Yakin

JAWAPAN DAN ULASAN

KERTAS SOALAN PEPERIKSAAN SEBENAR SPM 2021-2024

MATEMATIK TAMBAHAN

Dwibahasa

SIJIL PELAJARAN MALAYSIA 2021

KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	$\angle AOB$ major $= 2\pi - \frac{\pi}{3}$ $= \frac{5}{3}\pi$ Luas / *Area* $= \frac{1}{2}(2)^2\left(\frac{5}{3}\pi\right)$ $= \frac{10}{3}\pi \text{ cm}^2$	 1 1	2
2	$m = \frac{7-1}{5-2} = 2$ $\frac{c-1}{0-2} = 2$ $c - 1 = -4$ $c = -3$ $\ln y = 2\ln x - 3$ $\ln y - \ln x^2 = -3$ $\ln\left(\frac{y}{x^2}\right) = -3$ $\frac{y}{x^2} = e^{-3}$ $y = \frac{x^2}{e^3}$	1 1 1 1	4

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
3	(*a*) $S_n < 650$ $217\left[\dfrac{1-\left(\frac{2}{3}\right)^n}{1-\frac{2}{3}}\right] < 650$ $1-\left(\frac{2}{3}\right)^n < \frac{650}{651}$ $1-\frac{650}{651} < \left(\frac{2}{3}\right)^n$ $\frac{1}{651} < \left(\frac{2}{3}\right)^n$ $\left(\frac{2}{3}\right)^n > \frac{1}{651}$ $n < \dfrac{\lg\left(\frac{1}{651}\right)}{\lg\left(\frac{2}{3}\right)}$ $n < 15.97$ $n = 15$	1 1	
	(*b*) $S_\infty - T_5 = \dfrac{217}{1-\frac{2}{3}} - 217\left(\frac{2}{3}\right)^4$ $= 651 - \frac{3\,472}{81}$ $= 608\frac{11}{81}$	2 1	5
4	(*a*) $\dfrac{dy}{dx} = 1 - \dfrac{4}{x^3}$	1	
	(*b*) $y = -2x$ $m_1 = -2$ $m_2 = \frac{1}{2}$ $1 - \frac{4}{x^3} = \frac{1}{2}$ $\frac{1}{2} = \frac{4}{x^3}$ $x = 2$ Gantikan $x = 2$ ke dalam *Substitute $x = 2$ into* $y = x + \frac{2}{x^2}$ $= 2 + \frac{2}{x^2}$ $= 2 + \frac{2}{4}$ $= \frac{5}{2}$ $P\left(2, \frac{5}{2}\right)$	1 1 1	4

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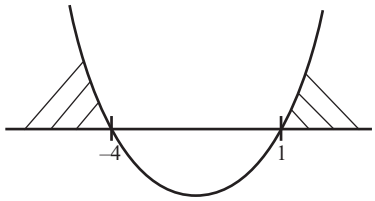
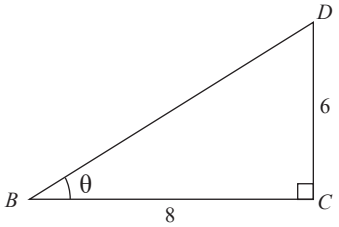
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
5	(*a*) $f(x) > 0$ $x^2 + 3x - 4 > 0$ $(x + 4)(x - 1) > 0$  $x < -4, x > 1$	1 1	
	(*b*) (i) $px + q - (x^2 + 3x - 4) = 0$ $-x^2 + (p - 3)x + q + 4 = 0$ $x^2 - (p - 3)x - q - 4 = 0$ $\alpha + \beta = p - 3$ $\alpha\beta = -q - 4$ (ii) $x^2 + rx + r - 10 = 0$ $\frac{2}{\alpha} + \frac{2}{\beta} = -r$ dan / *and* $\left(\frac{2}{\alpha}\right)\left(\frac{2}{\beta}\right) = r - 10$ $\frac{2}{\alpha} + \frac{2}{\beta} = -r$ $2\left(\frac{\beta + \alpha}{\alpha\beta}\right) = -r$ $\frac{2(p - 3)}{-q - 4} = -r$ $r = \frac{2(p - 3)}{q + 4}$ $\left(\frac{2}{\alpha}\right)\left(\frac{2}{\beta}\right) = r - 10$ $\frac{4}{\alpha\beta} = r - 10$ $\frac{4}{-q - 4} = r - 10$ $r = \frac{-4}{q + 4} + 10$ $\frac{2(p - 3)}{q + 4} = \frac{-4}{q + 4} + 10$ $2(p - 3) = -4 + 10(q + 4)$ $2(p - 3) = 10q + 36$ $p - 3 = 5q + 18$ $p = 5q + 21$	 1 1 1 1 1	7

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
6	(*a*) 		
	$\tan\theta = \frac{6}{8}$	1	
	$\theta = \tan^{-1}\left(\frac{6}{8}\right)$		
	$\theta = 0.6435$ radian	1	
	(*b*) $BD = \sqrt{6^2 + 8^2} = 10$ cm		
	$\angle ABH = \frac{\pi}{3}$ rad		
	$\angle HBD = \pi - \frac{\pi}{3} - 0.6435 = 1.451$ rad		
	$\angle GAH = \frac{\pi}{2} - \frac{\pi}{3} = \frac{\pi}{6}$ rad		
	$EF = \sqrt{12^2 + 18^2} = 21.63$ cm	1	
	$S_{GH} = 10\left(\frac{\pi}{6}\right) = \frac{5\pi}{3}$ cm		
	$S_{HD} = 10(1.451) = 14.51$	1	
	Perimeter $= 10 + \frac{5\pi}{3} + 14.51 + 2 + 21.63$	1	
	$= 53.38$ cm	1	6
7	(*a*) $\lvert \overrightarrow{ED} + \overrightarrow{DB} + \overrightarrow{BE} \rvert = 0$	1	
	(*b*) $\overrightarrow{EC} = 11\underline{i} + 4\underline{i} + 10\underline{j}$	1	
	$= 15\underline{i} + 10\underline{j}$	1	
	(*c*) $\begin{pmatrix}1\\1\end{pmatrix} + \begin{pmatrix}3\\4\end{pmatrix}t = \begin{pmatrix}5\\p\end{pmatrix}$	1	
	$1 + 3t = 5$		
	$t = \frac{4}{3}$	1	
	$1 + 4t = p$		
	$1 + 4\left(\frac{4}{3}\right) = p$		
	$\frac{3 + 16}{3} = p$		
	$p = \frac{19}{3}$	1	6

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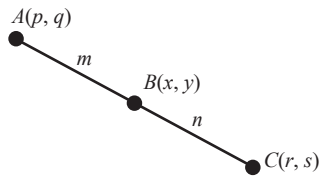
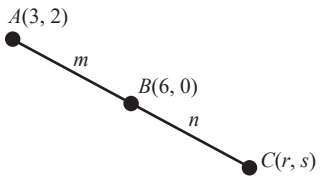
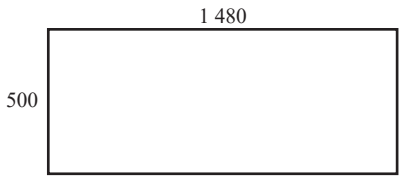
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*)  $\frac{q-y}{y-s}=\frac{m}{n}$ $nq-ny=my-ms$ $ms+nq=(m+n)y$ $y=\frac{ms+nq}{m+n}$ $\frac{x-p}{r-x}=\frac{m}{n}$ $nx-np=mr-mx$ $(m+n)x=mr+np$ $x=\frac{mr+np}{m+n}$ $(x, y)=\left(\frac{mr+np}{m+n}, \frac{ms+nq}{m+n}\right)$	1 1	
	(*b*) (i)  $\frac{m}{n}=\frac{6-3}{r-6}$ $\frac{m}{n}=\frac{3}{r-6}$ $m \leqslant n$ $r-6 \geqslant 3$ $r \geqslant 9$ $\frac{m}{n}=\frac{2-0}{0-s}$ $\frac{m}{n}=\frac{2}{-s}$ $m \leqslant n$ $2 \leqslant -s$ $s \leqslant -2$ (ii) $m_{AB}=\frac{2-0}{3-6}=-\frac{2}{3}$ $m=-\frac{p}{6}$ $-\frac{p}{6}=-\frac{2}{3}$ $p=4$	1 1 1 1	6

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
9	(*a*) $g(x) = -3x^2 + 8x - 4$	1	
	(*b*) Kawasan berlorek / *Shaded area* $= \int_1^2 (x^3 - 6x^2 + 12x - 6)\,dx - [-x^3 + 4x^2 - 4x]_1^2$	2	
	$= \left[\frac{x^4}{4} - \frac{6x^3}{3} + \frac{12x^2}{2} - 6x + x^3 - 4x^2 + 4x\right]_1^2$	1	
	$= \left[\frac{x^4}{4} - x^3 + 2x^2 - 2x\right]_1^2$ $= \left[\frac{2^4}{4} - 2^3 + 2(2)^2 - 2(2)\right] - \left[\frac{1}{4} - 1^3 + 2(1)^2 - 2(1)\right]$ $= \left(\frac{16}{4} - 8 + 8 - 4\right) - \left(\frac{1}{4} - 1 + 2 - 2\right)$ $= 0 - \left(-\frac{3}{4}\right)$ $= \frac{3}{4}$ unit^2	1	5
10	(*a*) $(x, x + 20, x + 40)$ mm	1	
	(*b*) $a = x$ $T_{72} = x + (72 - 1)(20)$ $= x + 1\,420$ $S_{72} = 55\,440$	1	
	$\frac{72}{2}(x + x + 1\,420) = 55\,440$ $2x + 1\,420 = \frac{55\,440}{36}$ $x = 60$	1	
	18 kepingan terakhir / *Last* 18 *terms*: $T_{55}, T_{56}, \ldots, T_{72}$ $S_{18} = \frac{18}{2}[2(60 + 30(20)) + (18 - 1)(20)]$	1	
	$= 14\,940$ mm	1	
	(*c*) **Cara 1 / *Method* 1** $60 + (72 - 1)(20) = 1\,480$  $2\pi r = 1\,480$ $r = \frac{1\,480}{2}$ $= \frac{740}{\pi}$ $60 + (72 - 1)(20) = 1\,480$ dan / *and* $r = \frac{740}{\pi}$	1	

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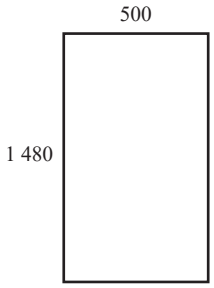
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$V_1 = \pi r^2 h$ $= \pi\left(\frac{740}{\pi}\right)^2(500)$ $= \frac{273\ 800\ 000}{\pi}\ \text{mm}^3$ $= \frac{2.738 \times 10^8}{\pi}\ \text{mm}^3$ **Cara 2 / *Method* 2**  $2\pi r = 500$ $r = \frac{500}{2\pi}$ $= \frac{250}{\pi}$ $V_2 = \pi r^2 h$ $= \pi\left(\frac{250}{\pi}\right)^2(1\ 480)$ $= \frac{92\ 500\ 000}{\pi}\ \text{mm}^3$ $= \frac{9.25 \times 10^7}{\pi}\ \text{mm}^3$ $V_1 = \pi\left(\frac{740}{\pi}\right)^2(500)$ dan / *and* $V_2 = \pi\left(\frac{250}{\pi}\right)^2(1\ 480)$ Cara 1 membentuk silinder dengan isi padu maksimum: *Method* 1 *forms a cylinder with maximum volume*: $V_1 = \frac{2.738 \times 10^8}{\pi}\ \text{mm}^3$ dan / *and* $r = \frac{740}{\pi}$	1 1	**8**
11	(*a*) (i) $6! = 720$ (ii) $\frac{1\ \text{kad / } card}{3\ \text{kad / } cards}$ atau / *or* $\frac{2\ \text{kad / } cards}{2\ \text{kad / } cards}$ $\frac{1\ \text{kad / } card}{3\ \text{kad / } cards} = 4 \times 2! \times 2! \times 3$ $= 48$ cara / *ways* $\frac{2\ \text{kad / } cards}{2\ \text{kad / } cards}$: $\frac{15\ \text{atau / } or\ 17\ \text{atau / } or\ 19}{26\ \text{atau / } or\ 62} = 6$ cara / *ways* : $\frac{51\ \text{atau / } or\ 57\ \text{atau / } or\ 59}{62} = 3$ cara / *ways*	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	: $\frac{26}{51 \text{ atau / } or \text{ } 57 \text{ atau / } or \text{ } 59} + \frac{26}{71 \text{ atau / } or \text{ } 75 \text{ atau / } or \text{ } 79} + \frac{26}{91 \text{ atau / } or \text{ } 95 \text{ atau / } or \text{ } 97} = 9$ cara / *ways* : $\frac{62}{71 \text{ atau / } or \text{ } 75 \text{ atau / } or \text{ } 79} = 3$ cara / *ways* : $\frac{62}{91 \text{ atau / } or \text{ } 95 \text{ atau / } or \text{ } 97} = 3$ cara / *ways* ATAU / *OR* ${}^1P_1 \times {}^1P_1 \times {}^3P_1 \times {}^3P_1$ atau / *or* ${}^1P_1 \times {}^1P_1 \times {}^2P_1 \times {}^3P_1$ atau / *or* ${}^1P_1 \times {}^3P_1 \times {}^1P_1 \times {}^1P_1$ atau / *or* ${}^2P_1 \times {}^3P_1 \times {}^1P_1 \times {}^1P_1$ atau / *or* ${}^4P_2 \times 1 \times 1$ Jumlah bilangan cara / *Total number of ways*: $= 48 + 6 + 3 + 9 + 3 + 3$ $= 72$	2 1	
	(*b*) (i) $n = 0$ (ii) ${}^pC_3 = 26(p-2)$ $\frac{p!}{(p-3)!3!} = 26(p-2)$ $\frac{p(p-1)(p-2)(p-3)!}{(p-3)!(6)} = 26(p-2)$ $p(p-1) = 26(6)$ $p(p-1) = 13(12)$ $p = 13$	1 1 1	7
12	(*a*) $P(X=2) + P(X=3) = 1 - \frac{81}{128} - \frac{1}{64}$ $= \frac{45}{128}$	1	
	(*b*) ${}^5C_2(p)^2(q)^3 + {}^5C_3(p)^3(q)^2 = \frac{45}{128}$ $10p^2q^3 + 10p^3q^2 = \frac{45}{128}$ $10p^2q^2(q+p) = \frac{45}{128}$ $p^2q^2(q+p) = \frac{9}{256}$ $p^2q^2(1) = \frac{9}{256}$ $pq = \frac{3}{16}$ $p = \frac{3}{16q}$ Tertunjuk / *Shown*	1 1 1	4

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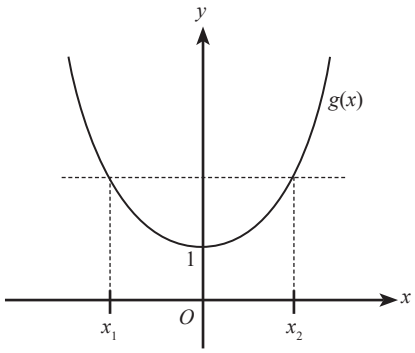
Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
13	(*a*) $\frac{3}{4x-1} = \frac{1}{3}$ $x = \frac{5}{2}$	1 1	
	(*b*) $f(m+1) = 3fg(p)$ $\frac{3}{4(m+1)-1} = 3\left(\frac{3}{4p^2+3}\right)$ $3(4m+4-1) = 4p^2+3$ $12m+9 = 4p^2+3$ $m = \frac{4p^2-6}{12}$ $m = \frac{2p^2-3}{6}$	1 1	
	(*c*) (i) $\frac{3}{4g(x)-1} = \frac{3}{4x^2+3}$ $4g(x)-1 = 4x^2+3$ $g(x) = x^2+1$ (ii) Ujian garis mengufuk *Horizontal line test*  Bukan hubungan satu kepada satu *Not one to one relationship*	1 1 1 1	8
14	(*a*) $(2^{x+1})^2 + \left(\sqrt{2^x}\right)^2 = \left(3\sqrt{2}\right)^2$ $4(2^{2x}) + 2^x = 18$ $4(2^{2x})^2 + 2^x - 18 = 0$ $[4(2^x)+9][2^x-2] = 0$ $4(2^x)+9 = 0$ $2^x = -\frac{9}{4}$ $2^x > 0$ $2^x = -\frac{9}{4}$ (tidak mungkin / *not possible*) $2^x - 2 = 0$ $2^x = 2$ $x = 1$	1 1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\frac{(5+\sqrt{7})t}{2} = 9(\sqrt{7}-1)$ $(5+\sqrt{7})t = 18\sqrt{7}-18$ $t = \frac{18\sqrt{7}-18}{5+\sqrt{7}} \times \frac{5-\sqrt{7}}{5-\sqrt{7}}$ $= \frac{90\sqrt{7}-126-90+18\sqrt{7}}{25-7}$ $= \frac{108\sqrt{7}-216}{18}$ $= 6\sqrt{7}-12$	1 1 1 1	**8**
15	(*a*) $\sin x = t$ kos / $\cos x = \pm\sqrt{1-t^2}$ $0 < x < 90°$ kos / $\cos x = \sqrt{1-t^2}$ $\sin 2x = 2t\sqrt{1-t^2}$	 1 1	
	(*b*) $2\,\text{kos}^2 / \cos^2\left(\frac{\theta}{2}\right) - 1 = k$ kos / $\cos\left(\frac{\theta}{2}\right) = \pm\sqrt{\frac{1+k}{2}}$ $270° < \theta < 360°$ $135° < \frac{\theta}{2} < 180°$ kos / $\cos\left(\frac{\theta}{2}\right) < 0$ kos / $\cos\left(\frac{\theta}{2}\right) = -\sqrt{\frac{1+k}{2}}$	1 1	
	(*c*) $\tan 45° = \frac{2\tan 22.5°}{1-\tan^2 22.5°}$ Biarkan / *Let* $\tan 22.5° = t$ $1 = \frac{2t}{1-t^2}$ $1-t^2 = 2t$ $t^2+2t-1=0$ $t = \frac{-2\pm\sqrt{2^2-4(1)(-1)}}{2(1)}$ $= \frac{-2\pm\sqrt{8}}{2}$ $t = \frac{-2+\sqrt{8}}{2}$ dan / *and* $t = \frac{-2-\sqrt{8}}{2}$ $\tan 22.5° > 0$ $\tan 22.5° = \frac{-2+2\sqrt{2}}{2}$ $= \sqrt{2}-1$	1 1 1 1	**8**

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KERTAS 2

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	$4x + y + 2z = 0$ ..... ① $-2x + 3y + z = 8$ ..... ② $x - y - z = -\frac{1}{2}$ ..... ③ Dari / *Form* ① : $y = -4x - 2z$ ..... ④	1	
	Ganti ④ ke dalam ② *Substitute* ④ *into* ② $-2x + 3(-4x - 2z) + z = 8$ $-2x - 12x - 6z + z = 8$ $-14x - 5z = 8$ $x = \frac{-5z - 8}{14}$ ..... ⑤	1	
	Ganti ④ dan ⑤ ke dalam ③ *Substitute* ④ *and* ⑤ *into* ③ $\left(\frac{-5z-8}{14}\right) - \left[-4\left(\frac{-5z-8}{14}\right) - 2z\right] - z = -\frac{1}{2}$ $-5z - 8 - 20z - 32 + 28z - 14z = -7$ $-11z = 33$ $z = -3$	1	
	$x = \frac{-5(-3) - 8}{14} = \frac{1}{2}$	1	
	$y = -4\left(\frac{1}{2}\right) - 2(-3) = 4$	1	
	$x = \frac{1}{2}$; $y = 4$; $z = -3$		5
2	(*a*) $\sqrt{0.25}$ bukan suatu surd kerana ia merupakan nombor nisbah. $\sqrt{0.25}$ *is not a surd because it is a rational number.*	1	
	(*b*) (i) $\log_a b = x$ $b = a^x$	1	
	$\log_c b = \log_c a^x$ $\log_c b = x \log_c a$	1	
	$x = \frac{\log_c b}{\log_c a}$ $\log_a b = \frac{\log_c b}{\log_c a}$	1	
	(ii) $\log_3 h + \log_9 k = \log_3 h + \frac{\log_3 k}{\log_3 9}$	1	
	$= \log_3 h + \frac{\log_3 k}{\log_3 3^2}$	1	
	$= \log_3 h + \frac{\log_3 k}{2}$ $= \log_3 h + \frac{1}{2}\log_3 k$ $= \log_3 h + \log_3 k^{\frac{1}{2}}$ $= \log_3 hk^{\frac{1}{2}}$	1	7

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
3	(*a*) $gf(x) = 3x - 4$, $f(x) = x + 2$ $g(x + 2) = 3x - 4$ $f^{-1}(x) = y$ $f(y) = x$ $y + 2 = x$ $y = x - 2$ $f^{-1}(x) = x - 2$ $g(x) = gf[f^{-1}(x)]$ $= 3(x - 2) - 4$ $= 3x - 10$	1 1 1	
	(*b*) (i) $f^2(x) = ff(x)$ $= (x + 2) + 2$ $= x + 4$ (ii) $f^3(x) = ff^2(x)$ $= (x + 4) + 2$ $= x + 6$ $f^n(x) = x + 2n$	 1 1 1 1	7
4	(*a*) $f(x) = (x - 3)^2 + k$ $f(0) = 5$ $(0 - 3)^2 + k = 5$ $9 + k = 5$ $k = -4$	 1 1	
	(*b*) (i) $f(x) = (x - 3)^2 - 4$ $= x^2 - 6x + 9 - 4$ $= x^2 - 6x + 5$ $f(x) = 0$ $x^2 - 6x + 5 = 0$ $(x - 1)(x - 5) = 0$ $x = 1, 5$ Punca-punca bagi graf fungsi $f(x)$ dan $g(x)$ ialah 1 dan 5. *The roots of graph $f(x)$ and graph $g(x)$ are 1 and 5.* $g(1) = 0$ $-3(1)^2 + (m - 4)(1) - 15 = 0$ $-3 + m - 4 - 15 = 0$ $m - 22 = 0$ $m = 22$ (ii) $g(x) = -3x^2 + 18x - 15$ $= -3(x^2 - 6x + 5)$ $= -3\left[x^2 - 6x + \left(\frac{-6}{2}\right)^2 - \left(\frac{-6}{2}\right)^2 + 5\right]$ $= -3(x - 3)^2 + 12$ Titik maksimum / *Maximum point* = (3, 12)	 1 1 1 1 1	7

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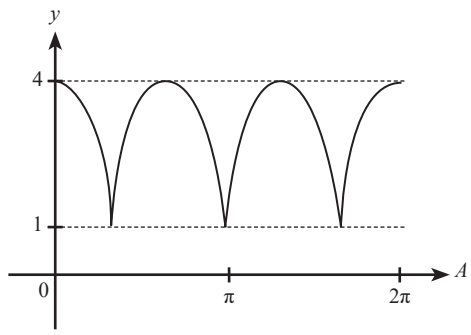
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
5	(*a*) (i) $2\,\text{kot}^2 A \sin^2 A = 2\left(\frac{\text{kos}^2 A}{\sin^2 A}\right)\sin^2 A$ $= 2\,\text{kos}^2 A$ $= (2\,\text{kos}^2 A - 1) + 1$ $= 1 + \text{kos}\,2A$ $2\cot^2 A \sin^2 A = 2\left(\frac{\cos^2 A}{\sin^2 A}\right)\sin^2 A$ $= 2\cos^2 A$ $= (2\cos^2 A - 1) + 1$ $= 1 + \cos 2A$	1 1	
	(ii) $2\,\text{kot}^2 A \sin^2 A = \frac{1}{2}$ $1 + \text{kos}\,2A = \frac{1}{2}$ $\text{kos}\,2A = -\frac{1}{2}$ $\alpha = \text{kos}^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{3}$ $2\cot^2 A \sin^2 A = \frac{1}{2}$ $1 + \cos 2A = \frac{1}{2}$ $\cos 2A = -\frac{1}{2}$ $\alpha = \cos^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{3}$ $2A = \pi - \frac{\pi}{3}, \pi + \frac{\pi}{3}$ $A = \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$	1 1 1	
	(*b*) 	4	9
6	(*a*) (i) $\overrightarrow{OX} = \overrightarrow{OA} + \overrightarrow{AX}$ $= 4\underline{a} + \underline{b}$ (ii) $\overrightarrow{BY} = \overrightarrow{BA} + \overrightarrow{AY}$ $= -3\underline{b} + (-\underline{a})$ $= -3\underline{b} - \underline{a}$	1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\overrightarrow{BP} = k\overrightarrow{BY}$ $\overrightarrow{OP} = \lambda\overrightarrow{OX}$ $\overrightarrow{BP} = \overrightarrow{BO} + \overrightarrow{OP}$ $k\overrightarrow{BY} = \left(\overrightarrow{BA} + \overrightarrow{AO}\right) + \lambda(4\underline{a} + \underline{b})$ $k(-\underline{a} - 3\underline{b}) = (-3\underline{b} - 4\underline{a}) + \lambda(4\underline{a} + \underline{b})$ $-k\underline{a} - 3k\underline{b} = (-4 + 4\lambda)\underline{a} + (-3 + \lambda)\underline{b}$ $-4 + 4\lambda = -k$ ..... ① $-3 + \lambda = -3k$ ..... ② $\lambda = 3 - 3k$ ..... ③ Gantikan ③ ke dalam ① *Substitute* ③ *into* ① $-4 + 4(3 - 3k) = -k$ $-4 + 12 - 12k = -k$ $k = \frac{8}{11}$ $\overrightarrow{BP} = \frac{8}{11}\overrightarrow{BY}$ $BP : PY = 8 : 3$	1 1 1 1 1	8
7	(*a*) $\frac{dy}{dx} = 2x - 2$ $y = \int(2x - 2)\,dx$ $= \frac{2x^2}{2} - 2x + c$ $x = -2, y = -7$ $-7 = (-2)^2 - 2(-2) + c$ $c = -15$ $y = x^2 - 2x - 15$	 1 1 1	
	(*b*) $y = (x + 1)^2 - 2(x + 1) - 15$ $y = x^2 + 2x + 1 - 2x - 2 - 15$ $y = x^2 - 16$ $x^2 = y + 16$ $V = \pi\int_{-16}^{0}(y + 16)\,dy$ $= \pi\left[\frac{y^2}{2} + 16y\right]_{-16}^{0}$ $= \pi\left[\frac{0^2}{2} + 16(0)\right] - \pi\left[\frac{(-16)^2}{2} + 16(-16)\right]$ $= 128\pi$	1 1 1 1	7

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*) (i) $A = (26 - 2x)(x)$ $= 26x - 2x^2$ (ii) $\frac{dA}{dx} = 0$ $26 - 4x = 0$ $x = 6.5$ cm $A_{\text{maksimum / maximum}} = 26(6.5) - 2(6.5)^2$ $= 84.5\ \text{cm}^2$	 1 1 1 1	

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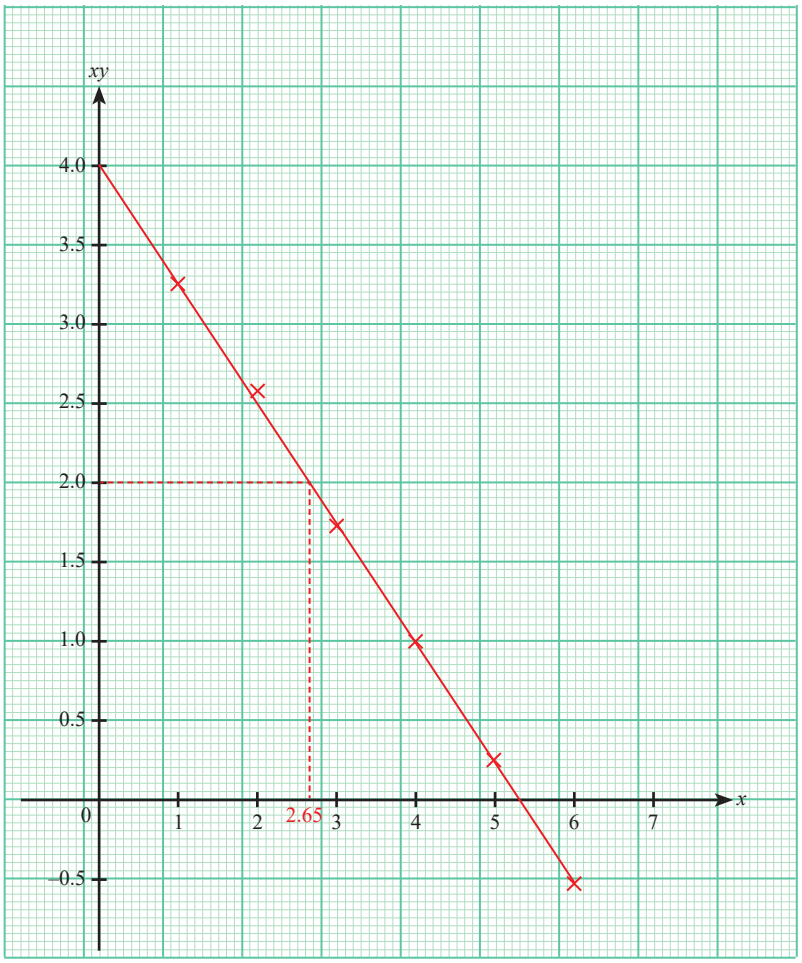
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\frac{dA}{dt} = 36 \text{ cm}^2 \text{ s}^{-1}, x = \sqrt{5}$ $\frac{dA}{dt} = \frac{dA}{dx} \times \frac{dx}{dt}$ $36 = \left[26 - 4\left(\sqrt{5}\right)\right] \times \frac{dx}{dt}$ $\frac{dx}{dt} = 2.11 \text{ cm s}^{-1}$ $x = \int \left(\frac{dx}{dt}\right) dt$ $= \int 2.11 \, dt$ $= 2.11t + c$ $t = 0, x = \sqrt{5}$ $\sqrt{5} = 2.11(0) + c$ $c = \sqrt{5}$ $x = 2.11t + \sqrt{5}$ $t = 3, x = 2.11(3) + \sqrt{5}$ $= 8.57$ cm	2 1 1	
	(*c*) $\delta x = 1.98 - 2 = -0.02$ cm $\delta A \approx \frac{dA}{dx} \times \delta x$ $\approx [26 - 4(2)] \times (-0.02)$ $\approx -\frac{9}{25} \text{ cm}^2$	1 1	**10**
9	(*a*) (i) $(x, y) = \left(\frac{3+7}{2}, \frac{2+(-6)}{2}\right)$ $= (5, -2)$ $(5, -2) = \left(\frac{2x + 3(-1)}{2+3}, \frac{2y + 3(-8)}{2+3}\right)$ $5 = \frac{2x-3}{5}$ $\quad -2 = \frac{2y-24}{5}$ $25 = 2x - 3$ $\quad -10 = 2y - 24$ $2x = 28$ $\quad 2y = 14$ $x = 14$ $\quad y = 7$ $D(14, 7)$ (ii) Luas / *Area* ΔCDE $= \frac{1}{2}\begin{vmatrix} 5 & 14 & 7 & 5 \\ -2 & 7 & -6 & -2 \end{vmatrix}$ $= \frac{1}{2}\lvert[5 \times 7 + 14 \times (-6) + 7 \times (-2)] - [-2 \times 14 + 7 \times 7 + (-6) \times 5]\rvert$ $= \frac{1}{2}\lvert -54 \rvert$ $= 27 \text{ unit}^2$	1 1 1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $m_{PA} = \dfrac{y-2}{x-3}$, $m_{PB} = \dfrac{y-(-8)}{x-(-1)}$	1	
	$\left(\dfrac{y-2}{x-3}\right)\left(\dfrac{y-(-8)}{x-(-1)}\right) = -1$	1	
	$y^2 + 8y - 2y - 16 = -(x^2 + x - 3x - 3)$ $x^2 + y^2 - 2x + 6y - 19 = 0$	1	
	(ii) $x = 5, y = -2$ $5^2 + (-2)^2 - 2(5) + 6(-2) - 19 = -12$	1	
	$-12 \neq 0$, maka lokus P tidak melalui C $-12 \neq 0$, *therefore locus P does not pass through point C*	1	**10**
10	(*a*)	1	
		3	

x	1	2	3	4	5	6
xy	3.25	2.56	1.74	1.00	0.25	–0.54

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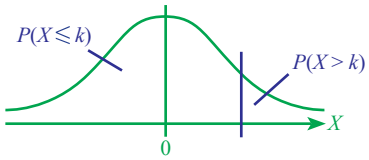
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $y^2 = \frac{4}{x^2}$ $x^2 y^2 = 4$ $(xy)^2 = 4$ $xy = 2$ $x = 2.65$	1	
	(ii) $y + \sqrt{h} = \frac{k^2}{x}$ $xy + x\sqrt{h} = k^2$ $xy = (-\sqrt{h})x + k^2$	1	
	$m = \frac{4-1}{0-4}$ $= -\frac{3}{4}$ $m = -\sqrt{h}$	1	
	$-\sqrt{h} = -\frac{3}{4}$ $\sqrt{h} = \frac{3}{4}$ $h = \frac{9}{16}$	1	
	$c = k^2$ $k^2 = 4$ $k = 2$	1 1	**10**
11	(*a*) (i) $n = 5\,000, p = \frac{97}{1+97+2} = 0.97$ $\mu = np$ $= (5\,000)(0.97)$ $= 4\,850$	 1 1	
	(ii) $p = 0.03, q = 0.97, n = 6, r = 2$ $P(X=2) = {}^6C_2(0.03)^2(0.97)^4$ $= 0.01195$	 1 1	
	(iii) $n = 10, p = \frac{1}{3}, q = \frac{2}{3}, r > 2$ $P(X>2) = 1 - P(X \leqslant 2)$ $= 1 - P(X=0) - P(X=1) - P(X=2)$ $= 1 - {}^{10}C_0\left(\frac{1}{3}\right)^0\left(\frac{2}{3}\right)^{10} - {}^{10}C_1\left(\frac{1}{3}\right)^1\left(\frac{2}{3}\right)^9 - {}^{10}C_2\left(\frac{1}{3}\right)^2\left(\frac{2}{3}\right)^8$ $= 1 - 0.0173 - 0.0867 - 0.1951$ $= 0.7009$	 1 1	
	(*b*) $P(X>k) = \frac{1}{4}[P(X \leqslant k)]$  		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$P(X \leqslant k) + P(X > k) = 1$ $4P(X \leqslant k) + P(X > k) = 1$ $P(X > k) = 0.2$ $\frac{k-12}{\sqrt{25}} = 0.842$ $k = 16.21$	 1 2 1	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
12	(*a*) $v_A = 24t - 4t^2 - 20$ $\frac{dv}{dt} = 0$ $24 - 8t = 0$ $t = 3$ s $v_{\text{maksimum / maximum}} = 24(3) - 4(3)^2 - 20$ $= 16 \text{ m s}^{-1}$	 1 1 1	
	(*b*) (i) $s_A = \int(24t - 4t^2 - 20)\,dt$ $= \frac{24t^2}{2} - \frac{4t^3}{3} - 20t + c$ $t = 0, s_A = 0$ $0 = 12(0)^2 - \frac{4}{3}(0)^3 - 20(0) + c$ $c = 0$ $s_A = 12t^2 - \frac{4}{3}t^3 - 20t$ $s_B = \int(24t - 25)\,dt$ $= \frac{24t^2}{2} - 25t + c$ $t = 0, s_B = 0$ $0 = 12(0)^2 - 25(0) + c$ $c = 0$ $s_B = 12t^2 - 25t$ $s_A = s_B$ $12t^2 - \frac{4}{3}t^3 - 20t = 12t^2 - 25t$ $-\frac{4}{3}t^3 + 5t = 0$ $-t\left(\frac{4}{3}t^2 - 5\right) = 0$ $\frac{4}{3}t^2 = 5$ $t = \sqrt{\frac{15}{4}}$ $= 1.936$ s	1 1 1	

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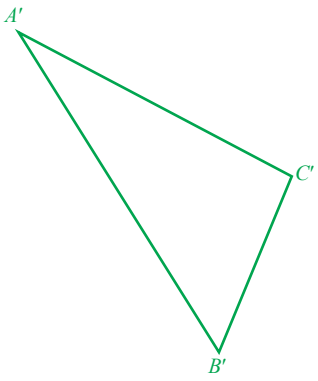
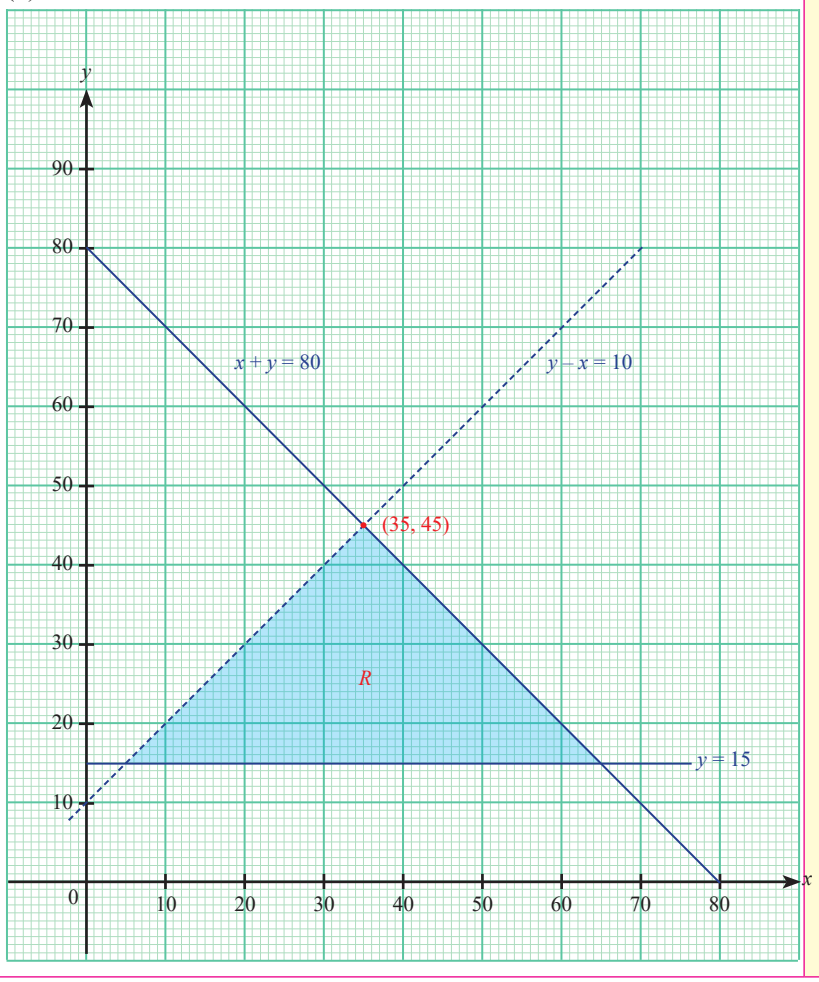
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $v_A = 0$ $24t - 4t^2 - 20 = 0$ $t^2 - 6t + 5 = 0$ $(t-1)(t-5) = 0$ $t = 1$ s, 5 s	1	
	$s = \left\lvert \int_0^1 (24t - 4t^2 - 20)\,dt \right\rvert + \int_1^5 (24t - 4t^2 - 20)\,dt$ $= \left\lvert \left[12t^2 - \frac{4}{3}t^3 - 20t\right]_0^1 \right\rvert + \left[12t^2 - \frac{4}{3}t^3 - 20t\right]_1^5$	1	
	$= \left\lvert \left[12(1)^2 - \frac{4}{3}(1)^3 - 20(1)\right] - \left[12(0)^2 - \frac{4}{3}(0)^3 - 20(0)\right] \right\rvert +$ $\left[\left[12(5)^2 - \frac{4}{3}(5)^3 - 20(5)\right] - \left[12(1)^2 - \frac{4}{3}(1)^3 - 20(1)\right]\right]$	1	
	$= \frac{28}{3} + \frac{128}{3}$ $= 52$ m	1	**10**
13	(*a*) (i) $x = 80$	1	
	(ii) $\frac{2.00}{y} \times 100 = 80$ $y = \text{RM}2.50$	1 1	
	(*b*) $\bar{I}_{20/18} = \frac{108 \times 60 + 104 \times 35 + 80 \times 5}{100}$ $= 105.20$	2 1	
	(*c*) $I_{21/20} = 140$ $I_{21/18} = \frac{105.20 \times 140}{100}$ $= 147.28$	1 1	
	$\frac{(43-5)}{P_{18}} \times 100 = 147.28$ $P_{18} = \text{RM}25.80$	1 1	**10**
14	(*a*) (i) $\frac{1}{2}(2.8)(3)\sin 143° = \frac{1}{2}(3)(3.6)\sin \angle BCD$ $\angle BCD = 152.09°$	1 1	
	(ii) $AC^2 = 2.8^2 + 3^2 - 2(2.8)(3)$ kos / cos $143°$ $AC = 5.50$ cm $CE = 5.50 - 4 = 1.50$ cm	1 1 1	
	(iii) $\frac{2.8}{\sin \angle BCA} = \frac{5.50}{\sin 143°}$ $\sin \angle BCA = 0.3064$ $\angle BCA = 17.84°$	1 1	
	$BE^2 = 3^2 + 1.5^2 - 2(3)(1.5)$ kos / cos $143°$ $BE = 1.64$ cm	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) 	1	
	(ii) $\angle A'B'C' = 37°$	1	**10**
15	(*a*) I : $x + y \leqslant 80$ II : $y - x < 10$ III : $y \geqslant 15$	1 1 1	
	(*b*) 	3	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*c*) (i) 44	1	
	(ii) Titik maksimum / *Maximum point* = (36, 44)	1	
	$a(36) + 4(36) + a(44) = 400$	1	
	$80a = 400 - 144$		
	$a = 3.2$		
	Baki bayaran murid kelas *B* *The balance of payment by a student of class B* = RM3.20	1	**10**

SIJIL PELAJARAN MALAYSIA 2022

KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	(*a*) $x = 6$	1	
	(*b*) $\frac{3p}{6-2} = 9$	1	
	$3p = 36$		
	$p = 12$	1	**3**
2	(*a*) (i) $x^{2k+p} = x^0$		
	$2k + p = 0$		
	$p = -2k$	1	
	(ii) $a^p = (a^{1/k})^6$		
	Bandingkan kuasa / *Comparing power*		
	$p = \frac{1}{k}(6)$		
	$p = \frac{6}{k}$	1	
	(*b*) $3^{y-2x-2} = 3^4$	1	
	Bandingkan kuasa / *Comparing power*		
	$y - 2x - 2 = 4$		
	$y = 2x + 6$	1	**4**
3	(*a*) Jika / *If*		
	$\log_a mn = p,\ mn = a^p$		
	$\log_a m = q,\ m = a^q$		
	$\log_a n = r,\ n = a^r$	1	
	Jadi / *So*,		
	$mn = a^q a^r = a^{q+r}$	1	
	Maka / *Then*,		
	$\log_a mn = q + r = \log_a m + \log_a n$	1	
	(*b*) $\log_u (u+3)(u-1) = 2$	1	
	$(u+3)(u-1) = u^2$	1	
	$u^2 + 2u - 3 = u^2$		
	$2u = 3$		
	$u = \frac{3}{2}$	1	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
4	(*a*) $\frac{dV}{dt} = \frac{-5.5}{60}$ cm^3 s^{-1} $V = x^3$ $\frac{dV}{dx} = 3x^2$ Bila / *When* $x = 15$, $\frac{dV}{dx} = 3(15)^2$ $= 675$ $\frac{dx}{dt} = \frac{dx}{dV} \times \frac{dV}{dt}$ $= \frac{1}{dV} \times \frac{dV}{dt}$ $= \frac{1}{675} \times \frac{-5.5}{60}$ $= \frac{-11}{81\,000}$	1 1 1	
	(*b*) $\int [2g(x) + 3]\, dx$ $= \int 2g(x)\, dx + \int 3\, dx$ $= 2\left(\frac{5}{1 - x^2}\right) + 3x + c$	2 1	6
5	$\overrightarrow{OP} = 2\underline{i} + 3\underline{j}$ $\overrightarrow{OQ} = q\underline{i} + 2q\underline{j}$ $\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$ $= -2\underline{i} - 3\underline{j} + q\underline{i} + 2q\underline{j}$ $= (-2 + q)\underline{i} + (-3 + 2q)\underline{j}$ Vektor unit / *Unit vector*, $\lvert\overrightarrow{PQ}\rvert = 1$ Maka / *Then*, $\sqrt{(-2 + q)^2 + (-3 + 2q)^2} = 1$ $4 - 4q + q^2 + 9 - 12q + 4q^2 = 1$ $5q^2 - 16q + 12 = 0$ $(5q - 6)(q - 2) = 0$ $q = \frac{6}{5}, q = 2$	1 1 1 1 1	4
6	$y = \frac{px}{qx - 1}$ $\frac{1}{y} = \frac{qx - 1}{px}$ $\frac{1}{y} = \frac{q}{p} - \frac{1}{px}$ $\frac{1}{y} = -\frac{1}{p}\left(\frac{1}{x}\right) + \frac{q}{p}$ $-\frac{1}{p} = \frac{1}{8}$ $p = -8$	1 1	

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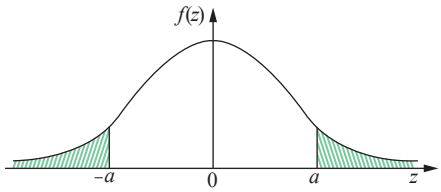
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Ganti / *Substitute*, $p = -8$, $x = \frac{1}{2}$, $y = -6$ $-6 = \dfrac{(-8)\left(\frac{1}{2}\right)}{q\left(\frac{1}{2}\right) - 1}$ $-3q + 6 = -4$ $3q = 10$ $q = \frac{10}{3}$	1 1	4
7	(*a*) $\frac{120\pi}{180} = \frac{2}{3}\pi$	1	
	(*b*) $\angle AOB = \frac{60(3.142)}{180}$ $= 1.047$ rad $h + h + 1.047h = 15.235$ $3.047h = 15.235$ $h = 5$ $\frac{1}{2}(5)^2(1.047) - \frac{1}{2}(k)^2(1.047) = 8.376$ $k^2 = 9$ $k = 3$, $k = -3$ (abai / *ignore*) $k = 3$	 2 1 2 1	7
8	(*a*) 	1	
	(*b*) (i) $k = 0.431$ (ii) Mod bahagian *A* / *Mode for part A* $k = -0.431$	1 1	3
9	(*a*) Benar. Saiz kasut boleh dibilang. *True. Shoe sizes can be counted.*	1	
	(*b*) (i) $P(X \leqslant 1) = 11P(X = 0)$ ${}^nC_0(p^0)(q^n) + {}^nC_1(p^1)(q^{n-1}) = 11\,{}^nC_0(p^0)(q^n)$ $q^n + npq^{n-1} = 11q^n$ $npq^{n-1} = 10q^n$ $\frac{npq^n}{q} = 10q^n$ Banding / *Compare*, $\frac{np}{q} = 10$ $n(1 - q) = 10q$ (ii) $n(1 - q) = 10q$ $np = 10q$ $6 = 10q$ $q = \frac{3}{5}$, $p = \frac{2}{5}$	1 1 1 1	5

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
10	(*a*) (i) $\frac{\text{RM}24}{4} = 6$ ${}^{10}C_6 = 210$ cara / *ways*	1	
	(ii) $({}^{8}C_4 \times {}^{10}C_4) + ({}^{8}C_6 \times {}^{10}C_3) + ({}^{8}C_8 \times {}^{10}C_2)$	2	
	= 18 105 cara / *ways*	1	
	(*b*) (i) $1 \times 1 \times 1 \times 59 \times 58 = 3\,422$	1	
	(ii) $21 \times 4 \times 4 \times 58 \times 62$ (huruf besar bukan vokal diikuti 2 nombor perdana) (*non-vowel capital letter followed by* 2 *prime numbers*) + $21 \times 4 \times 4 \times 4 \times 58$ (huruf besar bukan vokal diikuti 3 nombor perdana) (*non-vowel capital letter followed by* 3 *prime numbers*) + $21 \times 4 \times 4 \times 4 \times 4$ (huruf besar bukan vokal diikuti 4 nombor perdana) (*non-vowel capital letter followed by* 4 *prime numbers*)	2	
	= 1 291 584 cara / *ways*	1	**8**
11	$BD = \sqrt{(2+x)^2 - (2-x)^2}$ $= \sqrt{8x}$	1	
	$\sqrt{x} + \sqrt{8x} = \sqrt{1+\sqrt{2}}$	1	
	Kuasa dua kedua-dua bahagian / *Squaring both sides*, $\left(\sqrt{8x} + \sqrt{x}\right)^2 = \left(\sqrt{1+\sqrt{2}}\right)^2$ $9x + 2x\sqrt{8} = 1 + \sqrt{2}$ $x\left(9 + 2\sqrt{8}\right) = 1 + \sqrt{2}$ $x = \frac{1+\sqrt{2}}{9+2\sqrt{8}} \times \frac{9-2\sqrt{8}}{9-2\sqrt{8}}$	1	
	$= \frac{9 + 5\sqrt{2} - 8}{(9)^2 - \left(2\sqrt{8}\right)^2}$	1	
	$= \frac{1 + 5\sqrt{2}}{(9)^2 - \left(2\sqrt{8}\right)^2}$ $= \frac{1 + 5\sqrt{2}}{49}$	1	**5**
12	(*a*) $T_1 = a$, $T_2 = a + d$, $T_3 = a + d + d$ $= a + 2d$	1	
	$T_1 = a + (1-1)d$ $T_2 = a + (2-1)d$ $T_3 = a + (3-1)d$	1	
	Jadi / *So*, $T_n = a + (n-1)d$	1	

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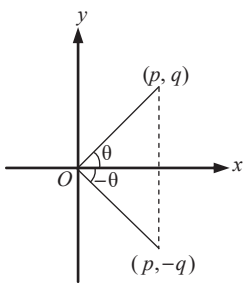
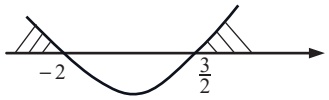
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $\frac{1}{2} \times 12 \times x = 72$ $x = 12$ $T_{31} = a + (31 - 1)d$ $= 12$ Diberi / *Given*, $a = 30d$	1	
	$30d + (31 - 1)d = 12$ $60d = 12$ $d = \frac{1}{5}$	1 1	
	(ii) $a = 30\left(\frac{1}{5}\right)$ $= 6$ Luas / *Area* $= S_{31} \times 12 \times 4 \times 10^{-5}$ cm² kg $= \frac{31}{2}\left[2(6) + (31 - 1)\left(\frac{1}{5}\right)\right] \times 12 \times 4 \times 10^{-5}$ cm² kg $= 0.1339$ cm² kg	2	
	RM9: $\frac{2.5}{0.1339} \approx 18$ gulungan / *rolls* RM6: RM1.20 setiap / *every* 0.5 kg → RM2.40 setiap kg / *every* kg $\frac{6}{2.4} = 2.5$ kg $\frac{2.5}{0.1339} \approx 18$ gulungan / *rolls* 18 + 18 = 36 gulungan / *rolls* 36 × 0.1339 kg = 4.821 kg 5 – 4.821 kg = 0.179 kg → 1 gulung lagi / *more roll* Bilangan gulungan maksimum = 36 + 1 *The number of maximum rolls is* = 37	1	**9**

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
13	(*a*) (i)  	1	
	(ii) $\tan(-\theta) = -\tan\theta$ $= -\frac{q}{p}$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $2 \text{ kos } x = \sqrt{3} \text{ kot } x$ $2 \text{ kos } x = \sqrt{3}\dfrac{\text{kos } x}{\sin x}$ $2 \text{ kos } x \sin x - \sqrt{3} \text{ kos } x = 0$ $\text{kos } x\,(2 \sin x - \sqrt{3}) = 0$ $\text{kos } x = 0,\quad x = 90°, 270°$ $\sin x = \dfrac{\sqrt{3}}{2},\quad x = 60°, 120°$ $x = 60°, 90°, 120°, 270°$	1 2	
	(*c*) $\tan m = \dfrac{p}{1}$ dalam sukuan 3 / *in quadrant* 3 $\text{kos } m = -\dfrac{1}{\sqrt{1+p^2}},\quad \sin m = -\dfrac{p}{\sqrt{1+p^2}}$ $\text{kos}\left(\dfrac{\pi}{3} - m\right) = \text{kos}\dfrac{\pi}{3}\text{ kos } m + \sin\dfrac{\pi}{3}\sin m$ $= \dfrac{1}{2}\text{ kos } m + \dfrac{\sqrt{3}}{2}\sin m$ $= -\dfrac{1}{2\sqrt{1+p^2}} - \dfrac{\sqrt{3}p}{2\sqrt{1+p^2}}$ $= \dfrac{-\sqrt{3}p - 1}{2\sqrt{1+p^2}}$	1 1 1	8
14	(*a*) $-\dfrac{1}{4} + \left[-\dfrac{1}{4} - (-2)\right] = \dfrac{3}{2}$  $x < -2,\ x > \dfrac{3}{2}$	1 1	
	(*b*) $h^2 - 4(2)(-2k + 5) > 0$ $h^2 + 16k - 40 > 0$ $k > \dfrac{40 - h^2}{16}$	1 1	
	(*c*) $f(x) = 2\left[x^2 + \dfrac{h}{2}x\right] - 2k + 5$ $= 2\left[x^2 + \dfrac{h}{2}x + \left(\dfrac{\frac{h}{2}}{2}\right)^2 - \left(\dfrac{\frac{h}{2}}{2}\right)^2\right] - 2k + 5$ $= 2\left(x + \dfrac{h}{4}\right)^2 - 2\left(\dfrac{h}{4}\right)^2 - 2k + 5$ $= 2\left(x + \dfrac{h}{4}\right)^2 - \dfrac{h^2}{8} - 2k + 5$ $-\dfrac{h}{4} = -\dfrac{1}{4}$ $h = 1$ Nilai minimum / *Minimum value* $= -\dfrac{1^2}{8} - 2k + 5$ $= \dfrac{39}{8} - 2k$	1 1 1 1	8

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
15	(*a*) $\frac{y_2 - y}{y - y_1} = \frac{n}{m}$ $my_2 - my = ny - ny_1$ $my_2 + ny_1 = ny + my$ $y(n + m) = my_2 + ny_1$ $y = \frac{ny_1 - my_2}{m + n}$	1 1	
	(*b*) $PR = 2.5x$ $\sqrt{\left(x - \frac{3}{2}\right)^2 + \left[y - \left(-\frac{1}{2}\right)\right]^2} = 2.5x$ $\left(\frac{2x - 3}{2}\right)^2 + \left(\frac{2y + 1}{2}\right)^2 = \left(\frac{5x}{2}\right)^2$ $\frac{4x^2 - 12x + 9}{4} + \frac{4y^2 + 4y + 1}{4} = \frac{25x^2}{4}$ $-21x^2 - 12x + 4y^2 + 4y + 10 = 0$	1 1 1	
	(*c*) $\frac{1}{2}\begin{vmatrix} 1 & 8 & 0 & 2 \\ 12 & 9 & y & 12 \end{vmatrix} = 30$ $\lvert 2(9) + 8y + 0(12) - 12(8) - 9(0) - 2y \rvert = 60$ $\lvert 18 + 8y - 96 - 2y \rvert = 60$ $18 + 8y - 96 - 2y = 60$ $y = 23$ (Abaikan / *Ignore*) atau / *or* $18 + 8y - 96 - 2y = -60$ $y = 3$	1 1 1	8

KERTAS 2

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	(*a*) $g^{-1}(x) = \pm\sqrt{x + 3}$ Tidak. Fungsi *g* tidak mempunyai songsangan. *No. Function g does not have inverse.*	1 1	
	(*b*) (i) $h(x) = fg(x)$ $= 1 - 2(x^2 - 3)$ $= 7 - 2x^2$ (ii) $f^{-1}(x) = \frac{1 - x}{2}$ $\left(\frac{1 - x}{2}\right)^2 - 3 = 1$ $(1 - x)^2 = 16$ $1 - x = \pm 4$ $x = -3, 5$	 2 1 1 1	7

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
2	(*a*) (i) $-2m = -1$ $m = \frac{1}{2}$	1	
	$y - (-2) = \frac{1}{2}(x + 8)$	1	
	$y = \frac{1}{2}x + 2$	1	
	(ii) $\frac{1}{2}x + 2 = -2x - 3$	1	
	$\frac{5}{2}x = -5$ $x = -2$		
	$y = -2(-2) - 3$ $= 1$		
	$\therefore Q(-2, 1)$	1	
	(*b*) $(-2, 1) = \left[\frac{2(-8) + 3(x)}{2 + 3}, \frac{2(-2) + 3(y)}{2 + 3}\right]$	1	
	$\frac{-16 + 3x}{5} = -2$ $x = 2$		
	$\frac{-4 + 3y}{5} = 1$ $y = 3$		
	$\therefore T(2, 3)$	1	7
3	(*a*) $\frac{5}{2} = \alpha + \beta$	1	
	$\frac{p}{2} = \alpha\beta$		
	$2\alpha - 1 + 2\beta - 1 = 2(\alpha + \beta) - 2$ $= 2\left(\frac{5}{2}\right) - 2$ $= 3$		
	$(2\alpha - 1)(2\beta - 1) = 4\alpha\beta - 2(\alpha + \beta) + 1$ $= 4\left(\frac{p}{2}\right) - 2\left(\frac{5}{2}\right) + 1$ $= 2p - 4$	1	
	$x^2 - (3)x + (2p - 4) = 0$ $x^2 - 3x + 2p - 4 = 0$	1	

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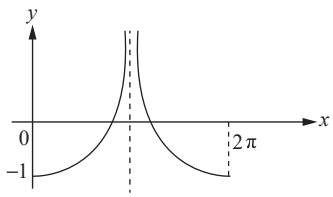
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $2x^2 - 5x + p = x + 1$ $2x^2 - 6x + p - 1 = 0$	1	
	$(-6)^2 - 4(2)(p - 1) = 0$ $36 - 8p + 8 = 0$ $p = \frac{44}{8}$	1	
	$p = \frac{11}{2}$	1	**6**
4	(*a*) $S_4 = 16(S_8 - S_4)$ $\frac{a(r^4 - 1)}{r - 1} = 16\left[\frac{a(r^8 - 1)}{r - 1} - \frac{a(r^4 - 1)}{r - 1}\right]$	1	
	$\left[\frac{a(r^4 - 1)}{r - 1}\right] \times \frac{(r - 1)}{a} = 16\left[\frac{a(r^8 - 1)}{r - 1} - \frac{a(r^4 - 1)}{r - 1}\right] \times \frac{(r - 1)}{a}$ $r^4 - 1 = 16r^8 - 16r^4$ $r^4 - 1 = 16r^8 - 16r^4$ $16r^8 - 17r^4 + 1 = 0$	1	
	Katakan / *Let* $x = r^4$, $16x^2 - 17x + 1 = 0$ $(x - 1)(16x - 1) = 0$ $x = r^4 = 1$ $r = \pm 1$ (Mustahil / *Impossible*) $x = r^4 = \frac{1}{16}$ $r = \pm \frac{1}{2}$ (Abai negatif / *Ignore negative*) $r = \frac{1}{2}$	1	
	(*b*) (i) $T_8 - T_4 = 120$ $ar^7 - ar^3 = 120$ $a\left(\frac{1}{2}\right)^7 - a\left(\frac{1}{2}\right)^3 = 120$	1	
	$\frac{-15}{128}a = 120$ $a = \frac{120}{-\frac{15}{128}}$	1	
	$a = -1\ 024$	1	
	(ii) $S_\infty = \frac{-1\ 024}{1 - \left(\frac{1}{2}\right)}$ $= -2\ 048$	1	**7**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
5	$AB = 2 \times$ Panjang lengkok / *Length of the arc PQ*: $y = 2\left(\frac{3}{2}\pi x\right)$ $y = 3\pi x$.....①	2	
	Luas kawasan tak berumput / *Area of the non-grass region*: $6xy - \frac{1}{4}(3x)^2(\pi) = (90x + 27)\pi$ .....②	1	
	Ganti / *Substitute* ① ke dalam / *into* ②: $6x(3\pi x) - \frac{1}{4}(3x)^2(\pi) = (90x + 27)\pi$ .....③	1	
	③ $\times \frac{1}{\pi}$: $18x^2 - \frac{9x^2}{4} = 90x + 27$ $21x^2 - 120x - 36 = 0$ $7x^2 - 40x - 12 = 0$ $(x - 6)(7x + 2) = 0$ $x = 6, x = -\frac{2}{7}$ (Abai / *Ignore*)	1	
	Ganti / *Substitute* $x = 6$ ke dalam / *into* ①:	1	
	$y = 3\pi(6)$ $= 18\pi$ atau / *or* 56.56	1	7
6	(*a*) $\text{kot}\,\frac{x}{2} - \tan\frac{x}{2}$ $= \frac{1}{\tan\frac{x}{2}} - \tan\frac{x}{2}$ $= \frac{1 - \tan^2\frac{x}{2}}{\tan\frac{x}{2}}$ $= \frac{1}{\left(\frac{\tan\frac{x}{2}}{1 - \tan^2\frac{x}{2}}\right)}$ $= \frac{1}{\frac{1}{2}\tan x}$	1	
	$= 2\,\text{kot}\,x$	1	
	(*b*) (i) 	3	
	(ii) $m < -1$	1	6

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
7	(*a*) (i) $\frac{dy}{dx} : 6 - 2x = 0$ $x = 3$	1	
	$EH = 3 - p + 2p$ $= 3 + p$	1	
	(ii) $\int \frac{dy}{dx} = \int 6 - 2x$ $y = 6x - x^2 + c$ .....①		
	Ganti / *Substitute* (0, 0) ke dalam / *into* ①	1	
	$0 = 6(0) - 0^2 + c$ $c = 0$		
	$y = 6x - x^2$.....②		
	Ganti / *Substitute* $x = 3 + p$ ke dalam / *into* ②		
	$y = 6(3 + p) - (3 + p)^2$ $= 9 - p^2$	1	
	Luas / *Area*, $L = (9 - p^2 - 1)(2p)$	1	
	$= 16p - 2p^3$	1	
	(*b*) Luas maksimum / *Maximum area*:		
	$\frac{dL}{dx} = 0$ $16 - 6p^2 = 0$	1	
	$p^2 = \pm\sqrt{\frac{8}{3}}$ $p = 1.633$	1	
	Jumlah kos / *Total cost* $= 40 \times [16(1.633) - 2(1.633)^3]$ $=$ RM697	2	**10**

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*) (i) $\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$	1	
	$= \underline{a} + \frac{1}{3}(-\underline{a} + \underline{b})$ $= \frac{2}{3}\underline{a} + \frac{1}{3}\underline{b}$	1	
	(ii) $\overrightarrow{BQ} = \overrightarrow{BO} + \overrightarrow{OQ}$ $= -\underline{b} + k\left(\frac{2}{3}\underline{a} + \frac{1}{3}\underline{b}\right)$	1	
	$= -\underline{b} + \frac{2}{3}k\underline{a} + \frac{k}{3}\underline{b}$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\overrightarrow{BQ} = h\overrightarrow{BC}$ $-\underline{b} + \frac{2}{3}k\underline{a} + \frac{k}{3}\underline{b} = h(-\underline{b} + 3\underline{a})$ $\left(-1 + \frac{k}{3}\right)\underline{b} + \frac{2}{3}k\underline{a} = -h\underline{b} + 3h\underline{a}$	1	
	Banding / *Compare*: $-1 + \frac{k}{3} = -h$	1	
	$\frac{2}{3}k = 3h$ $\frac{2}{3}k = 3\left(1 - \frac{k}{3}\right)$ $k = \frac{9}{5}$	1	
	$h = 1 - \frac{9}{15} = \frac{2}{5}$	2	
	(*c*) $5BQ = 2BC$ $BQ : QC = 2 : 3$	1	**10**
9	(*a*) (i) ${}^8C_8(0.9772^8)(0.0228^0)$ $= 0.8315$	1 1	
	(ii) $P(X \leqslant 6)$ $= 1 - {}^8C_8(0.9772^8)(0.0228^0) - {}^8C_7(0.9772^7)(0.0228^1)$ $= 0.0133$	2 1	
	(*b*) $\frac{61 - 60}{\sigma} = 1.999$ $\sigma = 0.5$	2 1	
	$P(X < 60.5)$ $= P\left(Z < \frac{60.5 - 60}{0.5}\right)$ $= P(Z < 1)$ $= 1 - P(Z \geqslant 1)$ $= 0.8413$	1 1	**10**
10	(*a*) $\frac{dy}{dx} = \frac{1}{2}(x + 9)^{-\frac{1}{2}}(1)$ $= \frac{1}{2}(-5 + 9)^{-\frac{1}{2}}$ $= \frac{1}{4}$	1 1	
	(*b*) $h = \sqrt{-5 + 9}$ $= \pm 2$ $\therefore h = 2$		
	$\int_{-9}^{-5}(x + 9)^{\frac{1}{2}} = \left[\frac{2}{3}(x + 9)^{\frac{3}{2}}\right]_{-9}^{-5}$	1	
	$= \frac{2}{3}(-5 + 9)^{\frac{3}{2}} - \frac{2}{3}(-9 + 9)^{\frac{3}{2}}$ $= \frac{16}{3}$	1	

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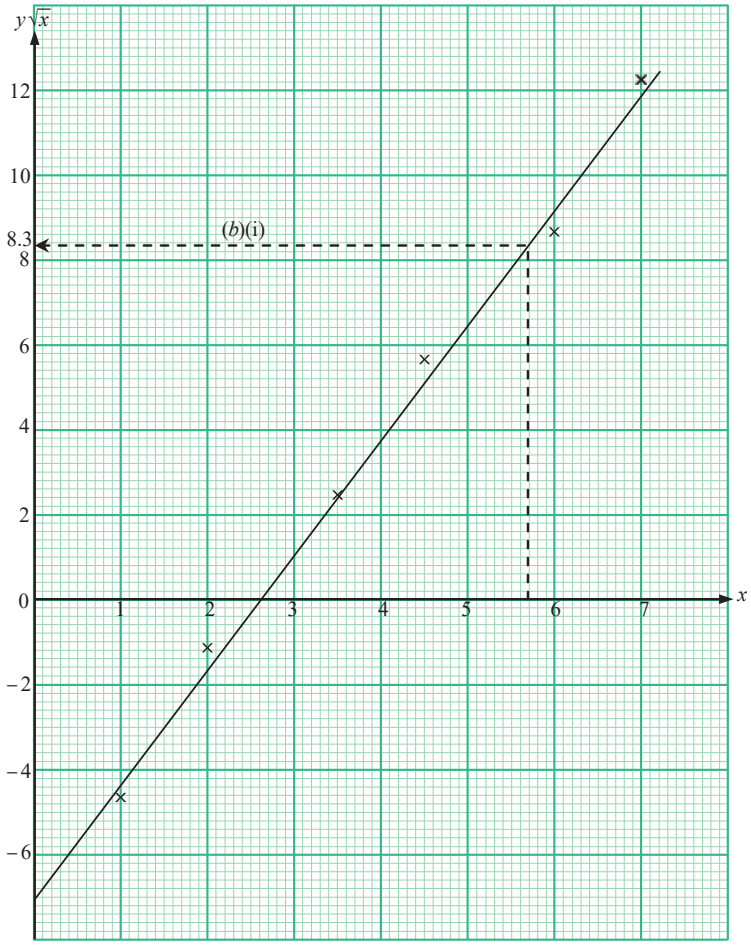
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Luas kawasan berlorek / *Shaded area region*		
	$= \frac{1}{2}\left(2 + \frac{3}{2}\right)(5) + \frac{16}{3}$	2	
	$= 14.08$	1	
	(*c*) $\pi\int_0^2 (y^2 - 9)^2 \, dy$		
	$= \pi\int_0^2 y^4 - 18y^2 + 81 \, dy$		
	$= \pi\left[\frac{y^5}{5} - \frac{18y^3}{3} + 81y\right]_0^2$		
	$= \pi\left[\frac{y^5}{5} - 6y^3 + 81y\right]_0^2$	1	
	$= \pi\left[\frac{(2)^5}{5} - 6(2)^3 + 81(2)\right] - \pi\left[\frac{(0)^5}{5} - 6(0)^3 + 81(0)\right]$	1	
	$= 120.4\pi$	1	**10**
11	(*a*)	1	

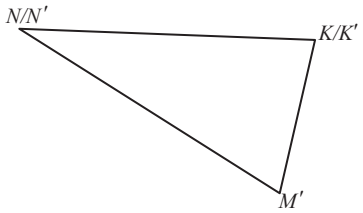
x	1.0	2.0	3.5	4.5	6.0	7.0
$y\sqrt{x}$	−4.70	−1.12	2.41	5.60	8.60	12.20



3

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $x = 5.7, y\sqrt{x}$		
	$y\sqrt{5.7} = 8.3$	1	
	$y = 3.476$	1	
	(ii) $y\sqrt{x} = \frac{b}{a}x + \frac{1}{a}$	1	
	$m = \frac{2.41 - (-7)}{3.5 - 0}$		
	$= 2.689$	1	
	$\frac{1}{a} = -7$	1	
	$a = -\frac{1}{7}$		
	$\frac{b}{-\frac{1}{7}} = 2.689$		
	$b = -0.3841$	1	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
12	(*a*) (i) $(\sqrt{p})^2 = 10^2 + 12^2 - 2(10)(12)\text{ kos } 60°$	1	
	$p = 124$	1	
	(ii) $\frac{MN}{\sin 40°} = \frac{\sqrt{124}}{\sin 110°}$	2	
	$MN = 7.617$	1	
	Luas / *Area*		
	$= \frac{1}{2}(10)(12)\sin 60° + \frac{1}{2}(\sqrt{124})(7.617)\sin 30°$	2	
	$= 73.16$	1	
	(*b*) 	1	
	$\angle N'K'M' = 80°$	1	**10**
13	(*a*) $x + y \leqslant 180$	1	
	$y - x < 60$	1	
	$y \geqslant \frac{1}{2}x$	1	

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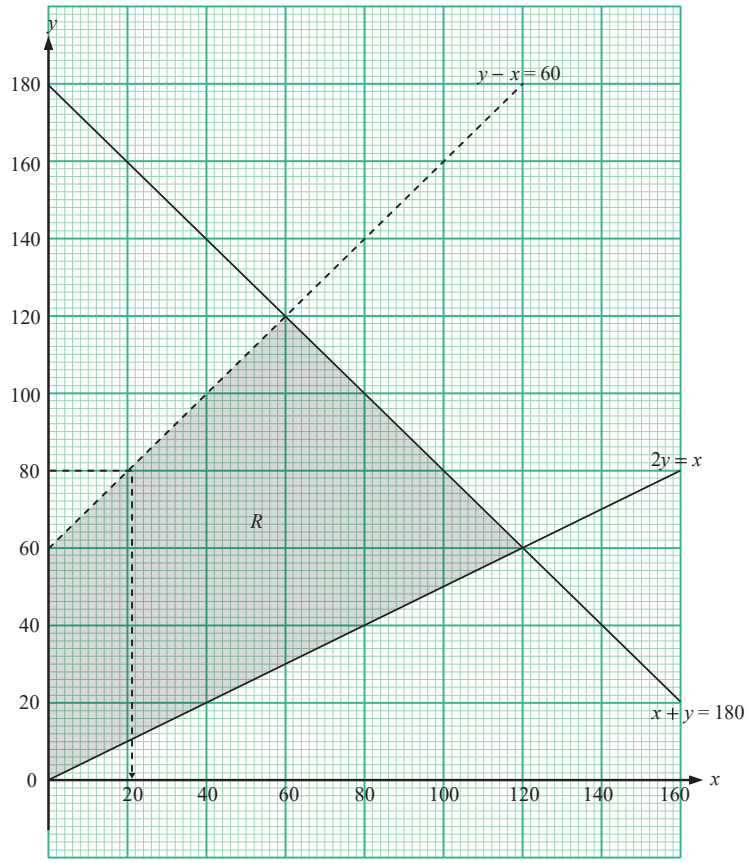
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) 	3	
	(*c*) (i) 120	1	
	(ii) (21, 80)	1	
	Untung maksimum / *Maximum profit* $= -5.5(21) + 40(80)$ $= \text{RM}3\ 084.50$	1 1	**10**
14	(*a*) (i) $\frac{z}{15}(100) = 130$ $z = \text{RM}19.50$	1 1	
	(ii) $\frac{y}{x}(100) = 140,\ x + 6 = y$ $140x = (x + 6)100$ $x = \text{RM}15$	1	
	$15 + 6 = y$ $y = \text{RM}21$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\frac{130(5) + 140p + 160q + 110(3)}{(5 + p + q + 3)} = 132$ $980 + 140p + 160q = 1\,056 + 132p + 132q$ $8p = 1\,056 - 980 - 28q$ $p = \frac{19}{2} - \frac{7}{2}q$	2 1	
	(*c*) $\bar{I} = \frac{132 \times 120}{100}$ $= 158.4$ $\frac{x}{\text{RM}40} \times 100 = 158.4$ $x = \text{RM}63.36$ Harga biskut tahun 2022 / *Biscuit's price in* 2022 $= \frac{115}{100} \times \text{RM}63.36$ $= \text{RM}72.86$	1 1 1	**10**
15	(*a*) Zarah *A* / *Particle A* $V_0 = 3(0)^2 + 8(0) + 5$ $= 5 \text{ m s}^{-1}$ Zarah *B* / *Particle B* $V_0 = 3(0)^2 - 2(0) + 4$ $= 4 \text{ m s}^{-1}$	1 2	
	(*b*) $S_A = S_B$ $t^3 + 4t^2 + 5t = t^3 - t^2 + 4t + 18$ $5t^2 + t - 18 = 0$ $(5t - 9)(t + 2) = 0$ $t = \frac{9}{5}$ dan / *and* $t = -2$ (Abai / *Ignore*) Jarak dilalui *A* ketika berlanggar / *Distance travelled by A when colliding* $= \left(\frac{9}{5}\right)^3 + 4\left(\frac{9}{5}\right)^2 + 5\left(\frac{9}{5}\right)$ $= 27.79$ Jarak dilalui *B* ketika berlanggar / *Distance travelled by B when colliding* $= 27.79 - 18$ $= 9.79$	1 1 1 1 1	
	(*c*) $t = \frac{9}{5}$ $a_A = 6t + 8$ $6\left(\frac{9}{5}\right) + 8 = 18.8$ $a_B = 6t - 2$ $6\left(\frac{9}{5}\right) - 2 = 8.8$	1 1 1	**10**

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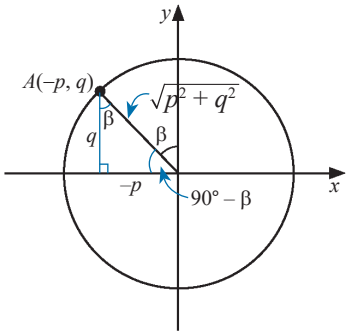
SIJIL PELAJARAN MALAYSIA 2023

KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	(*a*) $y - x = 45 - 50$ $y - x = -5$	1	
	(*b*) $\frac{y}{x} = \frac{45}{50}$ $\frac{y}{x} = \frac{9}{10}$	1	2
2	p ialah nilai persilangan bagi paksi-y. / *p is the value of y-intercept.* $\therefore p = 2$	1	
	$\frac{x}{6} + \frac{y}{2} = 1$ $\frac{y}{2} = -\frac{x}{6} + 1$ $y = -\frac{1}{3}x + 2$ $\therefore m_1 = -\frac{1}{3}$		
	$y = qx$ $\therefore m_2 = q$		
	$\frac{x}{6} + \frac{y}{2} = 1$ adalah berserenjang dengan / *is perpendicular to $y = qx$*		
	$m_1 m_2 = -1$ $\left(-\frac{1}{3}\right) \times (q) = -1$	1	
	$q = 3$	1	3
3	(*a*) L_1 lebih sesuai kerana garis lurus tersebut melalui sebanyak mungkin titik dan terdapat jumlah titik yang sama di kedua-dua belah garis lurus. *L_1 is suitable because it passes through as many points as possible and there is equal number of points on both sides of the straight line.*	1	
	(*b*) $Y = mX + C$ $\frac{1}{y} = \frac{(7-4)}{(6-2)}(x^2) + C$ $\frac{1}{y} = \frac{3}{4}x^2 + C$ Pada / *At* (10, 9), $9 = \frac{3}{4}(10) + C$ $9 = \frac{15}{2} + C$ $\frac{3}{2} = C$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$\frac{1}{y} = \frac{3}{4}x^2 + \frac{3}{2}$ $\frac{1}{y} = \frac{3x^2 + 6}{4}$ $\frac{y}{1} = \frac{4}{3x^2 + 6}$ $y = \frac{4}{3x^2 + 6}$	1 1	4
4	 (*a*) $\tan\beta = -\frac{p}{q}$	1	
	(*b*) $\tan(180° + \beta) = -\tan\beta$ $= -\left(-\frac{p}{q}\right)$ $= \frac{p}{q}$ kot / cot $(180° + \beta) = \frac{1}{\tan(180° + \beta)}$ $= \frac{1}{\frac{p}{q}}$ $= \frac{q}{p}$	1	2
5	(*a*) $\overrightarrow{SP} = -2\underline{i} + 3\underline{j}$	1	
	(*b*) (i) $\overrightarrow{SP} + 3\overrightarrow{PQ} = 13\underline{i} + 15\underline{j}$ $(-2\underline{i} + 3\underline{j}) + 3(5\underline{i} + m\underline{j}) = 13\underline{i} + 15\underline{j}$ $-2\underline{i} + 3\underline{j} + 15\underline{i} + 3m\underline{j}) = 13\underline{i} + 15\underline{j}$ $13\underline{i} + (3m + 3)\underline{j} = 13\underline{i} + 15\underline{j}$ $3m + 3 = 15$ $3m = 12$ $m = 4$	1 1 1	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $\overrightarrow{PQ} = 5\underline{i} + 4\underline{j}$ $\lvert\overrightarrow{PQ}\rvert = \sqrt{5^2 + 4^2}$ $\lvert\overrightarrow{PQ}\rvert = \sqrt{41}$ Vektor unit / *Unit vector* $= \dfrac{5\underline{i} + 4\underline{j}}{\sqrt{41}}$	1	**5**
6	(*a*) $f(7) = h$ $\lvert 7 - 3\rvert + 1 = h$ $\lvert 4\rvert + 1 = h$ $h = 5$ $f(x) = 5$ $\lvert x - 3\rvert + 1 = 5$ $\lvert x - 3\rvert = 4$ $x - 3 = 4$, $x - 3 = -4$ $x = 7$, $x = -1$ $\therefore$ Objek bagi h ialah -1. *Object of h is* -1.	1 1	
	(*b*) (i) $f(x) = 4x - 1$ Katakan / *Let* $4x - 1 = y$ $4x = y + 1$ $x = \dfrac{y + 1}{4}$ $f^{-1}(x) = \dfrac{x + 1}{4}$ $f^{-1}(p) = 2$ $\dfrac{p + 1}{4} = 2$ $p + 1 = 8$ $p = 7$ (ii) $fg(x) = 5f(2)$ $f(2x + 3) = 5[4(2) - 1]$ $4(2x + 3) - 1 = 5(8 - 1)$ $8x + 12 - 1 = 5(7)$ $8x + 11 = 35$ $8x = 24$ $x = 3$	1 1 1 1	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
7	(*a*) $y = -x + c$ ... ① $y = -2x^2 + 3x + p$ ... ② ① = ② : $-2x^2 + 3x + p = -x + c$ $-2x^2 + 3x + p + x - c = 0$ $-2x^2 + 4x + p - c = 0$	1	
	Tangen kepada lengkung / *Tangent to the curve*, $b^2 - 4ac = 0$ $(4)^2 - 4(-2)(p - c) = 0$ $16 + 8(p - c) = 0$ $16 + 8p - 8c = 0$	1	
	$8p = 8c - 16$ $p = c - 2$	1	
	(*b*) $(x + 1)(-3x - 3) < x - 1$ $-3x^2 - 3x - 3x - 3 - x + 1 < 0$ $-3x^2 - 7x - 2 < 0$ $3x^2 + 7x + 2 > 0$ $(3x + 1)(x + 2) > 0$ Apabila $(3x + 1)(x + 2) = 0$, $x = -\frac{1}{3}$ atau -2. *When* $(3x + 1)(x + 2) = 0$, $x = -\frac{1}{3}$ *or* -2.		
	$x < -2$ | $-2 < x < -\frac{1}{3}$ | $x > -\frac{1}{3}$ $(3x + 1)$: – | – | + $(x + 2)$: – | + | + $(3x + 1)(x + 2)$: + | – | +	1	
	Daripada jadual, $(3x + 1)(x + 2) > 0$ apabila $x < -2$ atau $x > -\frac{1}{3}$. *From the table*, $(3x + 1)(x + 2) > 0$ *when* $x < -2$ *or* $x > -\frac{1}{3}$. $\therefore x < -2$ atau / *or* $x > -\frac{1}{3}$	1	
	(*c*) $2x^2 + 6x + 4p^2 = 0$ Punca / *Roots* = p, $2p$ HTP / *SOR*: $p + 2p = -\frac{6}{2}$ $3p = -3$ $p = -1$	1	
	$\therefore 2x^2 + 6x + 4(-1)^2 = 0$ $2x^2 + 6x + 4 = 0$ Punca baru / *New roots*: $p - 1 = -1 - 1$, $p + 1 = -1 + 1$ $= -2$ $= 0$	1	
	HTP / *SOR*: $-2 + 0 = -2$ HDP / *POR*: $(-2)(0) = 0$ $x^2 -$ (HTP / *SOR*)x + (HDP / *POR*) = 0 $x^2 - (-2)x + 0 = 0$ $x^2 + 4x = 0$	1	**8**

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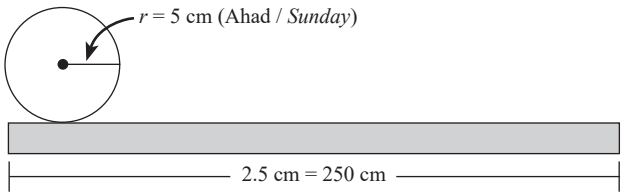
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*) Janjang aritmetik / *Arithmetic progression* $a, a + d, (a + d) + d, \ldots$	1	
	$T_4 = 3T_1$ $a + (4 - 1)(d) = 3a$ $a + 3d = 3a$ $3d = 2a \ldots ①$	1	
	$S_4 = 72°$ $\frac{4}{2}[2a + (4 - 1)(d)] = 72$ $2(2a + 3d) = 72$ $2(2a + 2a) = 72$ $8a = 72$ $a = 9$	1	
	$\therefore$ Bahagian terkecil / *Smallest piece* $= T_1 = a = 9°$	1	
	(*b*) Dari / *From* ①, $3d = 2(9)$ $3d = 18$ $d = 6$		
	$S_n = 360°$ $\frac{n}{2}[2(9) + (n - 1)(6)] = 360°$ $\frac{n}{2}(18 + 6n - 6) = 360°$ $n(6n + 12) = 720°$	1	
	$6n^2 + 12n - 720° = 0$ $n^2 + 2n - 120° = 0$ $(n - 10)(n + 12) = 0$	1	
	$n - 10 = 0$, $n + 12 = 0$ $n = 10$, $n = -12$ (abaikan / *ignore*) $\therefore\ n = 10$	1	7
9	(*a*) $2^x = 8^y = \sqrt{2^{3z}}$ $2^x = (2^3)^y = (2^{3z})^{\frac{1}{2}}$ $2^x = 2^{3y} = 2^{\frac{3z}{2}}$ $x = 3y = \frac{3z}{2}$	1	
	$x = 3y$ $\frac{x}{y} = \frac{3}{1}$ $x : y = 3 : 1$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$3y = \frac{3z}{2}$ $\frac{y}{z} = \frac{\left(\frac{3}{2}\right)}{3}$ $\frac{y}{z} = \frac{1}{2}$ $y : z = 1 : 2$ $x : y : z$ $3 : 1$ $1 : 2$ $\therefore\ x : y : z = 3 : 1 : 2$	1	
	(*b*) $9^{2pq+1} + 3^{4pq-3} = 732$ $3^{2(2pq+1)} + 3^{4pq-3} = 732$ $3^{4pq+2} + 3^{4pq-3} = 732$ $(3^{4pq})(3^2) + (3^{4pq})(3^{-3}) = 732$ $3^{4pq}(3^2 + 3^{-3}) = 732$ $3^{4pq}\left(9 + \frac{1}{27}\right) = 732$ $3^{4pq}\left(\frac{244}{27}\right) = 732$ $3^{4pq} = 732 \div \frac{244}{27}$ $3^{4pq} = 81$ $3^{4pq} = 3^4$ $4pq = 4$ $pq = 1$ $p = \frac{1}{q}$	1 1 1	
	(*c*) $\frac{1}{\log_a ab} + \frac{1}{\log_b ab} = \log_{ab} a + \log_{ab} b$ $= \log_{ab}(a \times b)$ $= \log_{ab} ab$ $= 1$	1 1	7
10	(*a*)  Isi padu$_{\text{sfera}}$ / *Volume*$_{sphere}$ $= \frac{4}{3}\pi r^3$, $\delta v = 20\pi \text{ cm}^3$ $\frac{dv}{dr} = \left(\frac{4}{3}\right)(3)\pi r^2$ $= 4\pi r^2$	1	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Apabila / *When* $r = 5$ cm, $4\pi(5)^2 = 100\pi$ $\frac{\delta r}{\delta v} \approx \frac{dr}{dv}$ $\frac{\delta r}{-20\pi} \approx \frac{1}{100\pi}$ $\delta r \approx -0.2$ $r_{\text{baru}/new} = r_{\text{lama}/old} + \delta r$ $= 5 \text{ cm} + (-0.2)$ $= 4.8$ cm $d_{\text{baru}/new} = 2(4.8 \text{ cm})$ $= 9.6$ cm Bilangan bola / *Number of balls* $\approx \frac{250 \text{ cm}}{9.6 \text{ cm}}$ ≈ 26.04 $= 26$ biji bola / *balls*	1 1 1	
	(*b*) $h(x) = 3x^2 + 7x - 8$ $h'(x) = 6x + 7$ $h''(x) = 6 > 0$ $\therefore h''(x) > 0$, titik pusingan minimum / *minimum turning point*.	1 1	
	(*c*) $\frac{dy}{dx} = (2x + 1)^3$ $\int dy = \int (2x + 1)^3 dx$ $y = \frac{(2x + 1)^4}{(4)(2)} + c$ $y = \frac{1}{8}(2x + 1)^4 + c$, pada / *at* $\left(\frac{1}{2}, 5\right)$ $5 = \frac{1}{8}\left[2\left(\frac{1}{2}\right) + 1\right]^4 + c$ $5 = 2 + c$ $c = 3$ $\therefore y = \frac{1}{8}(2x + 1)^4 + 3$	1 1 1	9
11	(*a*) Katakan X = peristiwa di mana produk boleh dijual *Let X = event that a product can be sold* $n = 820, p = \frac{19}{20}, q = \frac{1}{20}$ Min / *Mean* $= (820)\left(\frac{19}{20}\right)$ $= 779$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Sisihan piawai / *Standard deviation*,		
	$= \sqrt{(820)\left(\frac{19}{20}\right)\left(\frac{1}{20}\right)}$	1	
	$= \sqrt{\left(\frac{779}{20}\right)}$		
	$= 6.241$	1	
	(*b*) (i) $^{25}C_r = {}^{25}C_{r+13}$		
	$r + r + 13 = 25$	1	
	$2r + 13 = 25$		
	$2r = 12$		
	$r = 6$	1	
	(ii) Bilangan cara / *Number of ways* $= 2 \times {}^4P_4$	1	
	$= 48$	1	7
12	(*a*) $X \sim N(20, 0.5^2)$		
	Min / *Mean* = 20		
	Varians / *Variance* $= (0.5)^2 = 0.25$	1	
	(*b*) (i) $P(Z < m) = P(Z < k)$		
	$\frac{(-\alpha + 40) - 20}{0.5} = m$	1	
	$-\alpha + 40 - 20 = 0.5\,m$		
	$-\alpha + 20 = 0.5\,m$		
	$40 + 2\alpha = m$		
	(ii) $P(\lvert Z\rvert < k) = 0.2662$		
	$2[0.5 - P(Z > k)] = 0.2662$	1	
	$1 - 2P(Z > k)] = 0.2662$		
	$2P(Z > k)] = 0.7338$		
	$P(Z > k)] = 0.3669$		
	$\frac{\alpha - 20}{0.5} = 0.34$		
	$\alpha - 20 = 0.17$		
	$\alpha = 20.17$	1	4

Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
13	(*a*) (i) $6 \ln y = \sqrt{5} \ln x$		
	$6 \log_e y = \sqrt{5} \log_e x$		
	$\log_e y^6 = \log_e x^{\sqrt{5}}$		
	$y^6 = x^{\sqrt{5}}$	1	
	$y = \sqrt[6]{x^{\sqrt{5}}}$	1	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $\ln(x+y^2)-3=0$ $\ln(x+y^2)=3$ $\log_e(x+y^2)=3$ $x+y^2=e^3$ $y^2=e^3-x$ $y=\sqrt{e^3-x}$	 1 1	
	(*b*) $\dfrac{x+2\sqrt{2}}{2} : x\sqrt{2}-1 = 6:1$ $\dfrac{\frac{1}{2}x+\sqrt{2}}{x\sqrt{2}-1}=\dfrac{6}{1}$ $\frac{1}{2}x+\sqrt{2}=6(x\sqrt{2}-1)$ $\frac{1}{2}x+\sqrt{2}=6x\sqrt{2}-6$ $\frac{1}{2}x-6x\sqrt{2}=-6-\sqrt{2}$ $x\left(\frac{1}{2}-6\sqrt{2}\right)=-6-\sqrt{2}$ $x=\dfrac{(-6-\sqrt{2})}{\left(\frac{1}{2}-6\sqrt{2}\right)}\times\dfrac{\left(\frac{1}{2}+6\sqrt{2}\right)}{\left(\frac{1}{2}+6\sqrt{2}\right)}$ $x=\dfrac{-3-36\sqrt{2}-\frac{1}{2}\sqrt{2}-12}{\frac{1}{4}-72}$ $x=\dfrac{-15-\frac{73}{2}\sqrt{2}}{-\frac{287}{4}}$ $x=\dfrac{-\left(\frac{30+73\sqrt{2}}{2}\right)}{-\frac{287}{4}}$ $x=\dfrac{30+73\sqrt{2}}{2}\times\dfrac{4}{287}$ $x=\dfrac{60+146\sqrt{2}}{287}$ $x=\dfrac{60}{287}+\dfrac{146}{287}\sqrt{2}$	 1 1 1 1	**8**
14	(*a*) $2x-5\neq 0$ $2x\neq 5$ $x\neq\dfrac{5}{2}$ $\therefore h=\dfrac{5}{2}$	 1	
	(*b*) $f(x)=x$ $2x-5=x$ $2x-x=5$ $x=5$	 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*c*) (i) $gf(x) = \frac{4}{2x-5}$ $g(2x-5) = \frac{4}{2x-5}$ Katakan / *Let* $2x - 5 = m$ $2x = m + 5$ $x = \frac{m+5}{2}$ $g(m) = \frac{4}{2\left(\frac{m+5}{2}\right) - 5}$ $= \frac{4}{m+5-5}$ $= \frac{4}{m}$	1	
	$\therefore g(x) = \frac{4}{x}, x \neq 0$	1	
	(ii) $g^2(x) = g\left(\frac{4}{x}\right)$ $= \frac{4}{\frac{4}{x}}$ $= x$	1	
	$g^3(x) = gg^2(x)$ $= g(x)$ $g^3(x) = \frac{4}{x}$	1	
	$g^4(x) = g^2g^2(x)$ $= g^2(x)$ $g^4(x) = x$ $g^{\text{ganjil / odd}}(x) = \frac{4}{x}$ $g^{\text{genap / even}}(x) = x$ $4n - 3$ adalah ganjil bagi semua integer, n. $4n - 3$ *is odd for all integer*, n.		
	$\therefore g^{4n-3}(x) = \frac{4}{x}, x \neq 0$	1	**8**
15	(*a*)	2	

x	0	$\frac{\pi}{6}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2}{3}\pi$	$\frac{5}{6}\pi$	π	$\frac{7}{6}\pi$	$\frac{4}{3}\pi$	$\frac{3}{2}\pi$	$\frac{5}{3}\pi$	$\frac{11}{6}\pi$	2π
y	1	−1.12	−2	−1.12	1	3.12	4	3.12	1	−1.12	−2	−1.12	1

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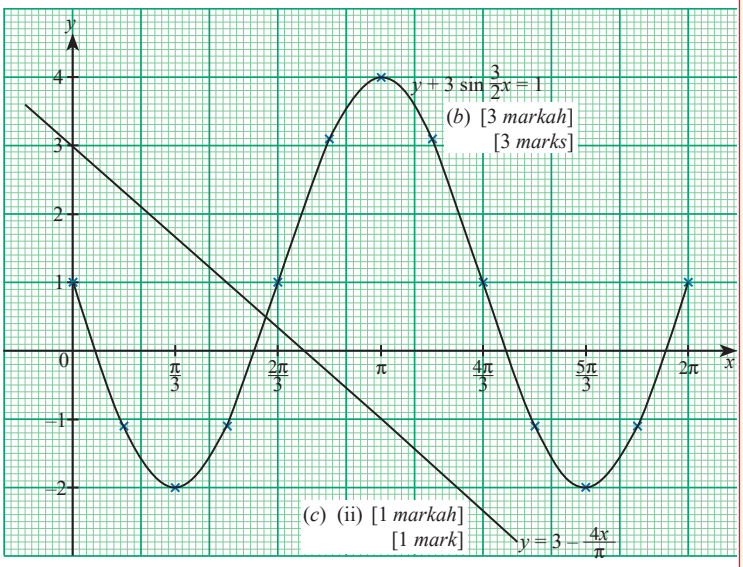
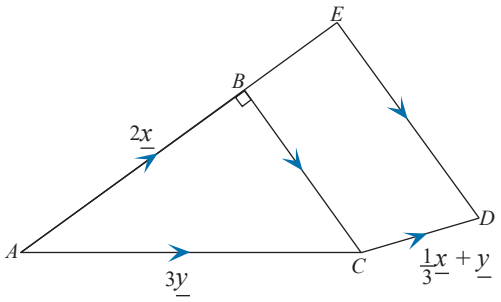
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (*c*)(ii) 	4	
	(*c*) (i) $y + 3\sin\frac{3}{2}x = 1$ $y = 1 - 3\sin\frac{3}{2}x$ $3\sin\frac{3}{2}x = \frac{4x}{\pi} - 2$ $0 = \frac{4x}{\pi} - 2 - 3\sin\frac{3}{2}x$ $0 = \frac{4x}{\pi} - 3 + 1 - 3\sin\frac{3}{2}x$ $0 = \frac{4x}{\pi} - 3 + y$ $3 - \frac{4x}{\pi} = y$	1	
	(ii) $x = \frac{19}{30}\pi$	1	**8**

x	0	π	2π
y	3	–1	–5

KERTAS 2

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	(*a*) $2p - q - r = 6$ $2p - r - 6 = q$ ... ① $p + 2q - 4r = 8$ ... ② $3p + q - r = 2$ ... ③ ① → ②; $p + 2(2p - r - 6) - 4r = 8$ $p + 4p - 2r - 12 - 4r - 8 = 0$ $5p - 6r - 20 = 0$ ... ④	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	① → ③; $3p + (2p - r - 6) - r = 2$ $3p + 2p - r - 6 - r - 2 = 0$ $5p - 2r - 8 = 0$ ... ⑤ ⑤ – ④; $5p - 2r - 8 - (5p - 6r - 20) = 0$ $5p - 2r - 8 - 5p + 6r + 20 = 0$ $4r + 12 = 0$ $4r = -12$ $r = -3$	1	
	Dari / *From* ⑤, $5p - 2(-3) - 8 = 0$ $5p + 6 - 8 = 0$ $5p - 2 = 0$ $5p = 2$ $p = \frac{2}{5}$	1	
	Dari / *From* ①, $q = 2\left(\frac{2}{5}\right) - (-3) - 6$ $q = \frac{4}{5} + 3 - 6$ $q = -\frac{11}{5}$	1	
	$\therefore p = \frac{2}{5}, q = -\frac{11}{5}, r = -3$	1	**5**
2	(*a*)  (i) $\overrightarrow{BC} = \overrightarrow{BA} + \overrightarrow{AC}$ $\overrightarrow{BC} = -\overrightarrow{AB} + \overrightarrow{AC}$ $\overrightarrow{BC} = -2\underline{x} + 3\underline{y}$ (ii) $\overrightarrow{ED} = \overrightarrow{EA} + \overrightarrow{AC} + \overrightarrow{CD}$ $\overrightarrow{ED} = -\overrightarrow{AE} + \overrightarrow{AC} + \overrightarrow{CD}$ $\overrightarrow{ED} = -\frac{3}{2}\overrightarrow{AB} + 3\underline{y} + \frac{1}{3}\underline{x} + \underline{y}$ $\overrightarrow{ED} = -\frac{3}{2}(2\underline{x}) + 4\underline{y} + \frac{1}{3}\underline{x}$ $\overrightarrow{ED} = -3\underline{x} + 4\underline{y} + \frac{1}{3}\underline{x}$ $\overrightarrow{ED} = 4\underline{y} - \frac{8}{3}\underline{x}$	1 1 1	

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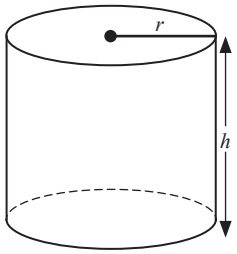
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\overrightarrow{ED} = -\frac{8}{3}\underline{x} + 4\underline{y}$ $\overrightarrow{ED} = \frac{4}{3}\left(-2\underline{x} + 3\underline{y}\right)$ $\overrightarrow{ED} = \frac{4}{3}\left(\overrightarrow{BC}\right)$ $\therefore\ \overrightarrow{ED} = \frac{4}{3}\overrightarrow{BC}$ $\therefore\ \overrightarrow{ED} \parallel \overrightarrow{BC}$	1 1	5
3	(*a*)  $I_{\text{silinder}} / V_{\text{cylinder}} = \frac{125}{4}\pi\ \text{m}^3$ $\pi r^2 h = \frac{125}{4}\pi$ $r^2 h = \frac{125}{4}$ $h = \frac{125}{4r^2}$ Jumlah luas permukaan, A *Total surface area*, A $A = 2\pi r^2 + 2\pi r h$ $= 2\pi r^2 + 2\pi r\left(\frac{125}{4r^2}\right)$ $= 2\pi r^2 + \frac{125\pi}{2r}$	1 1 1	
	(*b*) $A = 2\pi r^2 + \frac{125\pi}{2r}$ $= 2\pi r^2 + \frac{125}{2}\pi r^{-1}$ $\frac{dA}{dr} = 4\pi r + (-1)\left(\frac{125}{2}\right)\pi r^{-1-1}$ $= 4\pi r - \frac{125}{2}\pi r^{-2}$ Apabila / *When* $\frac{dA}{dr} = 0$, $4\pi r - \frac{125\pi}{2r^2} = 0$ $4\pi r = \frac{125\pi}{2r^2}$ $8\pi r^3 = 125\pi$ $8r^3 = 125$ $r^3 = \frac{125}{8}$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$r^3 = \sqrt[3]{\frac{125}{8}}$ $r = \frac{5}{2}$	1	
	$\frac{d^2A}{dr^2} = 4\pi - (-2)\left(\frac{125}{2}\right)\pi r^{-3}$ $= 4\pi + \frac{125\pi}{r^3}$; apabila / *When* $r = \frac{5}{2}$ $= 4\pi + \frac{125\pi}{\left(\frac{5}{2}\right)^3}$ $= 12\pi > 0 \Rightarrow$ minimum		
	Apabila / *When* $r = \frac{5}{2}$, $A = 2\pi\left(\frac{5}{2}\right)^2 + \frac{125\pi}{2\left(\frac{5}{2}\right)}$ $= \frac{25}{2}\pi + 25\pi$ $= 37.5\pi \text{ m}^2$ $= 117.825 \text{ m}^2$	1	
	Kos minimum / *Minimum cost* = 117.825 m² × RM720 = RM84 834	1	**7**
4	(*a*) $c = -1$ Pada / *At* $(p, -2)$; $-2 = \tan p - 1$ $-1 = \tan p$ (II, IV) Sudut rujukan / *Reference angle* = $\tan^{-1}(1)$ $= 45°$ $\therefore p = 360° - 45°$ $p = 315°$	1 1	
	(*b*) (i) 2 kos / cos $x = -1$; $\pi \leqslant x \leqslant 3\pi$ kos / cos $x = -\frac{1}{2}$(II, III) Sudut rujukan / *Reference angle* = kos / $\cos^{-1}\left(\frac{1}{2}\right)$ $= 60°$ $= \frac{\pi}{3}$ $x = \pi - \frac{\pi}{3}, \pi + \frac{\pi}{3}, 3\pi - \frac{\pi}{3}$ $x = \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{8\pi}{3}$ $\therefore x = \frac{4\pi}{3}, \frac{8\pi}{3}$	 1 1 1	

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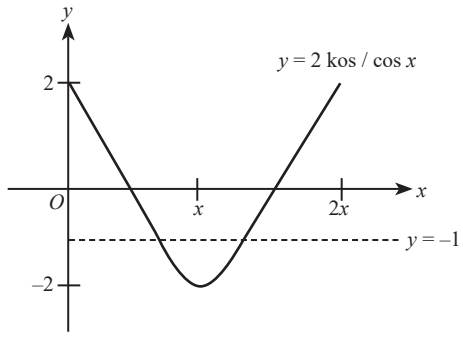
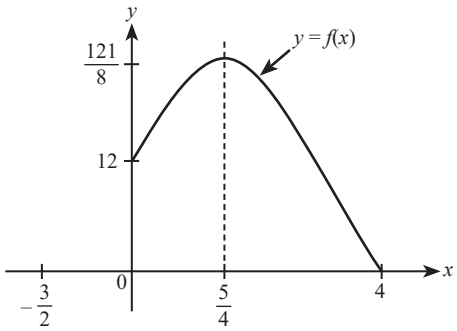
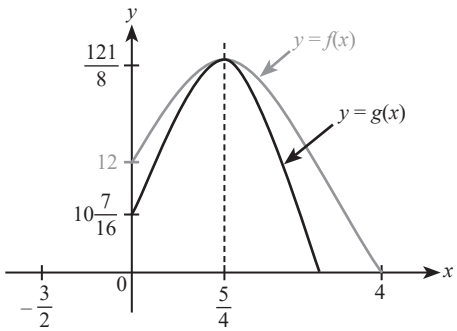
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii)  $\text{kos / cos } x < -\frac{1}{2}$ $2 \text{ kos / cos } x < -1$ $y < -1$ $\therefore \frac{2\pi}{3} \leqslant x \leqslant \frac{4\pi}{3}$	2 1	**8**
5	(*a*) $2x + 3 = 0$ $2x = -3$ $x = -\frac{3}{2}$ $f(x) = x(5 - 2x) + m$ $f(x) = 5x - 2x^2 + m$ $f(x) = -2x^2 + 5x + m$ Apabila / *When* $x = -\frac{3}{2}, f(x) = 0$ $-2\left(-\frac{3}{2}\right)^2 + 5\left(-\frac{3}{2}\right) + m = 0$ $-12 + m = 0$ $m = 12$	1 1 1	
	(*b*) $f(x) = -2x^2 + 5x + 12$ $= -2\left(x^2 - \frac{5}{2}x - 6\right)$ $= -2\left[x^2 - \frac{5}{2}x + \left(\frac{-\frac{5}{2}}{2}\right)^2 - \left(\frac{-\frac{5}{2}}{2}\right)^2 - 6\right]$ $= -2\left[x^2 - \frac{5}{2}x + \left(-\frac{5}{4}\right)^2 - \left(-\frac{5}{4}\right)^2 - 6\right]$ $= -2\left[\left(x - \frac{5}{4}\right)^2 - \frac{25}{16} - 6\right]$ $= -2\left[\left(x - \frac{5}{4}\right)^2 - \frac{121}{16}\right]$ $= -2\left(x - \frac{5}{4}\right)^2 + \frac{121}{8}$ $\therefore a = -2, h = \frac{5}{4}, k = \frac{121}{8}$	1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
		2	
	(c) $g(x) = (a-1)(x-h)^2 + k$ $= (-2-1)\left(x - \frac{5}{4}\right)^2 + \frac{121}{8}$ $= -3\left(x - \frac{5}{4}\right)^2 + \frac{121}{8}$ 	1	8
6	$S_{\infty A} = S_{\infty B}$ $\frac{8}{1-r_A} = \frac{4}{1-r_B}$ $8 - 8r_B = 4 - 4r_A$ $4r_A - 8r_B = 4 - 8$ $4r_A - 8r_B = -4$ $r_A - 2r_B = -1$ $r_A = 2r_B - 1 \ldots$ ① $T_{3A} + T_{3B} = \frac{9}{4}$ $8(r_A)^{3-1} + 4(r_B)^{3-1} = \frac{9}{4}$ $8r_A^2 + 4r_B^2 = \frac{9}{4}$ $8(2r_B - 1)^2 + 4r_B^2 = \frac{9}{4}$ $8(4r_B^2 - 4r_B + 1) + 4r_B^2 - \frac{9}{4} = 0$ $32r_B^2 - 32r_B + 8 + 4r_B^2 - \frac{9}{4} = 0$ $36r_B^2 - 32r_B + \frac{23}{4} = 0$ $36r_B^2 - 32r_B + \frac{23}{4} = 0$	1 1	

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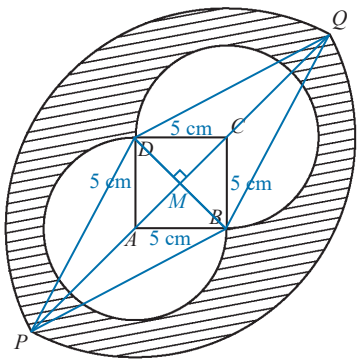
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$144r_B^2 - 128r_B + 23 = 0$ $(36r_B - 23)(4r_B - 1) = 0$ $36r_B - 23 = 0$, $4r_B - 1 = 0$ $r_B = \frac{23}{36}$, $r_B = \frac{1}{4}$	1	
	$T_{10A} < 0$ $8(r_A)^{10-1} < 0$ $8(r_A)^9 < 0$ $r_A < 0$... ②	1	
	Dari / *From* ① & ②, $r_A = 2\left(\frac{23}{36}\right) - 1$, $r_A = 2\left(\frac{1}{4}\right) - 1$ $r_A = \frac{5}{18} < 0$ (abaikan / *ignore*) , $r_A = -\frac{1}{2} < 0$	1	
	$S_{4A} = \frac{8\left[1 - \left(-\frac{1}{2}\right)^4\right]}{1 - \left(-\frac{1}{2}\right)}$ $= 5 < S_{4B}$	1	
	$S_{4B} = \frac{4\left[1 - \left(\frac{1}{4}\right)^4\right]}{1 - \left(\frac{1}{4}\right)} = 5.3125$	1	
	∴ Pernyataan tersebut adalah palsu. / *The statement is false.*	1	**8**
7	 (*a*) $PM = MQ = \frac{1}{2}PQ = 11.5$ cm $BM = DM = \frac{1}{2}BD$ $= \frac{1}{2}\left(\sqrt{5^2 + 5^2}\right)$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$= \frac{1}{2}(5\sqrt{2})$ $= \frac{5\sqrt{2}}{2}$ $\angle PBQ = 2 \times \angle QBM$ $= 2\tan^{-1}\left(\frac{QM}{BM}\right)$ $= 2\tan^{-1}\left(\frac{11.5}{\frac{5\sqrt{2}}{2}}\right)$ $= 2(72.91°)$ $= 145.82°$ $= 2.55$ rad	1 1	
	(*b*) (i) $BQ = \sqrt{MQ^2 + BM^2}$ $= \sqrt{(11.5)^2 + \left(\frac{5\sqrt{2}}{2}\right)^2}$ $= \sqrt{\frac{579}{4}}$ $= 12.0312$ cm Perimeter luar / *Outside perimeter* $= 2AB$ $= 2 \times r\theta$ $= 2(12.0312)(2.55)$ $= 61.3591$ cm (ii) Luas temberang PQ / *Area of segment PQ* $= \frac{1}{2}r^2\theta - \frac{1}{2}r^2 \sin\theta$ $= \frac{1}{2}(12.0312)^2(2.55) - \frac{1}{2}(12.0312)^2 \sin 145.82°$ $= 184.5560 - 40.6598$ $= 143.8962$ cm^2 Luas seluruh rajah / *Area of whole diagram* $= 2 \times 143.8962$ $= 287.7924$ cm^2 Luas sektor BCD / *Area of sector BCD* $= \frac{1}{2}(5)^2\left(\frac{3\pi}{2}\right)$ $= 58.9125$ cm^2 Luas kawasan berlorek / *Area of the shaded region* = Luas seluruh rajah − Luas sektor BCD − Luas sektor BAD − Luas $ABCD$ = *Area of whole diagram − Area of sector BCD − Area of sector BAD − Area of ABCD* $= 287.7924 - 58.9125 - 58.9125 - (5 \times 5)$ $= 144.9674$ cm^2	1 1 1 1 1 1 1	9

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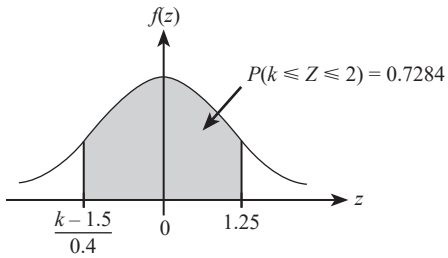
Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*) $y = x^2 - 9$ ... ① $\frac{x}{5} - \frac{y}{10} = 1$ $2x - y = 10$ $2x - 10 = y$ ... ② ① = ②, $x^2 - 9 = 2x - 10$ $x^2 - 2x - 9 + 10 = 0$ $x^2 - 2x + 1 = 0$ $(x - 1)(x - 1) = 0$ $x - 1 = 0$ $x = 1$ $\therefore p = 1$	1 1	
	(*b*) $y = x^2 - 9$ $y = (x + 3)(x - 3)$ Apabila / *When* $y = 0$, $(x + 3)(x - 3) = 0$ $x + 3 = 0$, $x - 3 = 0$ $x = -3$, $x = 3$ Luas / *Area* $= \left\lvert \int_1^3 (x^2 - 9)\, dx \right\rvert$ $= \left\lvert \left[\frac{1}{3}x^3 - 9x\right]_1^3 \right\rvert$ $= \left\lvert \left[\frac{1}{3}(3)^3 - 9(3)\right] - \left[\frac{1}{3}(1)^3 - 9(1)\right] \right\rvert$ $= \left\lvert -18 - \left(-\frac{26}{3}\right) \right\rvert$ $= \left\lvert -\frac{28}{3} \right\rvert$ $= \frac{28}{3}$ unit^2	1 1 1 1	
	(*c*) Dari / *From* ②, $y = 2x - 10$ apabila / *when* $x = 0$ $y = 2(0) - 10$ $y = -10$ $y = 2x - 10$ apabila / *when* $y = 0$ $0 = 2x - 10$ $-2x = -10$ $x = 5$ Isi padu kon / *Volume of cone* $= \frac{1}{3}\pi r^2 h$ $= \frac{1}{3}\pi(5)^2(10)$ $= 83\frac{1}{3}\pi$ 8 unit^3 Dari / *From* ①, $y = x^2 - 9$ apabila / *when* $x = 0$ $y = (0)^2 - 9$ $y = -9$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Luas lengkung / *Volume of the curve* $= \pi\int_{-9}^{0} x^2 dy = \pi\int_{-9}^{0}(y+9)\,dy$ $= \pi\left[\frac{1}{2}y^2 + 9y\right]_{-9}^{0}$ $= \pi\left[\frac{1}{2}(0)^2 + 9(0)\right] - \pi\left[\frac{1}{2}(-9)^2 + 9(-9)\right]$ $= 0 - \left(-\frac{81}{2}\pi\right)$ $= 40\frac{1}{2}\pi$ unit^3	1	
	$I_{\text{lorekan dikisar } 180°} = \frac{1}{2}$(Isi padu kon – Isi padu lengkung $V_{\text{shaded revolved } 180°} = \frac{1}{2}$(*Volume of cone – Volume of curve*) $= \frac{1}{2}\left(83\frac{1}{3}\pi - 40\frac{1}{2}\pi\right)$ $= \frac{1}{2}\left(42\frac{5}{6}\pi\right)$ unit^3	1	
	$= 21\frac{5}{12}\pi$ unit^3	1	**10**
9	(*a*) Katakan X = Murid tidak menaiki bas *Let X = Student not go by bus* $n = 8,\ q = 0.75,\ p = 1 - 0.75$ $= 0.25$	1	
	$P(x \leqslant 2) = P(X=0) + P(X=1) + P(X=2)$ $= {}^8C_0(0.25)^0(0.75)^8 + {}^8C_1(0.25)^1(0.75)^7 + {}^8C_2(0.25)^2(0.75)^6$ $= 0.1001 + 0.2670 + 0.3115$	1	
	$= 0.6786$	1	
	(*b*) (i) $X \sim N(1.5, 0.4^2)$ $P(X > 2) = P\left(Z > \frac{2-1.5}{0.4}\right)$ $= P(Z > 1.25)$	1	
	$= 0.1056$	1	
	(ii) 	1	
	$P(k \leqslant X \leqslant 2) = 72.84\%$ $P\left(\frac{k-1.5}{0.4} \leqslant Z \leqslant \frac{2-1.5}{0.4}\right) = 0.7284$ $P\left(\frac{k-1.25}{0.4} \leqslant Z \leqslant 1.25\right) = 0.7284$ $P\left(Z \geqslant \frac{k-1.5}{0.4}\right) - P(Z \geqslant 1.25) = 0.7284$	1	

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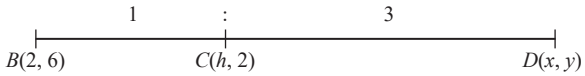
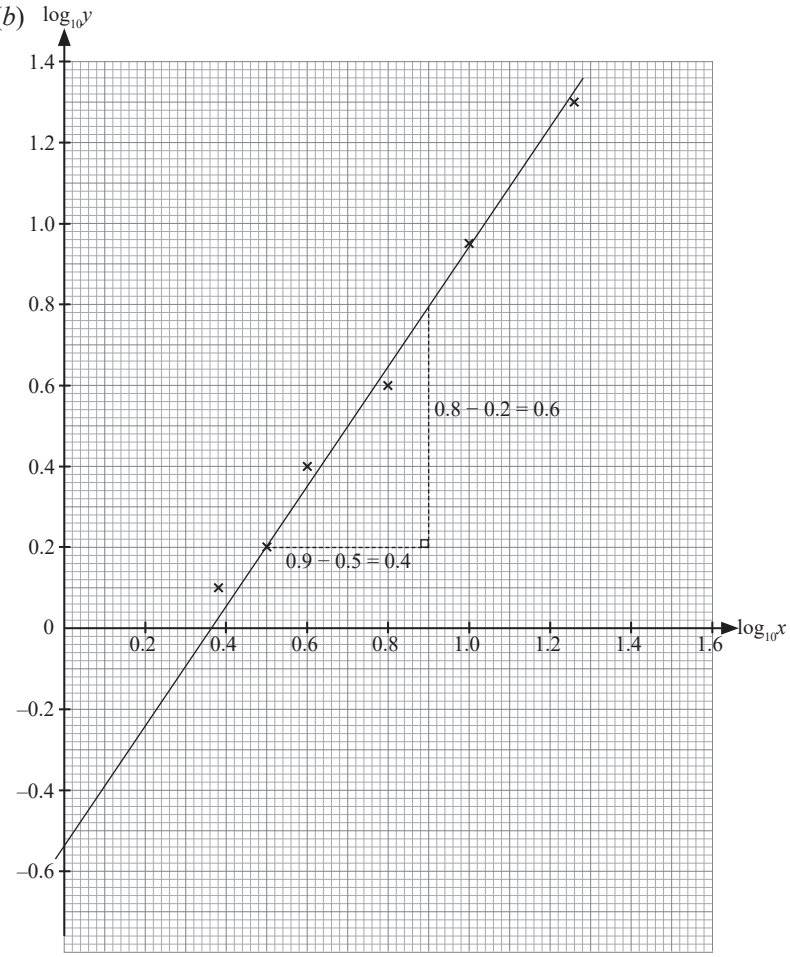
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$P\left(Z \geqslant \frac{k-1.5}{0.4}\right) - 0.1056 = 0.7284$ $P\left(Z \geqslant \frac{k-1.5}{0.4}\right) = 0.8340$ $1 - P\left(Z < \frac{k-1.5}{0.4}\right) = 0.8340$ $P\left(Z < \frac{k-1.5}{0.4}\right) = 0.1660$ $P\left(Z > \frac{k-1.5}{0.4}\right) = 0.1660$ $\frac{k-1.5}{0.4} = -0.97$ $k - 1.5 = -0.388$ $k = 1.112$	1 1 1	**10**
10	(*a*) (i)  $C(h, 2) = \left(\frac{3(2)+(1)(x)}{1+3}, \frac{(3)(6)+(1)(y)}{1+3}\right)$ $= \left(\frac{6+x}{4}, \frac{18+y}{4}\right)$ $\frac{6+x}{4} = h$, $\frac{18+y}{4} = 2$ $6 + x = 4h$, $18 + y = 8$ $x = 4h - 6$, $y = 8 - 18$ $y = -10$ $\therefore D(4h - 6, -10)$ (ii) Luas ΔACD / *Area of* $\Delta ACD = 27$ unit^2 $\frac{1}{2}\begin{vmatrix} -1 & h & 4h-6 & -1 \\ 0 & 2 & -10 & 0 \end{vmatrix} = 27$ $\left\lvert \begin{matrix} [(-1)(2) + (h)(-10) + (0)(4h-6) \\ -[(0)(h) + (2)(4h-6) + (-10)(-1) \end{matrix} \right\rvert = 54$ $\lvert(-2 - 10h) - (8h - 12 + 10)\rvert = 54$ $\lvert -2 - 10h - 8h + 12 - 10\rvert = 54$ $\lvert -18h\rvert = 54$ $-18h = 54$, $-(-18h) = 54$ $h = -3$ (abaikan / *ignore*) $h = 3$ $\therefore h = 3$	1 1 1 1	
	(*b*) (i) $D(4h - 6, -10)$ apabila / *when* $h = 3$ $\therefore D(6, -10)$ $BP = PD$ $\sqrt{(2-x)^2 + (6-y)^2} = \sqrt{(6-x)^2 + (-10-y)^2}$ $\sqrt{x^2 - 4x + 4 + y^2 - 12y + 36} = \sqrt{x^2 - 12x + 36 + y^2 + 20y + 100}$ $x^2 + y^2 - 4x - 12y + 40 = x^2 + y^2 - 12x + 20y + 136$ $-4x + 12x - 12y - 20y + 40 - 136 = 0$ $8x - 32y - 96 = 0$	1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) Pintasan paksi-y / *Intersection of y-axis*, $x = 0$ $8x - 32y - 96 = 0$ $8(0) - 32y - 96 = 0$ $-32y = 96$ $y = -3$	1	
	$\therefore E(0, -3)$	1	
	$m_{BA} = \frac{6-0}{2-(-1)} = 2$ $m_{CE} = \frac{-3-2}{0-3} = \frac{5}{3}$ $m_{BA} \neq m_{CE}$	1	
	$\therefore$ BA adalah tidak selari dengan CE. *BA is not parallel to CE.*	1	**10**
11	(*a*)	2	
	(*b*) 	3	

$\log_{10}x$	0.3802	0.4997	0.5999	0.8000	1	1.2601
$\log_{10}y$	0.1004	0.2014	0.4014	0.5999	0.9499	1.3002

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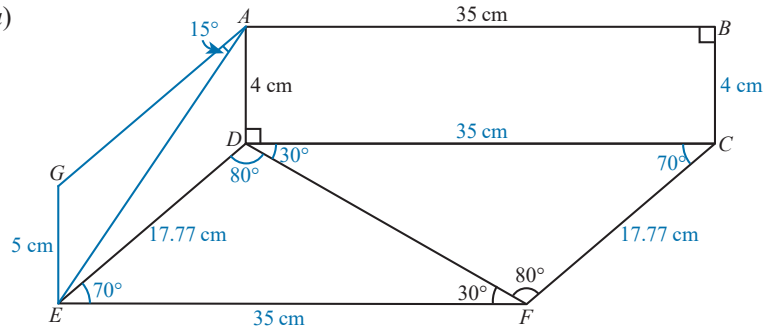
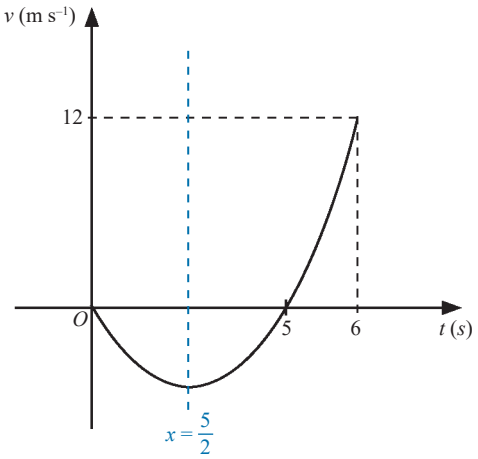
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*c*) $x^a = by$ $\log_{10} x^a = \log_{10} by$ $a \log_{10} x = \log_{10} b + \log_{10} y$ $\log_{10} y = a \log_{10} x - \log_{10} b$ $Y = m \quad X + C$	1 1	
	$m = a = \dfrac{0.8 - 0.2}{0.9 - 0.5}$ $a = \dfrac{3}{2}$	1	
	$-\log_{10} b = -0.54$ $\log_{10} b = 0.54$ $b = 10^{0.54}$ $b = 3.4674$	1 1	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
12	(*a*) 		
	(i) $\dfrac{CF}{\sin 30°} = \dfrac{35}{\sin 80°}$ $CF = \dfrac{35 \sin 30°}{\sin 80°}$ $CF = 17.77$ cm	1 1	
	(ii) $AC = \sqrt{35^2 + 4^2}$ $AC = 35.23$ cm	1	
	$CE^2 = 35^2 + 17.77^2 - 2(35)(17.77)$ kos / cos 110° $CE = \sqrt{1\,966.2118}$ $CE = 44.34$ cm	1	
	$AE^2 = 4^2 + 17.77^2 - 2(4)(17.77)$ kos / cos 90° $AE = \sqrt{331.7729}$ $AE = 18.21$ cm		
	$s = \dfrac{35.23 + 44.34 + 18.21}{2}$ $= 48.89$	1	
	Luas ΔACE / *Area of* ΔACE $= \sqrt{s(s-a)(s-b)(s-c)}$ $= \sqrt{48.89(48.89 - 35.23)(48.89 - 44.34)(48.89 - 18.21)}$ $= 305.33$ cm^2	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\dfrac{\sin \angle AGE}{18.21} = \dfrac{\sin 15°}{5}$ $\sin \angle AGE = 0.9426$ $\angle AGE = \sin^{-1}(0.9426)$ $\quad \angle AGE = 70.49°$ $\angle GEA = 180° - 15° - 70.49°$ $= 94.51°$ $\dfrac{AG}{\sin 94.51°} = \dfrac{5}{\sin 15°}$ $AG = \dfrac{5 \sin 94.51°}{\sin 15°}$ $AG = 19.26$ cm	1 1 1 1	**10**
13	(*a*) (i) $t = 5\ s$ (ii) Bergerak ke kiri / *Moves to left*: $v < 0$ $0 < t < 5$	1 1	
	(*b*) (i)  $v = at^2 + bt + c$ pada / *at* (0, 0) $0 = a(0)^2 + b(0) + c$ $0 = c$ $v = at^2 + bt + c$ pada / *at* (5, 0) $0 = a(5)^2 + b(5) + c$ $0 = 25a + 5b$ $-25a = 5b$ $-5a = b$ ... ① $v = at^2 + bt + c$ pada / *at* (6, 12) $12 = a(6)^2 + b(6)$ $12 = 36a + 6(-5a)$ $12 = 36a - 30a$ $12 = 6a$ $2 = a$ Dari / *From* ①, $b = -5(2)$ $= -10$ $\therefore v = 2t^2 - 10$ (Tertunjuk / *Shown*)	 1 1 1	

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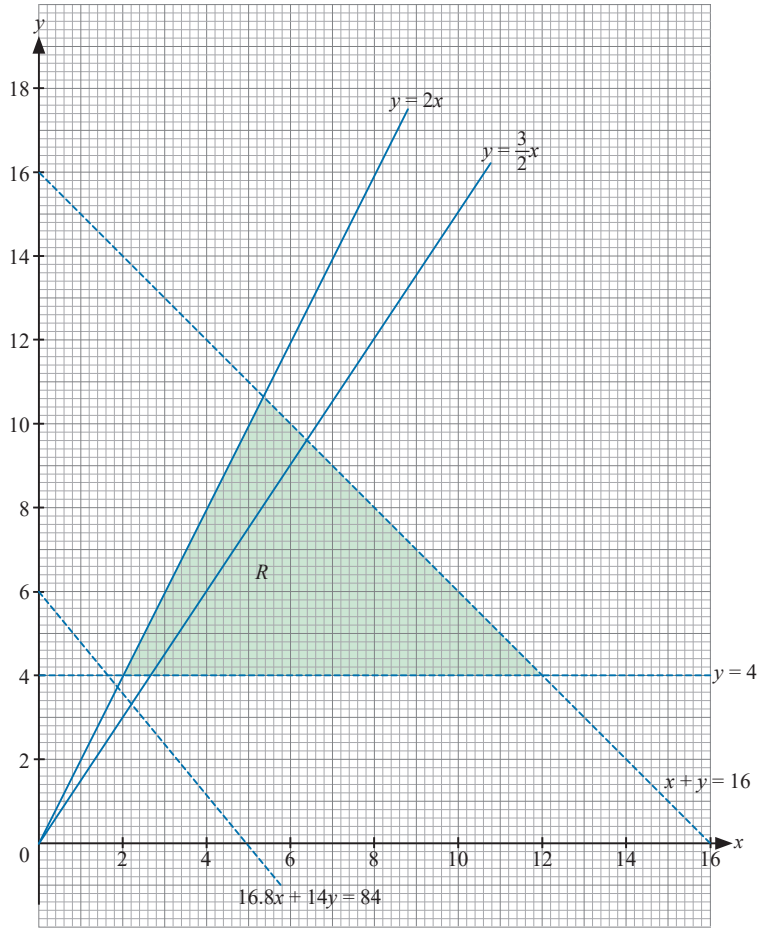
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $v = 2t^2 - 10$ $a = \frac{dV}{dt}$ $a = 4t - 10$ apabila / *when* $t = 2$ s $a = 4(2) - 10$ $a = -2 \text{ m s}^{-2}$	 1 1	
	(iii) Halaju maksimum / *Maximum velocity*: $a = 0$ $4t - 10 = 0$ $4t = 10$ $t = \frac{5}{2}$	 1	
	Jarak / *Distance* $= \left\lvert \int_{\frac{5}{2}}^{5} (2t^2 - 10t)\, dt \right\rvert + \int_{5}^{6} (2t^2 - 10t)\, dt$ $= \left\lvert \left[\frac{2}{3}t^3 - 5t^2\right]_{\frac{5}{2}}^{5} \right\rvert + \left[\frac{2}{3}t^3 - 5t^2\right]_{5}^{6}$ $= \left\lvert \left[\frac{2}{3}(5)^3 - 5(5)^2\right] - \left[\frac{2}{3}\left(\frac{5}{2}\right)^3 - 5\left(\frac{5}{2}\right)^2\right] \right\rvert + \left\{\left[\frac{2}{3}(6)^3 - 5(6)^2\right] - \left[\frac{2}{3}(5)^3 - 5(5)^2\right]\right\}$ $= \left\lvert -\frac{125}{3} - \left(-\frac{125}{6}\right) \right\rvert + \left[-36 - \left(-\frac{125}{3}\right)\right]$ $= \left\lvert -\frac{125}{6} \right\rvert + \frac{17}{3}$ $= \frac{125}{6} + \frac{17}{3}$ $= 26\frac{1}{2}$ m	 1 1	**10**
14	(*a*) $p = 16$ $q = 4$	1	
	(*b*) $y \leqslant 2x$ x: 0, 4 y: 0, 8	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
		2	
	(*c*) (i) Kaedah 1 = Kaedah algebra *Method* 1 = *Algebraic method* $y : x$ $3 : 2$ $6 : 4$ $9 : 6$ } Koordinat (4, 6) dan (9, 6) berada dalam rantau *R*. *The coordinates* (4, 6) *and* (9, 6) *are in R region.*	1	
	Kaedah 2 = Kaedah graf *Method* 2 = *Graphical method* $\frac{y}{x} = \frac{3}{2}$ $y = \frac{3}{2}x$ x: 0, 6 y: 0, 9 ∴ Bilangan yang mungkin bagi anak patung Mal ialah 4 dan 6. *Possible number of Mal's dolls are* 4 *and* 6.	1	

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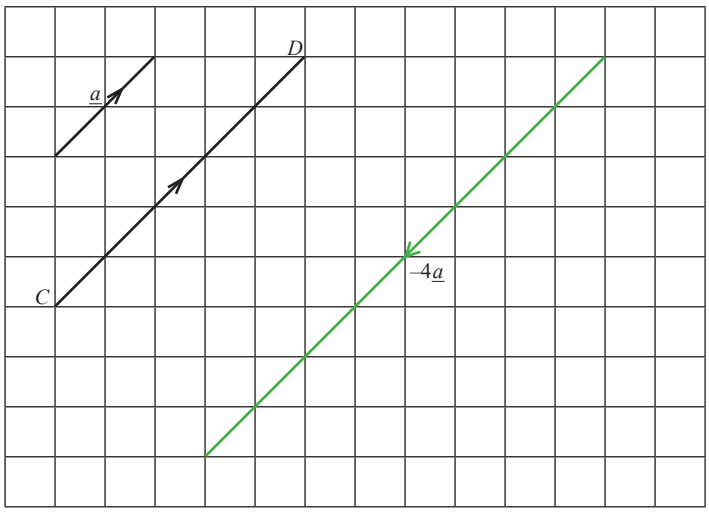
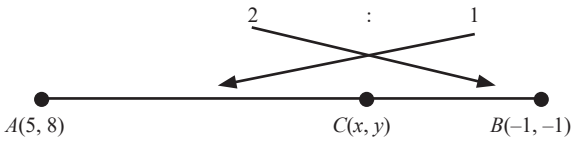
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $k = 16.8x + 14y$	1	
	Katakan / *Let* $16.8x + 14y = 84$		
	$\begin{array}{c\|c\|c} x & 0 & 5 \\ \hline y & 6 & 0 \end{array}$	1	
	Titik maksimum / *Maximum point* = (12, 4)	1	
	Kos maksimum / *Maximum cost* = 16.8(12) + 14(4) = RM257.60	1	**10**
15	(*a*) $x = \frac{27.5}{25} \times 100$ $= 110$	1	
	$\frac{22.5}{y} \times 100 = 150$	1	
	$\frac{22.5}{y} = 1.5$ $y = 15$	1	
	(*b*) $\frac{(3)(110) + (2)(112.5) + (m)(150) + (4)(120)}{3 + 2 + m + 4} = 127.5$	1	
	$\frac{1\,035 + 150m}{9 + m} = 127.5$ $1\,035 + 150m = 1\,147.5 + 127.5m$ $225m = 112.5$ $m = 5$	1	
	(*c*) (i) $\bar{I}_{2025/2021} = 127.5 \times \frac{120}{100}$ $\bar{I}_{2025/2021} = 153$	1	
	(ii) $\frac{P_{2025}}{100} \times 100 = 153$ $P_{2025} = \text{RM}153$	1	
	(iii) $\frac{(3)(110) + (2)(112.5) + (5)(I_C) + (4)(120)}{3 + 2 + 5 + 4} = 153$	1	
	$\frac{1\,035 + 5I_C}{14} = 153$ $1\,035 + 5I_C = 2\,142$ $5I_C = 1\,107$ $I_C = 221.4$		
	$\frac{P_{2025}}{15} \times 100 = 221.4$ $P_{2025} = \text{RM}33.21$	1	
	$\frac{33.21 - 15}{15} \times 100\% = 121.4\%$	1	**10**

SIJIL PELAJARAN MALAYSIA 2024

KERTAS 1

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	$(y = 4x^2 - 5) \div x^2$ $\frac{y}{x^2} = 4 - \frac{5}{x^2}$ $\frac{y}{x^2} = -5\left(\frac{1}{x^2}\right) + 4$ $\boldsymbol{Y = m \quad X \quad + C}$ $Y = \frac{y}{x^2}$ $X = \frac{1}{x^2}$	 1 1	2
2	(*a*) $\{-5, 10, 15, 25\}$	1	
	(*b*) $g(x) = 3 - x$ $g(4) = p - 10$ $3 - 4 = p - 10$ $-1 = p - 10$ $-1 + 10 = p$ $p = 9$	 1 1	3
3	(*a*) (i) $\overrightarrow{CD} = \underline{a} + \underline{a} + \frac{1}{2}\underline{a}$ $\overrightarrow{CD} = \frac{5}{2}\underline{a}$ (ii) 	1 1	
	(*b*)  $C(x, y) = \left(\frac{2(-1) + (1)(5)}{2 + 1}, \frac{(2)(-1) + (1)(8)}{2 + 1}\right)$ $= (1, 2)$	1 1	

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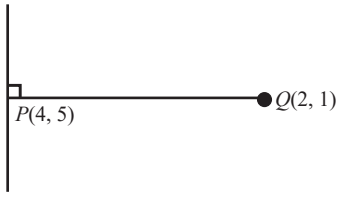
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*c*)  $m_{PQ} = \frac{5-1}{4-2}$ $= 2$ $m_{PQ} \times m_2 = -1$ $2 \times m_2 = -1$ $m_2 = -\frac{1}{2}$ $y - y_1 = m(x - x_1)$ $y - 5 = -\frac{1}{2}(x - 4)$ $y = -\frac{1}{2}x + 2 + 5$ $y = -\frac{1}{2}x + 7$	1 1 1	7
4	$\frac{\text{Panjang lengkok}}{\text{Lilitan bulatan}} = \frac{\text{Sudut yang dicangkum di pusat}}{360°}$ $\frac{s}{2\pi j} = \frac{\theta}{2\pi}$ $s = \frac{\theta}{2\pi} \times 2\pi j$ $s = j\theta$ $\frac{\textit{Length of arc}}{\textit{Circumference}} = \frac{\textit{Angle subtended at the centre}}{360°}$ $\frac{s}{2\pi r} = \frac{\theta}{2\pi}$ $s = \frac{\theta}{2\pi} \times 2\pi r$ $s = r\theta$	1 1	2
5	$\log_{\frac{m}{n}} p = \frac{1}{\log_p \frac{m}{n}}$ $= \frac{1}{\log_p m - \log_p n}$ $= \frac{1}{\frac{1}{\log_m p} - \frac{1}{\log_n p}}$ $= \frac{1}{\frac{1}{x} - \frac{1}{y}}$ $= \frac{1}{\frac{y-x}{xy}}$ $= \frac{xy}{y-x}$	1 1 1	3

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
6	$(2x + 3y - 2z = -6) \times 6$ $12x + 18y - 12z = -36$ ... ① $(-3x + y + 4z = -7) \times 3$ $-9x + 3y + 12z = -21$ ... ② $(-4x - 5y - 6z = 4) \times 2$ $-8x - 10y - 12z = 8$ ... ③ ① + ②: $(12x + 18y - 12z) + (-9x + 3y + 12z) = -36 + (-21)$ $3x + 21y = -57$ $x + 7y = -19$ $x = -19 - 7y$ ... ④ ① + ③: $(12x + 18y - 12z) - (-8x - 10y - 12z) = -36 - 8$ $20x + 28y = -44$ $5x + 7y = -11$ $5(-19 - 7y) + 7y = -11$ $-28y = -11 + 95$ $-28y = 84$ $y = \frac{84}{-28}$ $y = -3$ Dari / *From* ④, $x = -19 - 7(-3)$ $x = -19 + 21$ $x = 2$ Dari / *From* ①, $12(2) + 18(-3) - 12z = -36$ $24 - 54 - 12z = -36$ $-12z = -36 - 24 + 54$ $-12z = -6$ $z = \frac{-6}{-12}$ $z = \frac{1}{2}$ $\therefore x = 2, y = -3, z = \frac{1}{2}$	1 1 1 1 1	5
7	(*a*) (i) 4, 8, 16 $r_1 = \frac{8}{4} = 2$ $r_2 = \frac{16}{8} = 2$ Janjang geometri kerana $r_1 = r_2 = 2$ *Geometric progression because* $r_1 = r_2 = 2$	1	

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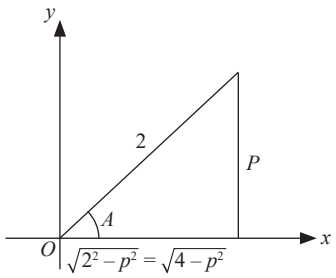
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) $T_n = ar^n - 1$ $= (4)(2)^{n-1}$ $= (2^2)(2)^{n-1}$ $= 2^{n-1+2}$ $= 2^{n+1}$	1 1	
	(*b*) *AP*: $T_n = a + (n-1)d$, $T_2 = 5p - 10$ $a + (2-1)d = 5p - 10$ $a + d = 5p - 10$ $d = 5p - 10 - a$ ... ① $T_{10} = 7a$ $a + (10-1)d = 7a$ $a + 9d = 7a$ $a + 9(5p - 10 - a) = 7a$ $a + 45p - 90 - 9a) = 7a$ $a - 9a - 7a = 90 - 45p$ $-15a = 90 - 45p$ $a = \frac{90 - 45p}{-15}$ $a = -6 + 3p$	 1 1 1	
	(*c*) $T_1 = a$, $T_n = 5a$ Jumlah sudut / *Total interior angle* $= (n-2) \times 180°$ $S_n = (n-2) \times 180°$ $\frac{n}{2}(a + l) = (n-2) \times 180°$ $\frac{n}{2}(a + 5a) = (n-2) \times 180°$ $\frac{n}{2}(6a) = (n-2) \times 180°$ $3an = (n-2) \times 180°$ $a = \frac{(n-2) \times 180°}{3n}$ $a = \frac{(n-2) \times 60°}{n}$	 1 1	**8**
8	(*a*)  kos / cos $A = \frac{\sqrt{4 - p^2}}{2}$	1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) $\sin(A+B)-\sin(A-B)=2p$ $(\sin A \text{ kos } B + \text{kos } A \sin B) - (\sin A \text{ kos } B - \text{kos } A \sin B) = 2p$ $\sin A \text{ kos } B + \text{kos } A \sin B - \sin A \text{ kos } B + \text{kos } A \sin B = 2p$ $2 \text{ kos } A \sin B = 2p$ $2\left(\frac{\sqrt{4-p^2}}{2}\right)\sin B = 2p$ $\sqrt{4-p^2}\sin B = 2p$ $\sin B = \frac{2p}{\sqrt{4-p^2}}$ $\sin(A+B)-\sin(A-B)=2p$ $(\sin A \cos B + \cos A \sin B) - (\sin A \cos B - \cos A \sin B) = 2p$ $\sin A \cos B + \cos A \sin B - \sin A \cos B + \cos A \sin B = 2p$ $2 \cos A \sin B = 2p$ $2\left(\frac{\sqrt{4-p^2}}{2}\right)\sin B = 2p$ $\sqrt{4-p^2}\sin B = 2p$ $\sin B = \frac{2p}{\sqrt{4-p^2}}$	1 1 1	5
9	(*a*) Luas / *Area*, $A = 2x(5x-1)$ $A = 10x^2 - 2x$ $\frac{dA}{dx} = 20x - 2$ Apabila / *When* $x = 3$, $\frac{dA}{dx} = 20(3) - 2$ $\frac{dA}{dx} = 58$ $\frac{\delta A}{\delta x} \approx \frac{dA}{dx}$ $\delta A = \frac{dA}{dx} \times \delta x$ $\delta A = (58)[(3+p)-3]$ $\delta A = (58)(p)$ $\delta A = 58p$	1 1 1	
	(*b*) (i) $A = \frac{1}{2}(3y+5y)(38-8y)$ $= \frac{1}{2}(8y)(38-8y)$ $= 4y(38-8y)$ $= 152y - 32y^2$ $\frac{dA}{dy}$: $152 - 64y = 0$ $-64y = -152$ $y = \frac{-152}{-64}$ $y = 2.375$ m $\frac{d^2A}{dy^2} = -64 < 0$ $\therefore$ A adalah maksimum apabila $y = 2.375$ m. *A is maximum when* $y = 2.375$ m.	1 1 1	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) Luas Q / *Area of* $Q = 152y - 32y^2$ $= 152(2.375) - 32(2.375)^2$ $= 180.5\ \text{m}^2$	1	
	Perimeter, $P = 54$ m $2[(x-1)+x] = 54$ $2(2x-1) = 54$ $2x - 1 = 27$ $2x = 28$ $x = 14$ m	1	
	Luas P / *Area of* $P = (x-1)(x)$ $= (14-1)(14)$ $= 182\ \text{m}^2$		
	∴ Lot P yang akan ditanam dengan rumput yang paling banyak kerana luas P ialah 182 m², iaitu 1.5 m² lebih banyak daripada luas Q, iaitu 180.5 m². *Lot P will be planted with most grass because the area of P is* 182 m², *which* 1.5 m² *more than the area of Q, which is* 180.5 m².	1	9
10	(*a*) $\int [3g(x)+1]\,dx = 3\left(\frac{1}{x^2+1}\right) + \int 1\,dx$ $= \frac{3}{x^2+1} + x + c$	2 1	
	(*b*) (i) $\int_0^h f(y)\,dy + \left\lvert \int_h^k f(y)\,dy \right\rvert + \int_k^m f(y)\,dy = \frac{9}{2}$ $\frac{3}{2} + \left\lvert \int_h^k f(y)\,dy \right\rvert + \frac{3}{2} = \frac{9}{2}$ $\left\lvert \int_h^k f(y)\,dy \right\rvert = \frac{9}{2} - \frac{3}{2} - \frac{3}{2}$ $\left\lvert \int_h^k f(y)\,dy \right\rvert = \frac{3}{2}$ $\int_h^k f(y)\,dy = -\frac{3}{2}$	1	
	$\int_0^k f(y)\,dy = \int_0^h f(y)\,dy + \int_h^k f(y)\,dy$ $= \frac{3}{2} + \left(-\frac{3}{2}\right)$ $= 0$	1	
	(ii) $\int_h^k x\,dy + \int_k^m \frac{5}{4} f(y)\,dy = \int_h^k f(y)\,dy + \frac{5}{4}\int_k^m f(y)\,dy$ $= -\frac{3}{2} + \frac{5}{4}\left(\frac{3}{2}\right)$ $= -\frac{3}{2} + \frac{15}{8}$ $= \frac{3}{8}$	1	6

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
11	(*a*) $^{n+1}C_2 = 4n$		
	$\frac{(n+1)!}{2![(n+1)-2]!} = 4n$	1	
	$\frac{(n+1)!}{2!(n-1)!} = 4n$		
	$\frac{(n+1)(n)(n-1)!}{2!(n-1)!} = 4n$		
	$\frac{n(n+1)}{2} = 4n$		
	$n^2 + n = 8n$		
	$n^2 + n - 8n = 0$		
	$n^2 - 7n = 0$		
	$n(n-7) = 0$		
	$n = 0$; $n - 7 = 0$		
	$n = 7$	1	
	$\therefore n = 7$		
	Jumlah bilangan poligon / *Total number of polygons*		
	$= {}^7C_3 + {}^7C_4 + {}^7C_5 + {}^7C_6 + {}^7C_7$		
	$= 35 + 35 + 21 + 7 + 1$	1	
	$= 99$	1	
	(*b*) (i) Bilangan cara / *Number of ways* $= {}^{10}P_{10}$	1	
	$= 3\ 628\ 800$	1	
	(ii) $> 50 \rightarrow B, E, G, H$		
	$< 50 \rightarrow A, C, D, F, I, J$		
	Bilangan cara / *Number of ways* $= {}^1P_1 \times {}^1P_1 \times {}^4P_3 \times {}^5P_5$	1	
	$= 1 \times 1 \times 24 \times 120$		
	$= 2\ 880$	1	8
12	(*a*) Konsonan / *Consonant* = *C*, *R*, *D*, *K*		
	Vokal / *Vowel* = *E*, *I*		
	P(Konsonan / *Consonant*) $= \frac{4}{6}$		
	$= \frac{2}{3}$		
	Jangkaan bilangan / *Expected value* $= (120)\left(\frac{2}{3}\right)$	1	
	$= 80$	1	
	(*b*) Katakan / *Let X* = Konsonan / *Consonant*		
	$P(X > 2) = P(X = 3) + P(X = 4) + P(X = 5)$	1	
	$= {}^5C_3\left(\frac{2}{3}\right)^3\left(\frac{1}{3}\right)^2 + {}^5C_4\left(\frac{2}{3}\right)^4\left(\frac{1}{3}\right)^1 + {}^5C_5\left(\frac{2}{3}\right)^5\left(\frac{1}{3}\right)^0$	1	
	$= 0.3292 + 0.3292 + 0.1317$	1	
	$= 0.7901$	1	6

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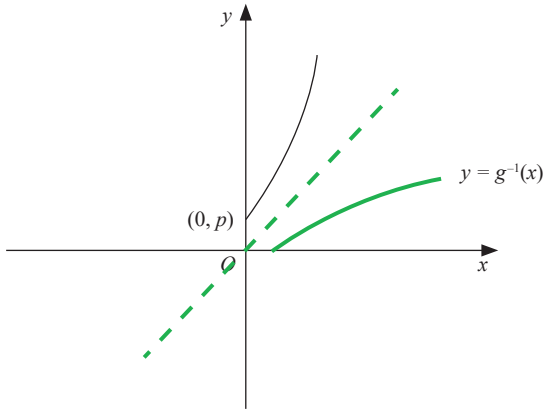
Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
13	(*a*) (i) $\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$		
	$\overrightarrow{PQ} = -\overrightarrow{OP} + \overrightarrow{OQ}$		
	$\overrightarrow{PQ} = -(4h\underline{i} + 2h\underline{j}) + (-h\underline{j})$	1	
	$\overrightarrow{PQ} = -4h\underline{i} - 2h\underline{j} - h\underline{j}$		
	$\overrightarrow{PQ} = -4h\underline{i} - 3h\underline{j}$	1	
	(ii) $\overrightarrow{PQ} = -4h\underline{i} - 3h\underline{j}$		
	$\sqrt{(-4h)^2 + (-3h)^2} = 1$	1	
	$\sqrt{16h^2 + 9h^2} = 1$		
	$\sqrt{25h^2} = 1$		
	$h^2 = \frac{1}{25}$		
	$h = \pm\frac{1}{5}$		
	$\therefore h = \frac{1}{5}$	1	
	(*b*) $P\left(\frac{4}{5}, \frac{2}{5}\right)$, $Q\left(0, -\frac{1}{5}\right)$, $R\left(-8, -\frac{31}{5}\right)$		
	$\overrightarrow{QR} = \overrightarrow{QO} + \overrightarrow{OR}$		
	$\overrightarrow{QR} = -\overrightarrow{OQ} + \overrightarrow{OR}$		
	$\overrightarrow{QR} = -\left(-\frac{1}{5}\underline{j}\right) + \left(-8\underline{i} - \frac{31}{5}\underline{j}\right)$	1	
	$\overrightarrow{QR} = \frac{1}{5}\underline{j} - 8\underline{i} - \frac{31}{5}\underline{j}$		
	$\overrightarrow{QR} = -8\underline{i} - 6\underline{j}$	1	
	$\overrightarrow{PQ} = -4h\underline{i} - 3h\underline{j}$		
	$\overrightarrow{PQ} = -\frac{4}{5}\underline{i} - \frac{3}{5}\underline{j}$		
	$\overrightarrow{PQ} = \frac{1}{10}(-8\underline{i} - 6\underline{j})$		
	$\overrightarrow{PQ} = \frac{1}{10}\overrightarrow{QR}$	1	
	$\therefore \overrightarrow{PQ}$ dan $\overrightarrow{QR}$ adalah selari dan Q ialah titik sepunya. Maka, P, Q, dan R adalah segaris.	1	
	$\overrightarrow{PQ}$ is parallel to $\overrightarrow{QR}$ and Q is the common point. So, P, Q and R are collinear.		**8**
14	(*a*) $gf(x) = x^2 + 1$	1	
	(*b*) (i) $f^{-1}(x - 2) = x$	1	
	Katakan / *Let* $x - 2 = y$		
	$x = y + 2$		
	$f^{-1}(y) = y + 2$		
	$\therefore f^{-1}(x) = x + 2$	1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$g(x) = [f^{-1}(x)]^2 + 1$ $= (x + 2)^2 + 1$ $= x^2 + 4x + 4 + 1$ $= x^2 + 4x + 5$	1	
	(ii)  	1	
	(*c*) $f(x) = x - 2$ $f^2(x) = ff(x) = f(x - 2)$ $= (x - 2) - 2$ $= x - 4$ $f^3(x) = ff^2(x) = f(x - 4)$ $= (x - 4) - 2$ $= x - 6$ $f^4(x) = f^2f^2(x) = f^2(x - 4)$ $= (x - 4) - 4$ $= x - 8$	1	
	$f(x) = x - 2(1)$ $f^2(x) = x - 2(2)$ $f^3(x) = x - 2(3)$ $f^4(x) = x - 2(4)$ $f^n(x) = x - 2(n)$	1	
	$\therefore\ f^{75}(x) = x - 2(75)$ $f^{75}(x) = x - 150$	1	**8**
15	(*a*) $(x)(x) + (2x + 10)(x) > 8$ $x^2 + 2x^2 + 10x - 8 > 0$ $3x^2 + 10x - 8 > 0$ $(3x - 2)(x + 4) > 0$		

	$x < -4$	$-4 < x < \frac{2}{3}$	$x > \frac{2}{3}$
$3x - 2$	–	–	+
$x + 4$	–	+	+
$(3x - 2)(x + 4)$	⊕	–	⊕

1

$x > \frac{2}{3}, x < -4$ — 1

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $x^2 + 3x = -4p$ $x^2 + 3x + 4p = 0$		
	$b^2 - 4ac < 0$ $(3)^2 - 4(1)(4p) < 0$ $9 - 16p < 0$ $-16p < -9$ $p > \frac{9}{16}$	1 1	
	(ii) $x^2 + 3x + 4p = 0$ Punca / *Roots*: α, β HTP / *SOR*: $\alpha + \beta = -\frac{3}{1}$ $= -3$ HDP / *POR*: $\alpha\beta = \frac{4p}{1}$ $= 4p$		
	Punca baru / *New roots* = $\alpha - \beta + 1, \beta - \alpha + 1$ HTP baru / *New SOR*: $(\alpha - \beta + 1) + (\beta - \alpha + 1) = \alpha - \beta + 1 + \beta - \alpha + 1$ $= 2$	 1	
	HDP baru / *New POR*: $(\alpha - \beta + 1) + (\beta - \alpha + 1) = \alpha\beta - \alpha^2 + \alpha - \beta^2 + \alpha\beta - \beta + \beta - \alpha + 1$ $= -\alpha^2 - \beta^2 + 2\alpha\beta + 1$ $= -(\alpha^2 + \beta^2) + 2\alpha\beta + 1$ $= -[(\alpha + \beta)^2 - 2\alpha\beta] + 2\alpha\beta + 1$ $= -(\alpha + \beta)^2 + 4\alpha\beta + 1$ $= -(-3)^2 + 4(4p) + 1$ $= -9 + 16p + 1$ $= -8 + 16p$	 1 1	
	Persamaan baru / *New equation*: $x^2 - 2x + (-8 + 16p) = 0$ $x^2 - 2x + 16p - 8 = 0$	 1	**8**

KERTAS 2

Bahagian A

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
1	(*a*) (i) Luas / *Area* $= \frac{1}{2} j^2\theta / \frac{1}{2} r^2\theta$ $\frac{1}{2}(AC)^2(2.8) = 113.4$ $(AC)^2 = \frac{113.4}{(2.8)\left(\frac{1}{2}\right)}$ $(AC)^2 = 81$ $AC = \sqrt{81}$ $AC = 9$ cm	1 1	
	(ii) $OA = \frac{1}{2} AC = 4.5$ cm $\therefore OC = 4.5 \text{ cm} + 9 \text{ cm}$ $= 13.5$ cm $\sin\theta = \frac{CP}{OC}$ $\sin\theta = \frac{7.74}{13.5}$ $\theta = \sin^{-1}\left(\frac{7.74}{13.5}\right)$ $\theta = 34.98°$ $\theta = 0.6106$ rad $\theta = 0.611$ rad	1 1	
	(*b*) $S_{CD} = (13.5)(0.611)$ $= 8.2485$ cm $S_{BC} = (9)(2.8)$ $= 25.2$ cm Perimeter $= AB + BC + CD + DO + OA$ $= 9 + 25.2 + 8.2485 + 13.5 + 4.5$ $= 60.4485$ cm	1 1 1	7
2	(*a*) $f(x) = 3x^2 + 3px + p$ $f(x) = 3\left(x^2 + px + \frac{p}{3}\right)$ $f(x) = 3\left[x^2 + px + \left(\frac{p}{2}\right)^2 - \left(\frac{p}{2}\right)^2 + \frac{p}{3}\right]$ $f(x) = 3\left[\left(x + \frac{p}{2}\right)^2 - \frac{p^2}{4} + \frac{p}{3}\right]$ $f(x) = 3\left(x + \frac{p}{2}\right)^2 - \frac{3p^2}{4} + p$	1	

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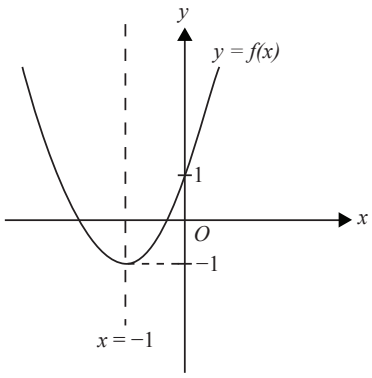
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Nilai minimum / *Minimum value* $= -1$ $-\frac{3p^2}{4} + p = -1$ $-3p^2 + 4p = -4$ $-3p^2 + 4p + 4 = 0$ $3p^2 - 4p - 4 = 0$ $(3p + 2)(p - 2) = 0$ $3p + 2 = 0, p - 2 = 0$ $p = -\frac{2}{3}, p = 2$	1 2	
	(*b*) $p = 2; f(x) = 3\left(x + \frac{2}{2}\right)^2 - \frac{3(2)^2}{4} + 2$ $f(x) = 3(x + 1)^2 - 1$ Apabila / *When* $f(x) = 0$; $3(x + 1)^2 - 1 = 0$ $(x + 1)^2 = \frac{1}{3}$ $x + 1 = \pm\sqrt{\frac{1}{3}}$ $x = -1 \pm \sqrt{\frac{1}{3}}$ Apabila / *When* $x = 0$; $f(x) = 3(0 + 1)^2 - 1$ $f(x) = 2$ Apabila / *When*, $x + 1 = 0$ $x = -1$  	1 1	6

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
3	(*a*) $p^{x-2} \cdot q^{x+2} = (pq)^{2x}$ $\left(\frac{p^x}{p^2}\right)(q^x)(q^2) = (pq)^{2x}$ $(pq)^x\left(\frac{q^2}{p^2}\right) = (pq)^{2x}$ $\left(\frac{q}{p}\right)^2 = \frac{(pq)^{2x}}{(pq)^x}$ $\left(\frac{q}{p}\right)^2 = (pq)^{2x-x}$ $\left(\frac{q}{p}\right)^2 = (pq)^x$ (Ditunjukkan / *Shown*)	1 1 1	
	(*b*) $\frac{k}{4-\sqrt{7}} + \sqrt{28} = \frac{k}{4-\sqrt{7}} + \sqrt{28}\left(\frac{4-\sqrt{7}}{4-\sqrt{7}}\right)$ $= \frac{k+\sqrt{28}\,(4-\sqrt{7})}{4-\sqrt{7}}$ $= \frac{k+4\sqrt{28}-\sqrt{196}}{4-\sqrt{7}}$ $= \frac{k+4(2\sqrt{7})-14}{4-\sqrt{7}}$ $= \frac{k-14+8\sqrt{7}}{4-\sqrt{7}} \times \frac{4+\sqrt{7}}{4+\sqrt{7}}$ $= \frac{4k-56+32\sqrt{7}+k\sqrt{7}-14\sqrt{7}+56}{16-7}$ $= \frac{4k+(18+k)\sqrt{7}}{9}$ $= \frac{4k}{9} + \left(\frac{18+k}{9}\right)\sqrt{7}$ $p = \frac{4k}{9}$, $q = \frac{18+k}{9}$	1 1 1	6
4	(*a*) (i) $\overrightarrow{AB} = \overrightarrow{AC} + \overrightarrow{CB}$ $= -5\underline{v} + 6\underline{u}$ (ii) $\overrightarrow{CR} = \overrightarrow{CA} + \overrightarrow{AR}$ $= 5\underline{v} + \frac{2}{5}\overrightarrow{AB}$ $= 5\underline{v} + \frac{2}{5}(-5\underline{v} + 6\underline{u})$ $= 5\underline{v} - 2\underline{v} + \frac{12}{5}\underline{u}$ $= 3\underline{v} + \frac{12}{5}\underline{u}$	1 1 1	

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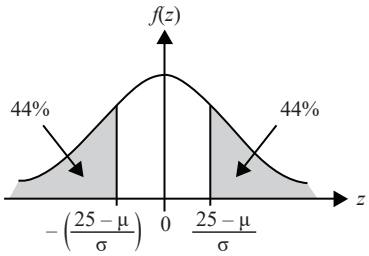
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*b*) (i) $\overrightarrow{CR} = 3(\underline{i} + 4\underline{j}) + \frac{12}{5}(5\underline{i})$	1	
	$\overrightarrow{CR} = 3\underline{i} + 12\underline{j} + 12\underline{i}$		
	$\overrightarrow{CR} = 15\underline{i} + 12\underline{j}$		
	$\lvert \overrightarrow{CR} \rvert = \sqrt{15^2 + 12^2}$	1	
	$\lvert \overrightarrow{CR} \rvert = 3\sqrt{41}$	1	
	(ii) Luas / *Area*, $\Delta CAR = 3 \times \Delta CPQ$		
	$\frac{1}{2} \times CR \times$ tinggi / *height* $= 3\left(\frac{40}{3}\right)$		
	$\frac{1}{2} \times 3\sqrt{41} \times x = 40$	1	
	$3\sqrt{41} \times x = 80$		
	$x = \frac{80}{3\sqrt{41}}$		
	$x = \frac{80}{3\sqrt{41}} \times \frac{3\sqrt{41}}{3\sqrt{41}}$		
	$x = \frac{80\sqrt{41}}{123}$		
	$\therefore$ Jarak terdekat / *Shortest distance* = 4.1646 unit	1	**8**
5	(*a*) $y = \int (4x - 6)\, dx$		
	$y = \frac{4x^2}{2} - 6x + c$		
	$y = 2x^2 - 6x + c$, melalui / *pass through* (1, 4)	1	
	$4 = 2(1)^2 - (6)1 + c$	1	
	$4 = -4 + c$		
	$c = 4 + 4$		
	$c = 8$		
	$\therefore y = 2x^2 - 6x + 8$	1	
	(*b*) $m_{\text{tangen /tangent}} : \frac{dy}{dx} = 4x - 6$ pada / *at* (1, 4)		
	$\frac{dy}{dx} = 4(1) - 6$	1	
	$= -2$		
	$m_{\text{normal}} \times m_{\text{tangen/tangent}} = -1$		
	$m_{\text{normal}} \times -2 = -1$		
	$m_{\text{normal}} = \frac{1}{2}$		
	Persamaan normal melalui $P(1, 4)$: *Equation of normal passes through* $P(1, 4)$:		
	$y - y_1 = m(x - x_1)$		
	$y - 4 = \frac{1}{2}(x - 1)$	1	
	$y = \frac{1}{2}x - \frac{1}{2} + 4$		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$y = \frac{1}{2}x + \frac{7}{2}$ $y = 2x^2 - 6x + 8$ ... ① $y = \frac{1}{2}x + \frac{7}{2}$ ... ② ① = ② ; $2x^2 - 6x + 8 = \frac{1}{2}x + \frac{7}{2}$ $2x^2 - 6x - \frac{1}{2}x + 8 - \frac{7}{2} = 0$ $2x^2 - \frac{13}{2}x + \frac{9}{2} = 0$ $4x^2 - 13x + 9 = 0$ $(4x - 9)(x - 1) = 0$ $4x - 9 = 0, x - 1 = 0$ $x = \frac{9}{4}$, $x = 1$ (abaikan / *ignore*) Dari / *From* ②, $y = \frac{1}{2}x + \frac{7}{2}$ $y = \frac{1}{2}\left(\frac{9}{4}\right) + \frac{7}{2}$ $y = \frac{37}{8}$ $\therefore Q\left(\frac{9}{4}, \frac{37}{8}\right)$	1 1	7
6	$P(x < 25) = 44\%$ $P\left(Z < \frac{25 - \mu}{\sigma}\right) = 0.44$ $\frac{25 - \mu}{\sigma} = -0.151$ $25 - \mu = -0.151\sigma$ ... ①  	1	

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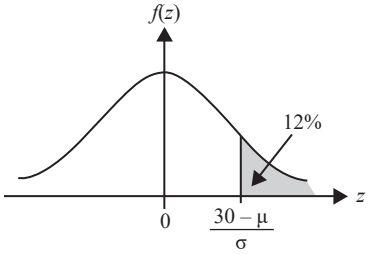
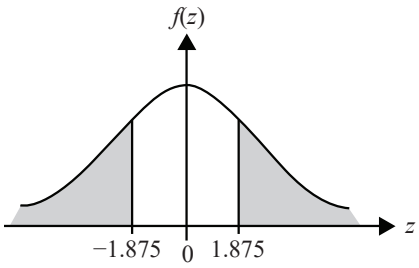
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$P(x \geqslant 30) = 12\%$ $P\left(Z > \frac{30-\mu}{\sigma}\right) = 0.12$ $\frac{30-\mu}{\sigma} = 1.175$ $30 - \mu = 1.175\sigma$ ... ②  	1	
	② − ①; $(30 - \mu) - (25 - \mu) = 1.175\sigma - (-0.151\sigma)$ $30 - \mu - 25 + \mu = 1.175\sigma + 0.151\sigma$ $5 = 1.326\sigma$ $\frac{5}{1.326} = \sigma$ $\sigma = 3.7707$	1	
	Dari / *From* ①, $25 - \mu = -0.151\sigma$ $25 - \mu = -0.151(3.7707)$ $-\mu = -0.5694 - 25$ $-\mu = -25.5694$ $\mu = 25.5694$  		
	$P(X < 18.5) = \frac{1}{n}$ $P\left(Z < \frac{18.5 - 25.57}{3.77}\right) = \frac{1}{n}$ $P(Z < -1.875) = \frac{1}{n}$	1	
	$0.0303 = \frac{1}{n}$ $n = \frac{1}{0.0303}$	1	
	$n = 33$	1	**6**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
7	Jarak yang dilalui dalam nisbah sama → Janjang geometri *The distance travelled are in the same ratio → Geometric progression* T_1: $A \rightarrow C$ T_2: $C \rightarrow D$ T_3: $D \rightarrow E$ $T_1 + T_2 = \frac{629}{4}$ $a + ar^{2-1} = \frac{629}{4}$ $a + ar = \frac{629}{4}$ $a(1 + r) = \frac{629}{4}$ ... ①	1 1	
	$T_3 = \frac{4\,913}{80}$ $ar^{3-1} = \frac{4\,913}{80}$ $ar^2 = \frac{4\,913}{80}$ ... ②	1	
	$\frac{②}{①}$; $\frac{ar^2}{a(1+r)} = \frac{\left(\frac{4\,913}{80}\right)}{\left(\frac{629}{4}\right)}$ $\frac{r^2}{1+r} = \frac{289}{740}$ $740r^2 = 289 + 289r$ $740r^2 - 289r - 289 = 0$ $(20r - 17)(37r + 17) = 0$ $20r - 17 = 0$, $37r + 17 = 0$ $r = \frac{17}{20}$; $r = -\frac{17}{37}$ (abai / *ignore*)	1 1	
	Dari / *From* ①, $a(1 + r) = \frac{629}{4}$ $a\left(1 + \frac{17}{20}\right) = \frac{629}{4}$ $\frac{37}{20}a = \frac{629}{4}$ $\frac{37}{20}a = \frac{\left(\frac{629}{4}\right)}{\left(\frac{37}{20}\right)}$ $a = 85$	1	

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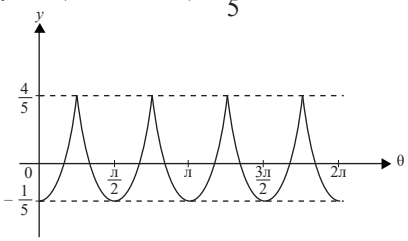
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Jumlah jarak / *Total distance* $= S_\infty$ $= \dfrac{85}{1 - \frac{17}{20}}$ $= 566\frac{2}{3}$ cm	1	
	Purata laju / *Average speed* $= \dfrac{566\frac{2}{3}\text{ cm}}{60\text{ s}}$	1	
	$= 9.44\text{ cm s}^{-1}$ $9.44\text{ cm s}^{-1} < 10\text{ cm s}^{-1}$	1	
	Purata laju guli adalah tidak melebihi 10 cm s^{-1}. *The average speed of the marble does not exceed* 10 cm s^{-1}.	1	**10**

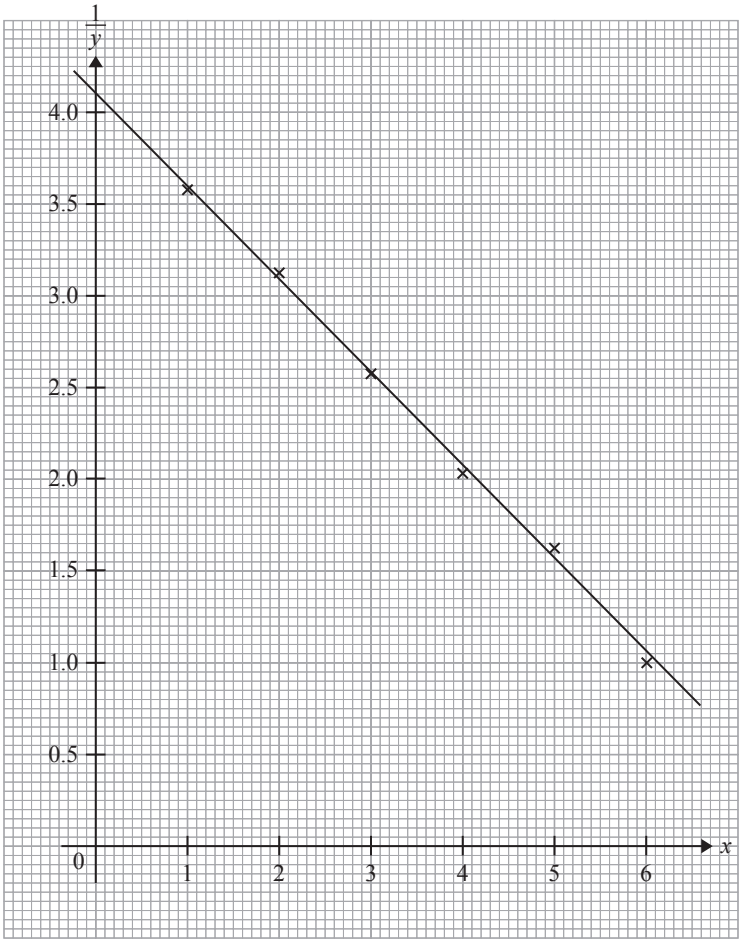
Bahagian B

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
8	(*a*) (i) kos/cos 2θ = kos/cos $(\theta + \theta)$ kos/cos 2θ = kos/cos θ kos/cos $\theta - \sin\theta \sin\theta$ kos/cos 2θ = kos^2/cos$^2\theta - \sin^2\theta$ (Terbukti / *Proven*)	1 1	
	(ii) $3\text{ kos}^2/\cos^2\theta = 2 + 3\sin^2\theta$ $3\text{ kos}^2/\cos^2\theta - 3\sin^2\theta = 2$ $3(\text{kos}^2/\cos^2\theta - \sin^2\theta) = 2$ $3\text{ kos/cos }2\theta = 2$ kos/cos $2\theta = \frac{2}{3}$ (I, IV) Sudut rujukan / *Reference angle*: $\text{kos}^{-1}/\cos^{-1}\left(\frac{2}{3}\right) = 48.19°$; $180° \leqslant \theta \leqslant 360°$, $360° \leqslant 2\theta \leqslant 720°$ $2\theta = 48.19°, 360° - 48.19°, 360° + 48.19°, 360° + 311.81°$ $= 48.19°, 311.81°, 408.19°, 671.81°$ $\theta = 24.10°, 155.91°, 204.10°, 335.91°$ $\therefore \theta = 204.10°, 335.91°$	1 1 1	
	(*b*) (i) $y = -\lvert\text{kos}^2/\cos^2\theta - \sin^2\theta\rvert + \frac{4}{5}$ $y = -\lvert\text{kos/cos }2\theta\rvert + \frac{4}{5}$, $0 \leqslant \theta \leqslant 2\pi$  	1 3	
	(ii) $-\frac{1}{5} < h < \frac{4}{5}$	1	**10**

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
9	(*a*)	1	

x	1	2	3	4	5	6
$\frac{1}{y}$	3.57	3.13	2.56	2.04	1.64	1

(*b*)



3

(*c*) (i) Apabila / *When* $x = 4.5$,

$\frac{1}{y} = 1.825$ — 1

$y = \frac{1}{1.825}$

$y = 0.5479$ — 1

(ii) $\frac{y}{1} = \frac{a}{b-x}$

$\frac{1}{y} = \frac{b-x}{a}$

$\frac{1}{y} = -\frac{1}{a}x + \frac{b}{a}$ — 1

$Y = mX + C$

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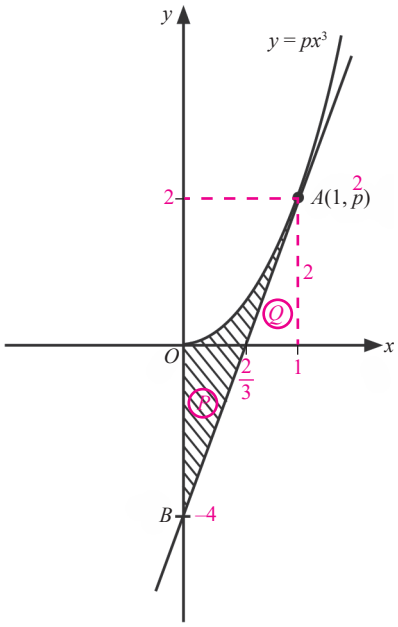
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$-\frac{1}{a} = m$ $-\frac{1}{a} = \frac{3.5 - 3.85}{1.2 - 0.5}$ $-\frac{1}{a} = -\frac{1}{2}$ $a = 2$ $\frac{b}{a} = C$ $\frac{b}{2} = 4.10$ $b = 2(4.10)$ $b = 8.20$	 1 1 1	**10**
10	(*a*) $y = px^3$ $\frac{dy}{dx} = 3px^2$ $m_{\text{tangen / tangent}}$: $\frac{dy}{dx}$ melalui / *passes* $A(1, p) = m_{AB}$: $3p(1)^2 = \frac{-4 - p}{0 - 1}$ $3p = \frac{-4 - p}{-1}$ $-3p = -4 - p$ $-3p + p = -4$ $-2p = -4$ $p = \frac{-4}{-2}$ $p = 2$	 1 1 1 1	
	(*b*) Persamaan tangen melalui / *Equation tangent passes* $A(1, 2)$: $y - 2 = \frac{-4 - 2}{0 - 1}(x - 1)$ $y - 2 = 6(x - 1)$ $y = 6x - 6 + 2$ $y = 6x - 4$ Apabila / *When* $y = 0$, $6x - 4 = 0$ $6x = 4$ $x = \frac{2}{3}$	 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	 Luas / *Area*, $\Delta P = \frac{1}{2} \times \frac{2}{3} \times 4$ $= \frac{4}{3}$	1	
	Luas / *Area*, $\Delta Q = \frac{1}{2} \times \left(1 - \frac{2}{3}\right) \times 2$ $= \frac{1}{3}$		
	Luas lorekan / *Shaded area* $= \int_0^1 2x^3\,dx - \frac{1}{3} + \frac{4}{3}$ $= \left[\frac{2x^4}{4}\right]_0^1 - \frac{1}{3} + \frac{4}{3}$ $= \left[\left(\frac{2(1)^4}{4}\right)\right] - \left(\frac{2(0)^4}{4}\right) + 1$ $= \left(\frac{1}{2} - 0\right) + 1$ $= \frac{1}{2} + 1$ $= \frac{3}{2}$	1 1	

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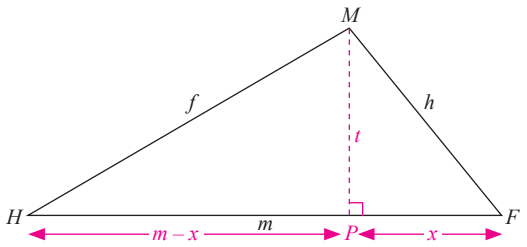
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*c*) Isi padu / *Volume* $= \frac{1}{4}\pi \int_0^1 (2x^3)^2 dx$ $= \frac{1}{4}\pi \int_0^1 4x^6 dx$ $= \frac{1}{4}\pi \left[\frac{4x^7}{7}\right]_0^1$ $= \frac{1}{4}\pi \left[\frac{4(1)^7}{7}\right] - \left[\frac{4(0)^7}{7}\right]$ $= \frac{1}{4}\left(\frac{4}{7}\right)\pi$ unit^3 $= \frac{1}{7}\pi$ unit^3	1 1	**10**
11	(*a*) $m_{PQ} = -3m$ $\frac{4-1}{-1-1} = -3m$ $-\frac{3}{2} = -3m$ $\frac{-\frac{3}{2}}{-3} = m$ $\frac{1}{2} = m$ (Ditunjukkan / *Shown*)	1 1	
	(*b*) Katakan / *Let*, $R(x, y)$ $m_{QR} = m$ $\frac{4-y}{-1-x} = \frac{1}{2}$ $2(4-y) = 1(-1-x)$ $8 - 2y = -1 - x$ $-2y = -1 - x - 8$ $-2y = -9 - x$ ... ① $m_{PR} = 3m$ $\frac{1-y}{1-x} = 3\left(\frac{1}{2}\right)$ $\frac{1-y}{1-x} = \frac{3}{2}$ $3(1-x) = 2(1-y)$ $3 - 3x - 2 = -2y$ $1 - 3x = -2y$ $3x - 1 = 2y$ ... ② ① = ②; $3x - 1 = 9 + x$ $3x - x = 9 + 1$ $2x = 10$ $x = 5$	 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Dari / *From* ①, $2y = 9 + x$ $2y = 9 + 5$ $2y = 14$ $y = 7$ $\therefore R(5, 7)$	1	
	(*c*) (i) Luas / *Area*, ΔPQR $= \frac{1}{2}\begin{vmatrix} 1 & -1 & 5 & 1 \\ 1 & 4 & 7 & 1 \end{vmatrix}$ $= \frac{1}{2}\|[(1)(4) + (-1)(7) + (5)(1)] - [(1)(-1) + (4)(5) + (7)(1)]\|$ $= \frac{1}{2}\|2 - 26\|$ $= \frac{1}{2}\|-24\|$ $= \frac{1}{2}(24)$ $= 12 \text{ unit}^2$	1 1	
	(ii) $RU = \frac{5}{2}QU$ $\sqrt{(x-5)^2 + (y-7)^2} = \frac{5}{2}\sqrt{[(x-(-1)]^2 + (y-4)^2}$ $\sqrt{x^2 - 10x + 25 + y^2 - 14y + 49} = \frac{5}{2}\sqrt{x^2 + 2x + 1 + y^2 - 8y + 16}$ $x^2 + y^2 - 10x - 14y + 74 = \left(\frac{5}{2}\right)^2(x^2 + y^2 + 2x - 8y + 17)$ $x^2 + y^2 - 10x - 14y + 74 = \frac{25}{4}(x^2 + y^2 + 2x - 8y + 17)$ $4x^2 + 4y^2 - 40x - 56y + 296 = 25x^2 + 25y^2 + 50x - 200y + 425$ $0 = 21x^2 + 21y^2 + 90x - 144y + 129$ $0 = 7x^2 + 7y^2 + 30x - 48y + 43$	1 1 1	**10**

Bahagian C

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
12	(*a*)  $PF = x$, $PH = m - x$, $MP = t$ Dengan Teorem Pythagoras / *By Pythagoras Theorem*, $f^2 = t^2 + (m - x)^2$ $f^2 = t^2 + m^2 - 2mx + x^2$ ... ①	1	

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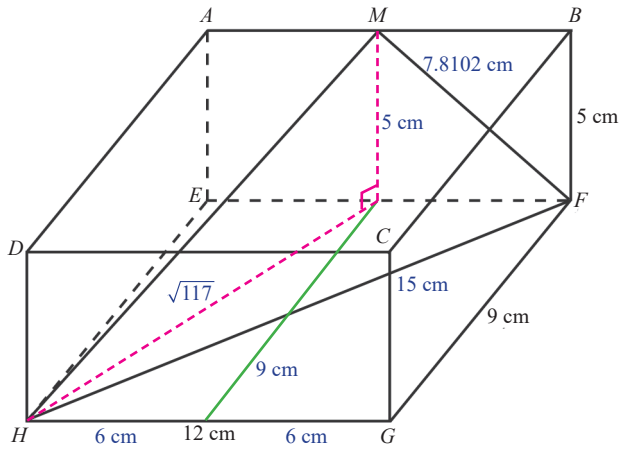
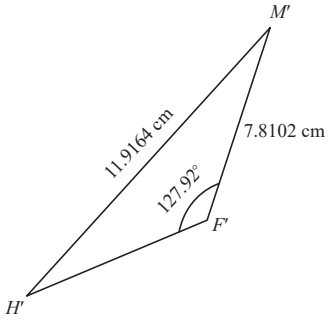
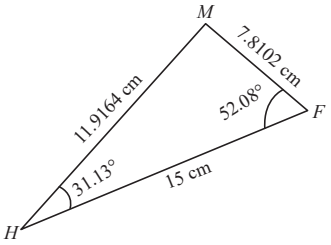
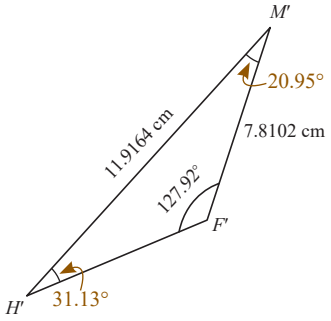
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$h^2 = t^2 + x^2$ ... ② kos/cos $\angle F = \dfrac{x}{h}$ $x = h$ kos/cos $\angle F$ ... ③ ② dan/*and* ③ → ①; $f^2 = t^2 + x^2 + m^2 - 2mx$ $f^2 = h^2 + m^2 - 2m(h \text{ kos/cos } \angle F)$ $f^2 = h^2 + m^2 - 2mh \text{ kos/cos } \angle F$	 1 1	
	(*b*) (i)  $FM = \sqrt{6^2 + 5^2} = 7.8102$ cm $FH = \sqrt{12^2 + 9^2} = 15$ cm $HC = \sqrt{9^2 + 6^2}$ $= \sqrt{117}$ $= 10.8167$ cm $HM = \sqrt{5^2 + 10.8167^2}$ $= \sqrt{142}$ $= 11.9164$ cm $HM^2 = MF^2 + HF^2 - 2(MF)(HF)$ kos/cos $\angle MFH$ $(\sqrt{142})^2 = (7.8102)^2 + (15)^2 - 2(7.8102)(15)$ kos/cos $\angle MFH$ $142 = 285.9992 - 234.306$ kos/cos $\angle MFH$ 234.306 kos/cos $\angle MFH = 285.9992 - 142$ 234.306 kos/cos $\angle MFH = 143.9992$ $\angle MFH = \text{kos}^{-1}/\cos^{-1}\left(\dfrac{143.9992}{234.306}\right)$ $\angle MFH = \text{kos}^{-1}/\cos^{-1}(0.6146)$ $\angle MFH = 52.08°$	 1 1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(ii) (*a*) $\angle F' = 180° - 52.08°$ $= 127.92°$  	1	
	(*b*) $\dfrac{\sin \angle H}{7.8102} = \dfrac{\sin 52.08°}{11.9164}$ $\sin \angle H = 0.5170$ $\angle H = \sin^{-1}(0.5170)$ $\angle H = 31.13°$  	1	
	 $\angle F'M'H' = 180° - 31.13° - 127.92°$ $= 20.95°$	1	
	Luas / *Area* $= \dfrac{1}{2}ab \sin c$ $= \dfrac{1}{2}(11.9164)(7.8102) \sin 20.95°$ $= 16.6386 \text{ cm}^2$	1	**10**

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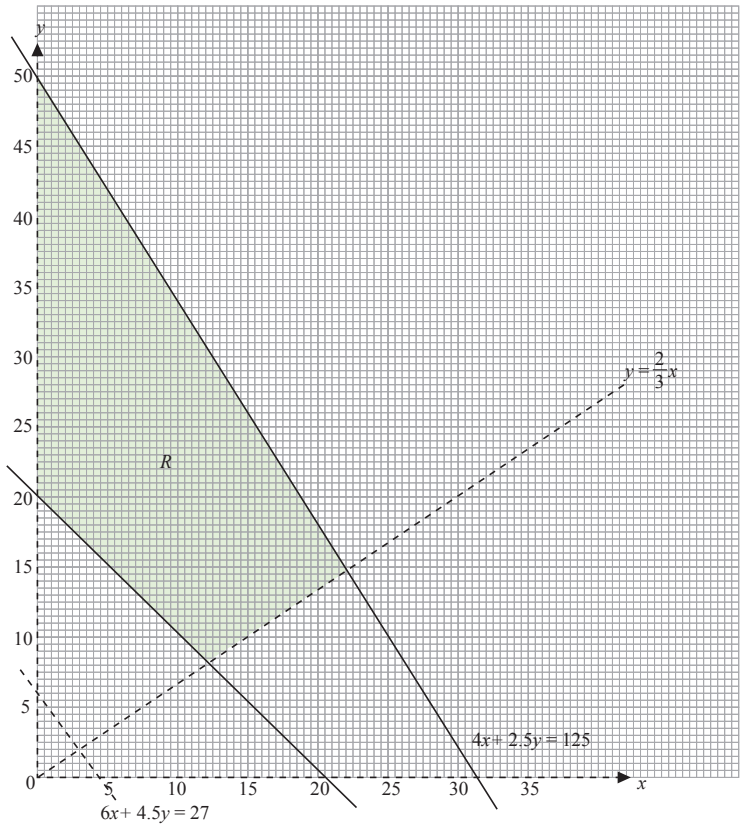
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
13	(*a*) $4x + 2.5y \leqslant 125$	1	
	(*b*) $y = \frac{20-0}{0-20}x + 20$ $y = -x + 20$ $y \geqslant 20 - x$	1	
	(*c*) $x < \frac{3}{2}y$ $y > \frac{2}{3}x$  	1 2	
	(*d*) (i) 17 bungkus / *packets*	1	
	(ii) Untung / *Profit*, $P = (10 - 4)x + (7 - 2.5)y$ $= 6x + 4.5y$	1	
	Katakan / *Let* $6x + 4.5y = 27$ Titik optimum / *Optimal point*: (0, 50)		
	$P = 6(0) + 4.5(50)$ $= \text{RM}225$	1	
	Simpanan / *Saving* = 50% × RM225 = RM112.50		

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	Baki / *Remaining* = RM112.50 − RM40 = RM72.50	1	
	∴ Ya, harga jualan adalah sesuai kerana Mus boleh menyimpan duit dan membayar upah pekerja dan masih mempunyai baki sebanyak RM72.50 untuk modal seterusnya. *Yes, the selling price is suitable because he is able to save money and for the wages and still have a balance of* RM72.50 *for his capital rolling.*	1	**10**
14	(*a*) Apabila / *When* $t = 0$, $v = 3(0)^2 + 4(0) - 15$ $v = -15$ m s^{-1} (zarah bergerak ke kiri / *particle is moving to the left*) ∴ Titik *A* berada di kanan titik *B*. / *Point A is to the right of point B.*	1	
	(*b*) $a = \frac{dv}{dt}$ $a = 6t + 4$; apabila / *when* $t = 1.3$ s $a = 6(1.3) + 4$ $a = 11.8$ m s^{-2}	1 1	
	(*c*) Maksimum / *Maximum*, *s*; $v = 0 \Rightarrow 3t^2 + 4t - 15 = 0$ $(3t - 5)(t + 3) = 0$ $3t - 5 = 0$, $t + 3 = 0$ $t = \frac{5}{3}$, $t = -3$ (abaikan/*ignore*) $s = \int(3t^2 + 4t - 15)\,dt$ $s = \frac{3t^3}{3} + \frac{4t^2}{2} - 15t + c$ $s = t^3 + 2t^2 - 15t + c$ Apabila / *when* $t = 0$, $s = 0$; $0 = (0)^3 + 2(0)^2 - 15(0) + c$ $0 = c$ $\therefore s = t^3 + 2t^2 - 15t$ Apabila / *when* $t = \frac{5}{3}$; $s = \left(\frac{5}{3}\right)^3 + 2\left(\frac{5}{3}\right)^2 - 15\left(\frac{5}{3}\right)$ $s = -14\frac{22}{27}$ m ∴ Zarah *P* tidak akan melalui titik *B* kerana ia hanya boleh bergerak dengan jarak maksimum sejauh $14\frac{22}{27}$ m dari titik *A*, sedangkan titik *B* berada sejauh 15 m dari titik *A*. *Particle P will not pass through point B because it can only travel a maximum distance of* $14\frac{22}{27}$ m *from point A, whereas point B is* 15 m *away from A.*	1 1 1 1	

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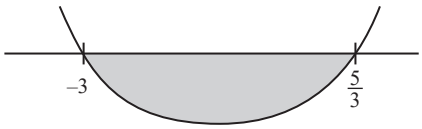
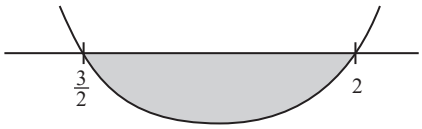
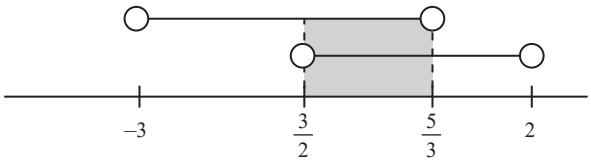
No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	(*d*) Zarah bergerak ke kiri / *Particles move to the left*, $v < 0$ $v_P < 0$ $3t^2 + 4t - 15 < 0$ $(3t - 5)(t + 3) < 0$  $3 < t < \frac{5}{3}$	1	
	$v_Q < 0$ $2t^2 - 7t + 6 < 0$ $(2t - 3)(t - 2) < 0$  $\frac{3}{2} < t < 2$	1	
	 Kedua-dua zarah bergerak ke kiri apabila $\frac{3}{2} < t < \frac{5}{3}$. *Both particles were move to the left when* $\frac{3}{2} < t < \frac{5}{3}$.	1	**10**
15	(*a*) $\bar{I}_{\frac{23}{22}} = 130$ $\frac{2.10}{x} \times 100 = 130$ $\frac{2.10}{x} = \frac{130}{100}$ $x = \frac{2.10 \times 100}{130}$ $x = 1.62$ $y = \frac{2.40}{2.00} \times 100$ $y = 120$	1 1	

No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$\bar{I}_{\frac{23}{22}} = 150$ $\frac{z}{1.20} \times 100 = 150$ $z = \frac{150 \times 1.20}{100}$ $z = 1.80$	1	
	(*b*) (i) $\bar{I}_{\frac{23}{22}} = 135$ $\frac{(130)(n) + (120)(m+n) + (160)\left(\frac{m}{3}\right) + (150)(2n)}{n + m + n + \frac{m}{3} + 2n} = 135$ $\frac{130n + 120m + 120n + \frac{160}{3}m + 300n}{4n + \frac{4}{3}m} = 135$ $550n + \frac{520}{3}m = 135\left(4n + \frac{4}{3}m\right)$ $550n + \frac{520}{3}m = 540n + 180m$ $550n - 540n = 180m - \frac{520}{3}m$ $10n = \frac{20}{3}m$ $\frac{10}{\frac{20}{3}} = \frac{m}{n}$ $\frac{3}{2} = \frac{m}{n}$	1	
	$\therefore m : n = 3 : 2$	1	
	$A : B = n : m + n$ $A : B = 2 : 3 + 2$ $A : B = 2 : 5$	1	
	(ii) $\bar{I}_{23/22} = 135$ $\frac{P_{2023}}{P_{2022}} \times 100 = 135$ $\frac{P_{2023}}{\text{RM25}} \times 100 = 135$ $P_{2023} = \frac{135 \times \text{RM25}}{100}$ $P_{2023} = \text{RM33.75}$	1	

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No.	Skema Pemarkahan *Marking Scheme*	Markah *Marks*	Jumlah Markah *Total Marks*
	$\bar{I}_{25/23} = 100 + 20.25$ $\frac{P_{2025}}{P_{2023}} \times 100 = 120.25$ $\frac{P_{2025}}{\text{RM}33.75} \times 100 = 120.25$ $P_{2025} = \frac{120.25 \times \text{RM}33.75}{100}$ $P_{2025} = \text{RM}40.58$	1	
	Bilangan kotak / *Number of box* = 200 ÷ 40 = 5 Harga kotak / *Price of box* = 5 × RM1.50 = RM7.50 Jumlah kos pada tahun 2025 / *Total cost in the year* 2025 = RM40.58 + RM7.50 = RM48.08	1	
	RM48.08 > RM45 ∴ Duit yang diperuntukkan adalah tidak mencukupi. *The allocated money is not enough.*	1	**10**