{vmatrix} 1 & 8 & p & 1 \\ 3 & 2 & -1 & 3 \end{vmatrix} = 13$ $\frac{1}{2}\lvert[(1)(2) + (8)(-1) + (p)(3)] - [(3)(8) + (p)(2) + (1)(-1)]\rvert = 13$ $\lvert(2 - 8 + 3p) - (24 + 2p - 1)\rvert = 26$ $\lvert-29 + p\rvert = 26$ $-29 + p = 26$, $-29 + p = -26$ $p = 55$ (Abaikan / *Ignore*) $p = 3$ $\therefore p = 3$	 1 1 1	
	(*b*) Katakan $P(x, y)$ ialah koordinat bagi bola *Let* $P(x, y)$ *be the coordinates of the ball* $P(x, y) = \left(\frac{(2)(3) + (1)(8)}{1 + 2}, \frac{(2)(-1) + (1)(2)}{1 + 2}\right)$ $= \left(\frac{14}{3}, 0\right)$	 1 1	
	(*c*) Katakan $D(x, y)$ ialah koordinat pemain *Let* $D(x, y)$ *be the coordinates of the player* $DB = DP$ $\sqrt{(x - 3)^2 + [y - (-1)^2} = \sqrt{\left(x - \frac{14}{3}\right)^2 + (y - 0)^2}$ $\sqrt{x^2 - 6x + 9 + y^2 + 2y + 1} = \sqrt{x^2 - \frac{28}{3}x + \frac{196}{9} + y^2}$ $\frac{10}{3}x + 2y = \frac{106}{9}$ $15x + 9y = 53$	 1 1 1	**8**

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
8	(*a*) (i) Min / *Mean* = 120 $(n)(0.3) = 120$ $n = 400$	 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(ii) $n = 15, p = 0.3, q = 0.7$ $P(X \geqslant 2) = 1 - P(X \leqslant 1)$ $= 1 - P(X = 0) - P(X = 1)$ $= 1 - {}^{15}C_0(0.3)^0(0.7)^{15-0} - {}^{15}C_1(0.3)^1(0.7)^{15-1}$ $= 1 - {}^{15}C_0(0.3)^0(0.7)^{15} - {}^{15}C_1(0.3)^1(0.7)^{14}$ $= 1 - 0.004748 - 0.03052$ $= 0.9647$	 2 1	
	(*b*) (i) $X \sim N(55, 14^2)$ $P(X > 65) = P\left(Z > \frac{65 - 55}{14}\right)$ $= P(Z > 0.714)$ $= 0.2377$	 1 1	
	(ii) $P(X \leqslant m) = 0.44$ $P\left(Z \leqslant \frac{m - 55}{14}\right) = 0.44$ $\frac{m - 55}{14} = -0.151$ $m - 55 = -2.114$ $m = 52.886$ kg	 1 1 1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
9	(*a*) x | 2 | 4 | 6 | 8 | 10 | 12 | 14 y | 44.44 | 19.75 | 6.31 | 3.47 | 1.91 | 0.77 | 0.34 $\log_{10} y$ | 1.65 | 1.30 | 0.80 | 0.54 | 0.28 | –0.11 | –0.47	1	
	 	3	
	(*b*) Salah catat di / *Wrongly recorded at* (6, 0.8) Koordinat betul / *Correct coordinates*: (6, 0.94) $\log_{10} y = 0.94$ $y = 10^{0.94}$ $y = 8.7096$	1	
	(*c*) (i) $y = \frac{p}{q^x}$ $y = pq^{-x}$ $\log_{10} y = \log_{10} p + \log_{10} q^{-x}$ $\log_{10} y = \log_{10} p - x \log_{10} q$ $\log_{10} y = (-\log_{10} q)x + \log_{10} p$ $Y = \quad m \quad X + \quad C$	1	

(*b*) Salah catat di / *Wrongly recorded at* (6, 0.8)
Koordinat betul / *Correct coordinates*: (6, 0.94)
$\log_{10} y = 0.94$
$y = 10^{0.94}$
$y = 8.7096$ — 1

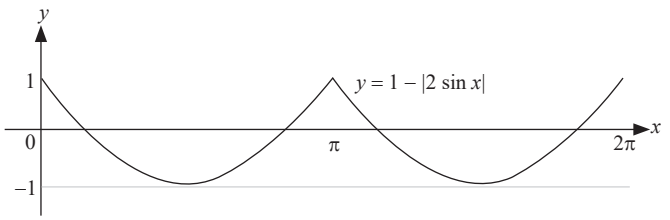
(*c*) (i) $y = \dfrac{p}{q^x}$
$y = pq^{-x}$
$\log_{10} y = \log_{10} p + \log_{10} q^{-x}$
$\log_{10} y = \log_{10} p - x \log_{10} q$
$\log_{10} y = (-\log_{10} q)x + \log_{10} p$
$Y = mX + C$ — 1
$\log_{10} p = 2.0$ — 1
$p = 10^{2.0}$ — 1
$p = 100$

(ii) $m = \dfrac{1.65 - 1.3}{2 - 4}$
$m = -0.175$
$-\log_{10} q = m$ — 1
$-\log_{10} q = -0.175$
$-\log_{10} q = m$
$q = 10^{0.175}$ — 1
$q = 1.4962$ — **10**

10

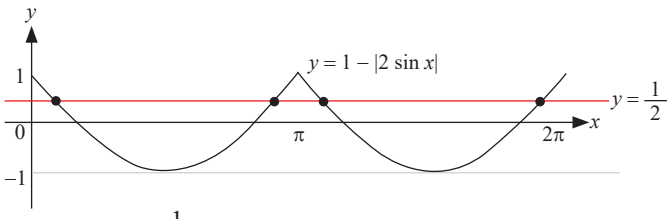
(*a*) $\dfrac{1 + \kos 2x}{\sin 2x} = \dfrac{1 + \kos^2 x - \sin^2 x}{2 \sin x \kos x}$ — 1
$= \dfrac{\kos^2 x + \sin^2 x + \kos^2 x - \sin^2 x}{2 \sin x \kos x}$ — 1
$= \dfrac{2 \kos^2 x}{2 \sin x \kos x}$ — 1
$= \dfrac{\kos x}{\sin x}$
$= \kot x$ (Ditunjukkan / *Shown*) — 1

(*b*) (i)



3

(ii)



1

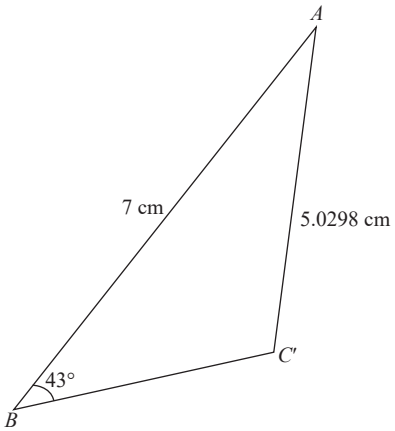
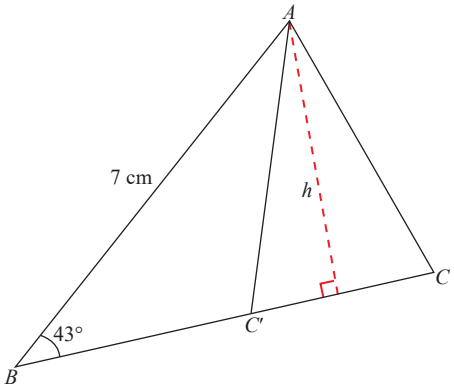
$|2 \sin x| + \dfrac{1}{2} = 1$
$\dfrac{1}{2} = 1 - |2 \sin x|$
$\dfrac{1}{2} = y$ — 1
Bilangan penyelesaian / *Number of solutions*: 4 — 1 — **10**

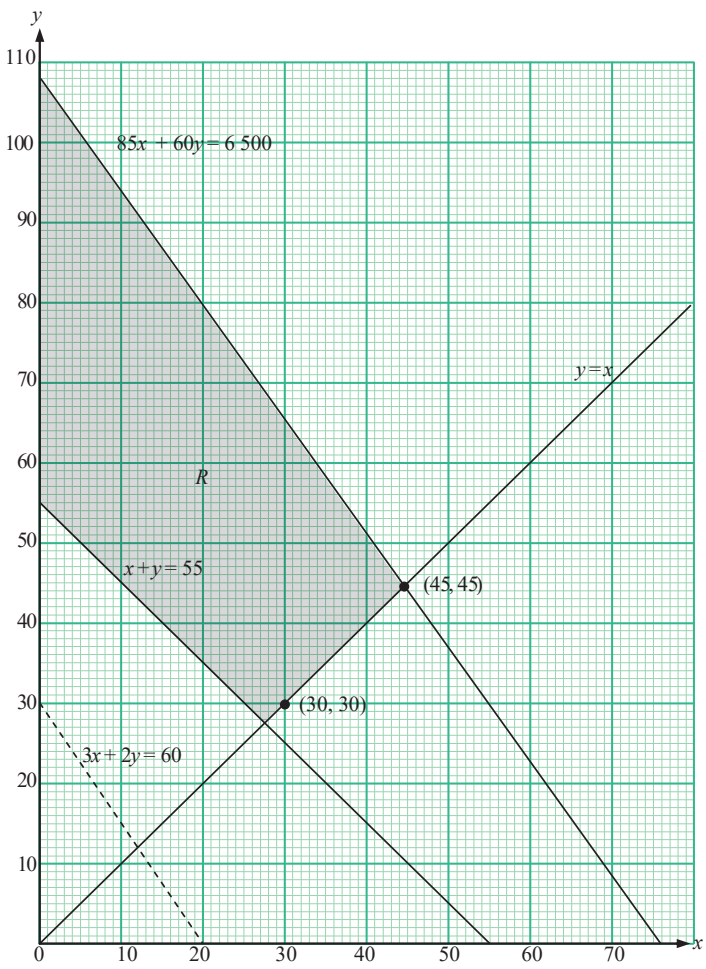
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
11	(*a*) $y = x^3 + x^2 - x + 5$ $\frac{dy}{dx} = 3x^2 + 2x - 1$ Fungsi kecerunan pada $S(-2, 3)$ / *Gradient function at* $S(-2, 3)$ $\frac{dy}{dx} = 3(-2)^2 + 2(-2) - 1$ $= 7$	 1 1 1	
	(*b*) Kecerunan garisan normal / *Gradient of the normal line* $m_1 m_2 = -1$ $7 \times m_2 = -1$ $m_2 = -\frac{1}{7}$ Persamaan normal pada $S(-2, 3)$ / *Equation of normal at* $S(-2, 3)$ $y - y_2 = m(x - x_1)$ $y - 3 = -\frac{1}{7}[x - (-2)]$ $y = -\frac{1}{7}x - \frac{2}{7} + 3$ $y = -\frac{1}{7}x + \frac{19}{7}$ atau / *or* $7y + x = 19$	 1 1 1	
	(*c*) $\frac{dy}{dx} = 0$ $3x^2 + 2x - 1 = 0$ $(3x - 1)(x + 1) = 0$ $x = \frac{1}{2}$ (Abaikan / *Ignore*) , $x = -1$ (Abaikan / *Ignore*) Apabila / *When* $x = \frac{1}{3}$; $y = \left(\frac{1}{3}\right)^3 + \left(\frac{1}{3}\right)^2 - \left(\frac{1}{3}\right) + 5$ $= 44\frac{22}{27}$ $\therefore B\left(\frac{1}{3}, 44\frac{22}{27}\right)$ $\frac{d^2y}{dx^2} = 6x + 2$ $= 6\left(\frac{1}{3}\right) + 2$ $= 4 > 0$ $\therefore B\left(\frac{1}{3}, 44\frac{22}{27}\right)$ ialah titik minimum / *is a minimum point.*	 1 1 1	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
12	(*a*) Halaju maksimum / *Maximum velocity*: $a_P = 0$ $\frac{dv_P}{dt} = 0$ $2t - 1 = 0$	1	
	$t = \frac{1}{2}$	1	
	Apabila / *When* $t = \frac{1}{2}$; $v_P = \left(\frac{1}{2}\right)^2 - \left(\frac{1}{2}\right) - 6$ $= -6\frac{1}{4}$ m s^{-1}	1	
	(*b*) Halaju maksimum / *Maximum velocity*: $v_P = 0$ $t^2 - t - 6 = 0$ $(t + 2)(t - 3) = 0$	1	
	$t + 2 = 0$, $t - 3 = 0$ $t = -2$ (Abaikan / *Ignore*) $t = 3$ $s_P = \int (t^2 - t - 6)\, dt$ $= \frac{t^3}{3} - \frac{t^2}{2} - 6t + c$ Apabila / *When* $t = 0$, $s_P = 0$; $s_P = \frac{t^3}{3} - \frac{t^2}{2} - 6t + c$ $0 = \frac{(0)^3}{3} - \frac{(0)^2}{2} - 6(0) + c$ $0 = c$ $\therefore s_P = \frac{t^3}{3} - \frac{t^2}{2} - 6t$	1	
	Apabila / *When* $t = 3$; $s_P = \frac{(3)^3}{3} - \frac{(3)^2}{2} - 6(3)$ $s_P = -13\frac{1}{2}$ m	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*c*) $s_Q = \int v_Q \, dt$ $= \int(-7) \, dt$ $= -7t + c$ Apabila / *When* $t = 0$, $s_Q = 0$; $s_Q = -7t + c$ $0 = -7(0) + c$ $0 = c$ $\therefore s_Q = -7t$ Apabila / *When* $t = 3$; $s_Q = -7(3)$ $s_Q = -21$ m (Q berada 21 m dari titik B / Q *is* 21 m *from point* B) Kedudukan Q dari A / *Position of* Q *from* A: 25 m – 21 m = 4 m $\therefore$ Bola Q berada 4 m di sebelah kanan titik A. *Ball* Q *is* 4 m *to the right of point* A.	1 1 1 1	**10**
13	(*a*) P: $I_{22/19} = 150$ $\frac{x}{9.10} \times 100 = 150$ $x = 13.65$ Q: $I_{22/19} = \frac{2.50}{1.50} \times 100$ $y = 166.67$ R: $I_{22/19} = 165$ $\frac{21}{z} \times 100 = 165$ $z = 12.73$	1 1 1	
	(*b*) $I_{22/19} = \frac{(55)(150) + (166.67)(30) + (15)(165)}{55 + 15 + 30}$ $= 157.25$	2 1	
	(*c*) $I_{23/22} = 130$ $I_{23/19} = \frac{157.25 \times 130}{100}$ $= 204.43$ $\frac{P_{2023}}{P_{2019}} \times 100 = 204.43$ $\frac{45 - 12}{P_{2019}} \times 100 = 204.43$ $P_{2019} = \text{RM}16.14$	1 1 1 1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
14	(*a*) (i) $\frac{1}{2}(7)(BC)\sin 43° = 16 \text{ unit}^2$ $BC = 6.703$	1 1	
	(ii) $AC^2 = 7^2 + (6.703)^2 - 2(7)(6.703)\cos 43°$ $AC^2 = 25.2985$ $AC = \sqrt{25.2985}$ $AC = 5.0298$ cm	1 1	
	(iii) $\frac{\sin \angle ACB}{7} = \frac{\sin 43°}{5.0298}$ $\sin \angle ACB = 0.9491$ $\angle ACB = \sin^{-1} 0.9491$ $= 71.64°$	1 1	
	(*b*) (i)  	1	
	(ii) $\angle AC'B = 180° - 71.64°$ $= 108.36°$	1	
	(iii)  		
	$\sin 43° = \frac{h}{7}$ $h = 7 \sin 43°$ $h = 4.774$ cm	1 1	**10**
15	(*a*) I $85x + 60y \leqslant 6\,500$ II $x + y \geqslant 55$ III $y \geqslant x$	1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Markah Total *Total Marks*
	(*b*)  	4	
	(*c*) (i) Bila $x = 30$, nilai minimum bagi $y = 30$. Maka, bilangan minimum rak kasut yang dibuat jika 30 buah rak buku yang dihasilkan ialah 30. *When* $x = 30$, *the minimum value of* $y = 30$. *Hence, the minimum number of shoe rack made if* 30 *of bookshelves made is* 30.	1	
	(ii) Keuntungan / *Profit* $= 30x + 20y$ Katakan / *Let* $30x + 20y = 600$ $3x + 2y = 60$ Untuk melukis garis lurus / *To draw straight line* $3x + 2y = 60$ x: 0, 20 y: 30, 0 Titik optimum ialah / *The optimal point is* (45, 45).	1	
	Keuntungan maksimum / *Maximum profit* = RM30(45) + RM20(45) = RM2 250	1	**10**