

Marking Scheme

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Mathematics T Paper 1 (954/1)/ Mathematics S Paper 1 (950/1)

$$\begin{aligned}
 1.(a) \quad & \log_4 x + \log_x 4 = 2.5 \\
 & \log_4 x + \frac{\log_4 4}{\log_4 x} = \frac{5}{2} & M1 \\
 & \log_4 x + \frac{1}{\log_4 x} = \frac{5}{2} \\
 & 2(\log_4 x)^2 - 5 \log_4 x + 2 = 0 & M1 \\
 & (2\log_4 x - 1)(\log_4 x - 2) = 0 & M1 \\
 & 2\log_4 x = 1, \quad \log_4 x = 2 & M1 \\
 & x^2 = 4, \quad x = 4^2 \\
 & x = 2, \quad x = 16 & A1 [5]
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & y = \frac{3\cos x}{x} \\
 & xy = 3\cos x & B1 \\
 & x \frac{dy}{dx} + y = -3 \sin x & B1 \\
 & x \frac{d^2y}{dx^2} + \frac{dy}{dx} + \frac{dy}{dx} = -3 \cos x & B1 \\
 & x \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} = -xy & B1 \\
 & x \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} + xy = 0 & A1 [5]
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & \text{GP}, \quad T_3 = ar^2 = 6, \\
 & T_6 = ar^5 = -\frac{2}{9} & \text{either one correct} & M1 \\
 & r = -\frac{1}{3}, \quad a = 54 & \text{both correct} & B1
 \end{aligned}$$

$$\begin{aligned}
 (a) \quad & S_n = 54 \left[\frac{1 - (-\frac{1}{3})^n}{1 - (-\frac{1}{3})} \right] & M1 \\
 & = \frac{81}{2} \left[1 - (-\frac{1}{3})^n \right] & A1
 \end{aligned}$$

$$\begin{aligned}
 (b) \quad & S_\alpha = \frac{54}{1 - (-\frac{1}{3})} & M1 \\
 & = \frac{81}{2} & A1 [6]
 \end{aligned}$$

$$4. \frac{1-4x-x^2}{(x+2)(x^2+1)} = \frac{A}{x+2} + \frac{Bx+C}{x^2+1} \quad M1$$

$$1-4x-x^2 = A(x^2+1) + (Bx+C)(x+2)$$

$$\text{When } x = -2, \quad 5 = 5A$$

$$A = 1$$

$$\text{Equating coefficient of } x^2, \quad -1 = 1 + B$$

$$B = -2$$

$$\text{Equating constants,} \quad 1 = 1 + 2C \\ C = 0$$

$$\text{Hence, } f(x) = \frac{1-4x-x^2}{(x+2)(x^2+1)} = \frac{1}{x+2} - \frac{2x}{x^2+1} \quad A1$$

$$\int_0^1 f(x) dx = \int_0^1 \left(\frac{1}{x+2} - \frac{2x}{x^2+1} \right) dx \quad M1$$

$$= [\ln|x+2| - \ln|x^2+1|]_0^1 \quad M1$$

$$= \left[\ln \left| \frac{x+2}{x^2+1} \right| \right]_0^1 \quad M1$$

$$= \ln \frac{3}{2} - \ln 2$$

$$= \ln \frac{3}{4} \quad A1 \quad [6]$$

$$5. (A - B) \cap (A \cap B)' = A \cap B'$$

Use left hand side:

$$= (A \cap B') \cap (A' \cup B') \quad A1$$

$$= [(A \cap B') \cap A'] \cup [(A \cap B') \cap B'] \quad A1$$

$$= [(B' \cap A) \cap A'] \cup [(A \cap B') \cap B'] \quad A1$$

$$= [B' \cap (A \cap A')] \cup [A \cap (B' \cap B')] \quad A1$$

$$= [B' \cap \emptyset] \cup [A \cap B'] \quad A1$$

$$= \emptyset \cup [A \cap B'] \quad A1$$

$$= A \cap B' \quad A1 \quad [7]$$

$$6. (a) \quad \frac{1-2k}{3k^2-(1-2k)} \geq 0$$

$$\frac{1-2k}{(3k-1)(k+1)} \geq 0 \quad B1$$

Solve the inequality using appropriate method M1

$$k < -1 \text{ or } \frac{1}{3} < k \leq \frac{1}{2} \quad A1$$

$$\begin{aligned}
 6. (b) \quad & \left| \frac{x+1}{3x-5} \right| < 1 \\
 & |x+1| < |3x-5| \\
 & (x+1)^2 < (3x-5)^2 & M1 \\
 & (x+1)^2 - (3x-5)^2 < 0 & M1 \\
 & -8x^2 + 32x - 24 < 0 \\
 & -8(x-1)(x-3) < 0 & M1 \\
 & \text{The solution set is } \{ x : x < 1, x > 3 \} & A1 \quad [7]
 \end{aligned}$$

$$7. (a) \quad y^2 = \ln(x^2 y)$$

$$y^2 = \ln x^2 + \ln y$$

$$2y \frac{dy}{dx} = \frac{2}{x} + \frac{1}{y} \frac{dy}{dx} & M1A1$$

$$\left(2y - \frac{1}{y} \right) \frac{dy}{dx} = \frac{2}{x}$$

$$\frac{dy}{dx} = \frac{2y}{x(2y^2 - 1)} & A1$$

$$(b) \quad \delta y = 0.01$$

$$x = e^{\frac{1}{2}} & B1$$

$$\delta y \approx \frac{dy}{dx} \delta x$$

$$0.01 \approx \frac{2(1)}{e^{\frac{1}{2}}(2-1)} \partial x & M1A1$$

$$\delta x \approx 0.008 \text{ (3 d.p.)} & A1 \quad [7]$$

$$\begin{aligned}
 8. \quad & (1-x)^{\frac{1}{2}} (1+2x)^{-\frac{1}{2}} \\
 & = \left[1 + \frac{1}{2}(-x) + \frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2!} (-x)^2 + \dots \right] \left[1 + \left(-\frac{1}{2}\right)(2x) + \frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!} (2x)^2 + \dots \right] & M1
 \end{aligned}$$

$$8. \quad = \left[1 - \frac{1}{2}x - \frac{1}{8}x^2 + \dots \right] \left[1 - x + \frac{3}{2}x^2 + \dots \right]$$

$$= 1 - \frac{3}{2}x + \frac{15}{8}x^2 + \dots$$
A1A1

The expansion is valid when $|x| < 1$ and $|2x| < 1$

$$\begin{aligned} \therefore |x| &< \frac{1}{2} \\ -\frac{1}{2} &< x < \frac{1}{2} \end{aligned}$$
M1

Since $\frac{1}{4} \in \left(-\frac{1}{2}, \frac{1}{2}\right)$, therefore $\frac{1}{4}$ can be used to estimate the value of $\sqrt{2}$

A1

$$\sqrt{\frac{1 - \frac{1}{4}}{1 + 2\left(\frac{1}{4}\right)}} \approx 1 - \frac{3}{2}\left(\frac{1}{4}\right) + \frac{15}{8}\left(\frac{1}{4}\right)^2$$
M1

$$\begin{aligned} \sqrt{\frac{1}{2}} &\approx \frac{95}{128} \\ \sqrt{2} &\approx 1.4844 \quad \text{or } 1.3474 \end{aligned}$$
A1 [8]

9. (a) $P(x) = 2x^3 - 3ax^2 + ax + b$

Find two linear equations and solve for a and b

M1

$$\begin{aligned} 2(1)^3 - 3a(1)^2 + a(1) + b &= 0 \\ -2a + b &= -2 \end{aligned}$$

$$\begin{aligned} P(-2) &= -54 \\ 2(-2)^3 - 3a(-2)^2 + a(-2) + b &= -54 \\ -14a + b &= -38 \end{aligned}$$

$$a = 3, b = 4$$
A1

$$\begin{aligned} P(x) &= 2x^3 - 9x^2 + 3x + 4 \\ &= (x - 1)(2x^2 - 7x - 4) \\ &= (x - 1)(2x + 1)(x - 4) \end{aligned}$$
M1
A1

$$\begin{aligned} 2x^6 - 9x^4 + 3x^2 + 4 \\ = (x^2 - 1)(2x^2 + 1)(x^2 - 4) \end{aligned}$$
M1

The zeroes are $-2, -1, 1$ and 2

A1

$$(b) \quad y = \frac{3x - 9}{(x + 1)(x - 2)}$$

$$y(x^2 - x - 2) = 3x - 9$$

$$yx^2 - yx - 2y = 3x - 9$$

$$yx^2 - (y+3)x + (9 - 2y) = 0$$
M1

- (9) For all real values of x is real, $b^2 - 4ac \geq 0$
 $(-y-3)^2 - 4(y)(9-2y) \geq 0$ M1
 $3y^2 - 10y + 3 \geq 0$
 $(3y-1)(y-3) \geq 0$
 $y \leq \frac{1}{3} \text{ or } y \geq 3$ A1
 $\therefore y$ does not have any real value between $\frac{1}{3}$ and 3 for all real values of x . A1 [10]
10. (a) $t = \frac{y}{2} + 1$
 $x = \left(\frac{y}{2} + 1\right)\left(\frac{y}{2} + 1 - 2\right)$ M1
 $x = \frac{y^2}{4} - 1$
 $y^2 = 4(x+1)$ A1
- | | | |
|-------|---------------------|----|
| (i) | Vertex = (-1, 0) | B1 |
| (ii) | Focus = (0, 0) | B1 |
| (iii) | Directrix, $x = -2$ | B1 |
- (b) $x = t(t-2)$ $y = 2(t-1)$
 $4 = 2(t-1)$
 $t = 3$
 $x = 3$ B1
- $\frac{dx}{dt} = 2t-2$ $\frac{dy}{dt} = 2$
 $\frac{dy}{dx} = \frac{2}{2t-2} = \frac{1}{t-1}$ M1
 $\frac{dy}{dx} = \frac{1}{2}$ A1
- The equation of normal:
 $y - 4 = -2(x - 3)$ M1
 $y = -2x + 10$
 $\frac{x}{5} + \frac{y}{10} = 1$ A1
- (c) $2x + y - 10 = 0, (-1, 0)$
 $d = \frac{|2(-1) + 0 - 10|}{\sqrt{2^2 + 1^2}}$ M1
 $= \frac{12}{\sqrt{5}}$
 $= \frac{12\sqrt{5}}{5}$ A1 [12]

$$11(a) \quad |A| = 0 \begin{vmatrix} 8 & -1 \\ 10 & -1 \end{vmatrix} - 0 \begin{vmatrix} 2 & -1 \\ 10 & -1 \end{vmatrix} + 4 \begin{vmatrix} 2 & -1 \\ 8 & -1 \end{vmatrix}$$

$$= 24$$

M1

A1

Since $|A| \neq 0$, therefore matrix A is non-singular

A1

$$(b)(i) \quad k = \alpha_{23}$$

$$k = -M_{23}$$

$$= - \begin{vmatrix} 0 & 2 \\ 4 & 10 \end{vmatrix}$$

$$= 8$$

M1

A1

$$(ii) \quad A^{-1} = \frac{1}{24} \begin{pmatrix} 2 & -8 & 6 \\ -4 & 4 & 0 \\ 32 & 8 & 0 \end{pmatrix}$$

M1

$$= \begin{pmatrix} \frac{1}{12} & -\frac{1}{3} & \frac{1}{4} \\ -\frac{1}{6} & \frac{1}{6} & 0 \\ \frac{4}{3} & \frac{1}{3} & 0 \end{pmatrix}$$

A1

$$(c) \quad 2b - c = 1$$

$$4a + 10b - c = 29$$

$$8b - c = 16$$

M1A1

$$(d) \quad \begin{pmatrix} 0 & 2 & -1 \\ 0 & 8 & -1 \\ 4 & 10 & -1 \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} = \begin{pmatrix} 1 \\ 16 \\ 29 \end{pmatrix}$$

B1

$$\begin{pmatrix} a \\ b \\ c \end{pmatrix} = \frac{1}{24} \begin{pmatrix} 2 & -8 & 6 \\ -4 & 4 & 0 \\ 32 & 8 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ 16 \\ 29 \end{pmatrix}$$

M1

$$= \begin{pmatrix} 2 \\ \frac{5}{2} \\ \frac{20}{3} \end{pmatrix}$$

A1

$$a = 2, b = \frac{5}{2}, c = \frac{20}{3}$$

A1 [13]

$$12.(a) \quad (i) \lim_{x \rightarrow 1^-} f(x) = \lim_{x \rightarrow 1^-} \frac{2(x-1)}{|x-1|}$$

M1

$$= \lim_{x \rightarrow 1^-} \frac{2(x-1)}{-(x-1)}$$

$$= -2$$

A1

12(a) (ii) $\lim_{x \rightarrow 1^+} f(x) = \lim_{x \rightarrow 1^-} f(x)$

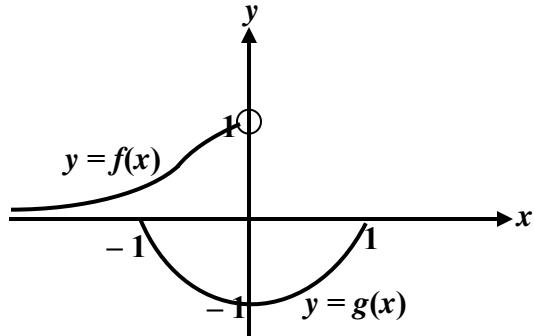
$$\lim_{x \rightarrow 1^+} (4x - k) = -2$$

M1

$$4(1) - k = -2 \\ k = 6$$

A1

(b)(i)



D1 : curve $y = f(x)$ or $y = g(x)$

D1 : curves $y = f(x)$ and $y = g(x)$

D1 : both graphs correct.

$$R_f = (0, 1) \text{ or } \{y : 0 < y < 1\}$$

B1

$$R_g = [-1, 0] \text{ or } \{y : -1 \leq y \leq 0\}$$

B1

(ii) $R_g = [-1, 0]$; $D_f = (-\infty, 0)$

Since $[-1, 0] \not\subset (-\infty, 0)$ because $0 \in [-1, 0]$ but $0 \notin (-\infty, 0)$ M1

That is $R_g \not\subset D_f$

$\therefore f \circ g$ does not exist. A1

- (iii) From the graph of function f , function f is one-to-one in the domain given because any horizontal line $y = c$, c constant, that cuts the graph of f , cuts only at a point. Therefore function f has an inverse function f^{-1} . B1

Let $f^{-1}(x) = y$

$$x = f(y)$$

$$x = \frac{1}{1+y^2}$$

$$y^2 = \frac{1-x}{x}$$

$$y = -\sqrt{\frac{1-x}{x}} \text{ because } y \in R_{f^{-1}} \text{ and } y \in D_f \text{ (i.e } y < 0)$$

M1

$$f^{-1}(x) = -\sqrt{\frac{1-x}{x}}$$

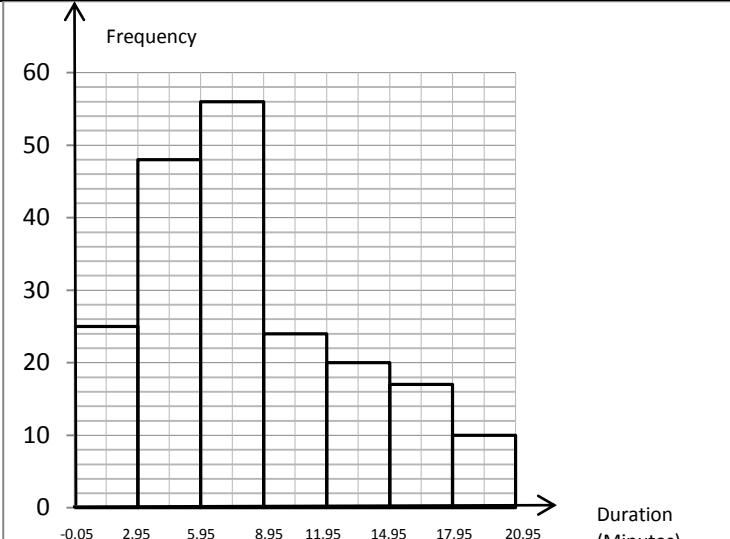
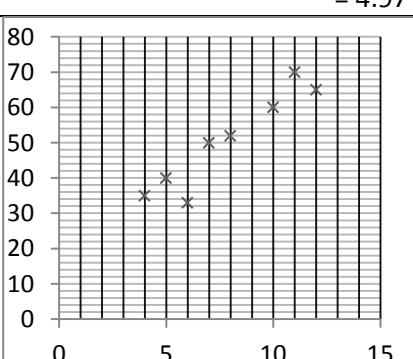
$$\text{Therefore } f^{-1} : x \rightarrow -\sqrt{\frac{1-x}{x}}, \quad 0 < x < 1 \quad \text{A1} \quad [14]$$

MARKING SCHEME FOR MATHEMATICS S PAPER 2

No.	Solution	Mark
1(a)	$S_{xy} = \sum xy - \frac{\sum x \sum y}{n}$ $= 3581 - \frac{(225)(238)}{15}$ $= 11$ $S_{xx} = \sum x^2 - \frac{(\sum x)^2}{n}$ $= 3625 - \frac{225^2}{15}$ $= 250$ $S_{yy} = \sum y^2 - \frac{(\sum y)^2}{n}$ $= 3792 - \frac{238^2}{15}$ $= \frac{236}{15}$ <p>Pearson's correlation coefficient,</p> $r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{11}{\sqrt{(250)(\frac{236}{15})}}$ $= 0.175$	M1 (Calculating any of the S_{xx} , S_{yy} , S_{xy}) M1 A1
1 (b)	Coefficient of determinant, $r^2 = (0.175)^2$ $= 0.0308$ 3.08% variation in y can be explained by x.	M1 A1 B1
2(a)	$Z_{0.025} = 1.96$ A 95% confidence interval for the proportion of lecturers who agreed that the standard of higher education is high $= (p \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{p(1-p)}{n}})$ $= (0.24 \pm 1.96 \sqrt{\frac{0.24(0.76)}{500}})$ $= (0.24 \pm 0.037)$ $= (0.203, 0.277)$	B1 M1 for 0.24±K M1-correct K A1
2(b)	$Z_{\frac{\alpha}{2}} \sqrt{\frac{p(1-p)}{n}} \leq 0.05$ $1.645 \sqrt{\frac{0.24(0.76)}{n}} \leq 0.05$ $n \geq \left(\frac{1.645}{0.05}\right)^2 (0.24)(0.76)$ $n \geq 197.43$ $n \approx 198$	M1 for ≤ 0.05 M1-substitution B1-z value 1.645 M1 A1
3(a)	$\frac{b}{4} + \frac{2b}{4} + \frac{3b}{4} + \frac{4}{21} + \frac{5}{21} = 1$ $b = \frac{8}{21}$	B1 A1

3(b)		D1-Uniform scale and at least 3 correct D1-all correct
3(c)	<p>Mean = $E(x) = \sum xf(x)$</p> $= 1\left(\frac{2}{21}\right) + 2\left(\frac{4}{21}\right) + 3\left(\frac{6}{21}\right) + 4\left(\frac{4}{21}\right) + 5\left(\frac{5}{21}\right)$ $= \frac{23}{7}$ <p>$E(x^2) = \sum x^2f(x)$</p> $= 1^2\left(\frac{2}{21}\right) + 2^2\left(\frac{4}{21}\right) + 3^2\left(\frac{6}{21}\right) + 4^2\left(\frac{4}{21}\right) + 5^2\left(\frac{5}{21}\right)$ $= \frac{87}{7}$ <p>Standard deviation = $\sqrt{E(x^2) - [E(x)]^2}$</p> $= \sqrt{\frac{87}{7} - \left(\frac{23}{7}\right)^2}$ $= 1.28$	B1 B1 M1 A1
4(a)	<p>Unbiased estimate for the population mean μ</p> $= \frac{\sum x}{n} = \frac{16000}{200}$ $= 80$ <p>Unbiased estimate for the population variance σ^2</p> $= \frac{n \sum x^2 - (\sum x)^2}{n(n-1)} = \frac{200(1283184) - (16000)^2}{200(199)}$ $= 16$	B1 M1 A1
4(b)	$Z_{0.025} = 1.96$ <p>A 95% confidence interval for the population proportion of students who completed the examination</p> $= (p \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{p(1-p)}{n}})$ $= (0.8 \pm 1.96 \sqrt{\frac{0.8(0.2)}{200}})$ $= (0.8 \pm 0.055)$ $= (0.745, 0.855)$	B1 M1 for $0.8 \pm K$ M1-correct K A1
4(c)	80% lies in the interval of (0.745, 0.855). Therefore, teacher Tan's claim is true.	B1-true B1-reason
5(a)	$P(A \setminus B) = \frac{3}{5}$ $\frac{P(A \cap B)}{P(B)} = \frac{3}{5}$ $P(B) = \frac{5}{3} P(A \cap B)$ $P(A \setminus B') = \frac{1}{7}$ $P(A \cap B') = \frac{1}{7} P(B')$	M1

	$P(A) - P(A \cap B) = \frac{1}{7}[1 - P(B)]$ $\frac{1}{4} - P(A \cap B) = \frac{1}{7}\left[1 - \frac{5}{3}P(A \cap B)\right]$ $\frac{16}{21}P(A \cap B) = \frac{3}{28}$ $P(A \cap B) = \frac{9}{64}$	M1 M1 A1
5(b)(i)	$P(B) = \frac{5}{3}P(A \cap B)$ $= \frac{5}{3}\left(\frac{9}{64}\right)$ $= \frac{15}{64}$	M1 A1
5(b)(ii)	$P(B \setminus A) = \frac{P(B \cap A)}{P(A)}$ $= \frac{\frac{9}{64}}{\frac{1}{4}} = \frac{9}{16}$	M1A1
5(c)	Since $P(A \setminus B) \neq P(A)$, A and B are not independent events.	B1-deduction B1-reason
6(a)	$P(X > 18.533) = 0.1$ $P\left(Z > \frac{18.533 - \mu}{\sigma}\right) = 0.1$ $\frac{18.533 - \mu}{\sigma} = 1.282$ $18.533 - \mu = 1.282\sigma \text{ ----I}$ $P(X \geq 17.632) = 0.95$ $P\left(Z \geq \frac{17.632 - \mu}{\sigma}\right) = 0.95$ $\frac{17.632 - \mu}{\sigma} = -1.645$ $17.632 - \mu = -1.645\sigma \text{ ---II}$ <p>I-II:</p> $0.901 = 2.927\sigma$ $\sigma = 0.308 \text{ (3dp)}$ <p>Substitute into I, $18.533 - \mu = 1.282(0.308)$</p> $\mu = 18.138 \text{ (3dp)}$	M1 M1 B1-both equations correct A1 A1
6(b)	$\bar{X} \sim N\left(18.138, \frac{0.308^2}{9}\right)$ $P(17.85 < \bar{X} < 18.05)$ $= P\left(\frac{17.85 - 18.138}{\frac{0.308}{3}} < Z < \frac{18.05 - 18.138}{\frac{0.308}{3}}\right)$ $= P(-2.805 < Z < -0.857)$ $= P(Z > 0.857) - P(Z > 2.805)$ $= 0.1957 - 0.00252$ $= 0.193$	B1 B1 for $17.85 < \bar{X} < 18.05$ M1 A1

7		1	2	3	4	A1-correct values of $\frac{Y}{T}$ M1-correct average B1-correction factor M1-adjusted S	
	2005	-	-	1.486	0.736		
	2006	0.568	1.011	1.556	0.860		
	2007	0.599	1.106	-	-		
	Average S	0.584	1.059	1.521	0.798		
	Correction factor	1.0096	1.0096	1.0096	1.0096		
	Adjusted S	0.590	1.069	1.536	0.806		
8(a)	 <p>The distribution is skewed to right.</p>						
8(b)	$\text{Mean} = \frac{\sum fx}{\sum f} = \frac{1661}{200} = 8.31 \text{ minutes}$ $\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - (\bar{x})^2}$ $= \sqrt{\frac{18733.4}{200} - \left(\frac{1661}{200}\right)^2}$ $= 4.97 \text{ minutes}$						
9(a)	 <p>Uniform scale and at least 5 correct points All correct</p>						
9(b)	$\sum x = 63, \quad \sum y = 405,$ $\sum xy = 3454,$ $\sum x^2 = 555, \quad \sum y^2 = 21843$						

	$b = \frac{\frac{1}{n} \sum xy - \bar{x}\bar{y}}{\frac{1}{n} \sum x^2 - \bar{x}^2}$ $b = \frac{\frac{1}{8}(3454) - \left(\frac{63}{8}\right)\left(\frac{405}{8}\right)}{\frac{1}{8}(555) - \left(\frac{63}{8}\right)^2}$ $= 4.49$ $a = \bar{y} - b\bar{x}$ $= \frac{405}{8} - 4.49 \left(\frac{63}{8}\right)$ $= 15.27$ <p>The equation of the regression line: $y = 15.27 + 4.49x$ $(\bar{x}, \bar{y}) = (7.88, 50.63)$ Straight line passing through his (\bar{x}, \bar{y})</p>	M1 (his value) A1 B1 A1 D1 D1																						
9(c)	$y = 15.27 + 4.49(8.5)$ $= 53.44 \approx 53$ (nearest integer)	M1 A1																						
10(a)	<table border="1"> <thead> <tr> <th rowspan="2">Type of handphone</th> <th colspan="2">Sales quantity</th> <th rowspan="2">$I = \frac{q_n}{q_o} \times 100$</th> </tr> <tr> <th>2009 (q_0)</th> <th>2010 (q_n)</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>26</td> <td>40</td> <td>153.85</td> </tr> <tr> <td>B</td> <td>18</td> <td>38</td> <td>211.11</td> </tr> <tr> <td>C</td> <td>19</td> <td>21</td> <td>110.53</td> </tr> <tr> <td>D</td> <td>30</td> <td>25</td> <td>83.33</td> </tr> </tbody> </table> <p>Average relative quantity index $= \frac{\sum I}{n} \times 100$ $= \frac{153.85+211.11+110.53+83.33}{4} \times 100$ $= 139.71$</p>	Type of handphone	Sales quantity		$I = \frac{q_n}{q_o} \times 100$	2009 (q_0)	2010 (q_n)	A	26	40	153.85	B	18	38	211.11	C	19	21	110.53	D	30	25	83.33	B1 M1 A1
Type of handphone	Sales quantity		$I = \frac{q_n}{q_o} \times 100$																					
	2009 (q_0)	2010 (q_n)																						
A	26	40	153.85																					
B	18	38	211.11																					
C	19	21	110.53																					
D	30	25	83.33																					
10(b)	<p>Paasche price index $= \frac{\sum p_n q_n}{\sum p_0 q_n} \times 100$ $= \frac{195(40)+270(38)+420(21)+720(25)}{130(40)+230(38)+380(21)+580(25)} \times 100$ $= 123.23$</p> <p>The price of handphones in 2010 has increased by 23.23% compared to that of 2009</p>	M1 A1 B1																						
11(a)	<pre> graph LR A((A)) -- 2 --> B((B)) B -- 3 --> C((C)) B -- 9 --> D((D)) C -- 6 --> D C -- 4 --> F((F)) D -- 5 --> E((E)) D -- 5 --> G((G)) E -- 5 --> H((H)) F -- 9 --> G G -- 4 --> H H -- 4 --> J((J)) </pre> <p>The diagram shows a Critical Path Method (CPM) network with nodes representing activities and arrows representing activities and their durations. The activities and their estimated durations are:</p> <ul style="list-style-type: none"> A to B: 2 B to C: 3 B to D: 9 C to D: 6 C to F: 4 D to E: 5 D to G: 5 E to H: 5 F to G: 9 G to H: 4 H to J: 4 	D1-correct sequence and flow D1-correct activities and duration																						

11(b)	<table border="1"> <thead> <tr><th>Activity</th><th>Total float</th></tr> </thead> <tbody> <tr><td>A</td><td>3</td></tr> <tr><td>B</td><td>11</td></tr> <tr><td>C</td><td>0</td></tr> <tr><td>D</td><td>3</td></tr> <tr><td>E</td><td>11</td></tr> <tr><td>F</td><td>0</td></tr> <tr><td>G</td><td>3</td></tr> <tr><td>H</td><td>0</td></tr> </tbody> </table> <p>Since the total float for activities C, F and H are zeroes, therefore the critical path is C-F-H and the minimum completion time is 19 weeks.</p>	Activity	Total float	A	3	B	11	C	0	D	3	E	11	F	0	G	3	H	0		B1-correct values of EST B1-correct values of EFT B1- correct values of LST B1-correct values of LFT B1-correct total float B1-critical path B1-minimum completion time																																																																							
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11(c)	<p>There is no effect on the completion time of the project.</p> <p>Reason: Total float for activity E represents the maximum time that it can be delayed (8 weeks < total float for activity E)</p>	B1-no effect B1-reason																																																																																										
12(a)	Maximize profit: $P = 50X_1 + 60X_2 + 20X_3$ Subject to: $5X_1 + 10X_2 + 3X_3 \leq 500$ $X_1 + 3X_2 + X_3 \leq 200$ $2X_1 + X_3 \leq 180$ $X_1, X_2, X_3 \geq 0$	B1 B1 B1 B1																																																																																										
12(b)	<p>Tableau 2</p> <table border="1"> <thead> <tr><th>Basic</th><th>P</th><th>X_1</th><th>X_2</th><th>X_3</th><th>S_1</th><th>S_2</th><th>S_3</th><th>Solution</th></tr> </thead> <tbody> <tr><td>P</td><td>1</td><td>-20</td><td>0</td><td>-2</td><td>6</td><td>0</td><td>0</td><td>3000</td></tr> <tr><td>X_2</td><td>0</td><td>$\frac{1}{2}$</td><td>1</td><td>$\frac{3}{10}$</td><td>$\frac{1}{10}$</td><td>0</td><td>0</td><td>50</td></tr> <tr><td>S_2</td><td>0</td><td>$\frac{1}{2}$</td><td>0</td><td>$\frac{1}{10}$</td><td>$\frac{-3}{10}$</td><td>1</td><td>0</td><td>50</td></tr> <tr><td>S_3</td><td>0</td><td>2</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>180</td></tr> </tbody> </table> <p>Tableau 3</p> <table border="1"> <thead> <tr><th>Basic</th><th>P</th><th>X_1</th><th>X_2</th><th>X_3</th><th>S_1</th><th>S_2</th><th>S_3</th><th>Solution</th></tr> </thead> <tbody> <tr><td>P</td><td>1</td><td>0</td><td>0</td><td>8</td><td>6</td><td>0</td><td>10</td><td>4800</td></tr> <tr><td>X_2</td><td>0</td><td>0</td><td>1</td><td>$\frac{1}{20}$</td><td>$\frac{1}{10}$</td><td>0</td><td>$\frac{-1}{4}$</td><td>5</td></tr> <tr><td>S_2</td><td>0</td><td>0</td><td>0</td><td>$\frac{7}{20}$</td><td>$\frac{-3}{10}$</td><td>1</td><td>$\frac{1}{4}$</td><td>95</td></tr> <tr><td>X_1</td><td>0</td><td>1</td><td>0</td><td>$\frac{1}{2}$</td><td>0</td><td>0</td><td>$\frac{1}{2}$</td><td>90</td></tr> </tbody> </table>	Basic	P	X_1	X_2	X_3	S_1	S_2	S_3	Solution	P	1	-20	0	-2	6	0	0	3000	X_2	0	$\frac{1}{2}$	1	$\frac{3}{10}$	$\frac{1}{10}$	0	0	50	S_2	0	$\frac{1}{2}$	0	$\frac{1}{10}$	$\frac{-3}{10}$	1	0	50	S_3	0	2	0	1	0	0	1	180	Basic	P	X_1	X_2	X_3	S_1	S_2	S_3	Solution	P	1	0	0	8	6	0	10	4800	X_2	0	0	1	$\frac{1}{20}$	$\frac{1}{10}$	0	$\frac{-1}{4}$	5	S_2	0	0	0	$\frac{7}{20}$	$\frac{-3}{10}$	1	$\frac{1}{4}$	95	X_1	0	1	0	$\frac{1}{2}$	0	0	$\frac{1}{2}$	90	M1-attempt to do row operation A1-all values in solution column correct M1-attempt to do row operation A1-all values in tableau correct
Basic	P	X_1	X_2	X_3	S_1	S_2	S_3	Solution																																																																																				
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12(c)	<p>90 units of tables, 5 units of sofas and none of chairs should be produced per week in order to maximise the total profit.</p> <p>The maximum profit is RM4800.</p>	A1 A1																																																																																										