

SECTION A Core: Data analysis

1	2	3	4	5	6	7	8	9	10	11	12	13
B	A	B	A	A	D	C	C	E	B	A	E	C

SECTION B

Module 1: Number patterns and applications

1	2	3	4	5	6	7	8	9
D	A	B	A	E	C	A	C	D

Module 2: Geometry and trigonometry

1	2	3	4	5	6	7	8	9
D	E	A	B	A	B	B	C	B

Module 6: Matrices

1	2	3	4	5	6	7	8	9
B	C	C	A	B	C	D	C	C

SECTION A Core: Data analysis

Q1 House prices are discrete and numerical; conditions are categorical.

Q2 Arrange the house prices in ascending order, the middle two are 269000 and 276000.

$$\text{Median} = \frac{269000 + 276000}{2} = 272500$$

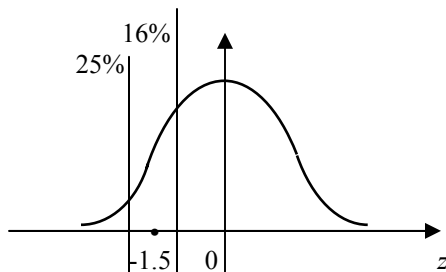
$$\text{Q3 } Q_1 = 48, Q_3 = \frac{69 + 70}{2} = 69.5, IQR = 69.5 - 48 = 21.5$$

$$\text{Q4 } Q_1 - 1.5 \times IQR = 48 - 1.5 \times 21.5 = 15.75$$

$$Q_3 + 1.5 \times IQR = 69.5 + 1.5 \times 21.5 = 101.75$$

All test marks are between 15.75 and 101.75, $\therefore$ no outliers

Q5



Q6 80 is 1σ higher than the mean 70, $\therefore$ 16% of students score higher than 80 in Science.

$$\text{Q7 English mark } 80 = 74 + 0.5\sigma$$

$$\text{Mathematics mark } 70 = 61 + 0.5\sigma$$

$$\text{Science mark } 80 = 70 + 1\sigma$$

$\therefore$ Student has the same rank in English and Mathematics.

Q8 Negative, linear and moderate.

$$\text{Q9 Residual} = \text{actual value} - \text{predicted value} \\ = 3 - (5.6 - 0.81 \times 2) = -0.98 \approx -1.0$$

$$\text{Q10 } y = a + bx. \text{ When } x = 0,$$

$$y = a = \bar{y} - r \frac{s_y}{s_x} \bar{x} = 5.28 - 0.8913 \times \frac{1.72}{0.243} \times 1.30 = 13.48$$

$$\text{Q11 } a = 13.48, b = r \frac{s_y}{s_x} = -6.31, \therefore y = 13.48 - 6.31x$$

$$\text{Q12 Fourth quarter seasonal index} \\ = 4 - (0.93 + 0.90 + 0.85) = 1.32$$

$$\text{Deseasonalised sale figure} = \frac{639500}{1.32} = 484470 \text{ dollars}$$

Q13 Annual rainfall peaked every $6/7$ years, $\therefore$ cyclical. There was a gentle up trend.

SECTION B

Module 1: Number patterns and applications

Q1 There is a common difference of $-\frac{1}{3}$ in sequence D.

$$\text{Q2 Common ratio: } \frac{1.04}{3.12} = \frac{3.12}{x}, x = 9.36$$

Q3 The sequence is formed by adding successive odd integer (1, 3, 5, ...) to a term to obtain the next term.
-1, 0, 3, 8, 15, 24, 35, 48, 63, 80, 99. There are 11 terms.

$$\text{Q4 } a = -\frac{1}{2}, r = \frac{\frac{1}{6}}{-\frac{1}{2}} = -\frac{1}{3}, S_{\infty} = \frac{a}{1-r} = \frac{-\frac{1}{2}}{1-\frac{1}{3}} = -\frac{3}{8}$$

Q5 For any arithmetic sequence with even number of terms,
 $t_1 + t_n = t_2 + t_{n-1} = t_3 + t_{n-2} = \dots$, $\therefore$ the sum of the middle two terms equals the sum of the first and the last terms.
For any arithmetic sequence with odd number of terms, the middle term equals a half of the sum of the first and the last terms.

$$\text{Q6 } T_{n+1} = 2T_n - 9, T_n = 12.5, p = 2 \times 12.5 - 9 = 16, \\ a = 2 \times 16 - 9 = 23, w = 2 \times 23 - 9 = 37$$

$$\text{Q7 } u_n = \frac{1}{2}u_{n-1} - 9, \therefore u_{n-1} = 2(u_n + 9), u_5 = 3, \\ \therefore u_4 = 2(u_5 + 9) = 2(12) = 24, u_3 = 2(u_4 + 9) = 2(33) = 66 \\ u_2 = 2(75) = 150, u_1 = 2(159) = 318$$

Q8 $t_{n+1} = at_n + b$, the ratio $\frac{t_{n+1}}{t_n} = a + \frac{b}{t_n}$ is a constant if $b = 0$ and $a \neq 0$. $\therefore$ The sequence is geometric if $b = 0$ and $a \neq 0$.

$$\text{Q9 } t_{n+2} = t_{n+1} + t_n \text{ where } t_1 = t_2 = 1. \text{ The generated sequence is } \\ 1, 1, 2, 3, 5, 8, 13, 21, 33, 54, \dots \\ \therefore t_8 \times t_5 - t_7 \times t_6 = 21 \times 5 - 13 \times 8 = 105 - 104 = 1$$

Module 2: Geometry and trigonometry

Q1 L = the base of the large right angle triangle – the base of the small right angle triangle = $\sqrt{8^2 - 3^2} = 4 = 3.4$

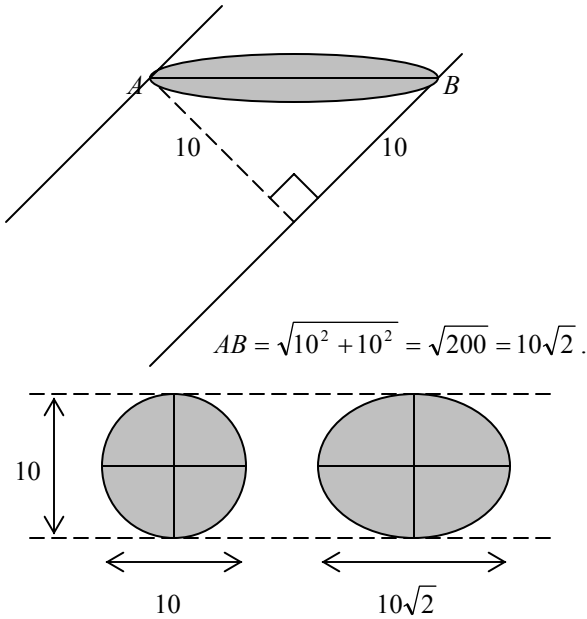
Q2 Length scale factor = $\frac{10\text{cm}}{0.5\text{m}} = \frac{10\text{cm}}{50\text{cm}} = 0.2$

$\therefore$ area scale factor = $0.2^2 = 0.04$

Q3 When the vase is upright, the depth of water would be $\frac{15 + 25}{2} = 20$ cm,

$\therefore$ volume of water = $\pi r^2 h = \pi 5^2 \times 20 = 1570.8 \text{ cm}^3 = 1.6 \text{ L}$

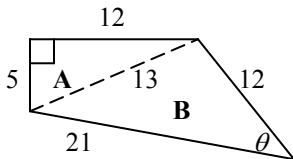
Q4



Area of circle = $\pi r^2 = \pi 5^2 = 78.5$

Area of ellipse = $\sqrt{2} \times 78.5 = 111.1 \text{ cm}^2$

Q5



Area **A** = $\frac{1}{2} \times 5 \times 12 = 30$.

$s = \frac{13 + 12 + 21}{2} = 23$,

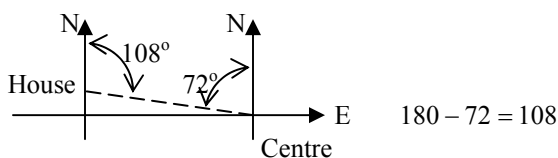
area **B** = $\sqrt{s(s-a)(s-b)(s-c)} = \sqrt{23(10)(11)(12)} = 71.1$

Total area = $30 + 71.1 = 101.1 \text{ cm}^2$

Q6 $\cos \theta = \frac{c^2 - a^2 - b^2}{2ab} = \frac{21^2 + 12^2 - 13^2}{2(21)(12)} = 0.8254$,

$\therefore \theta = \cos^{-1}(0.8254) = 34.4^\circ$

Q7

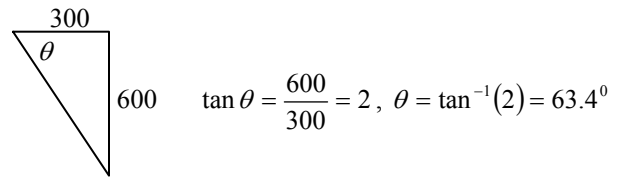


Q8 Horizontal distance from P to summit $\approx 300 \text{ m}$

Vertical distance from P to summit $\approx 1000 - 400 = 600 \text{ m}$

Average slope $\approx \frac{600}{300} = 2$

Q9



Module 6: Matrices

Q1 It is not a transitional matrix. Transitional matrices are square matrices.

$$\text{Q2 } 2 \begin{bmatrix} 0 & 1 \\ 1 & 2 \\ 2 & 3 \end{bmatrix} - \frac{1}{2} \begin{bmatrix} 0 & 4 \\ 4 & 8 \\ 8 & 12 \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ 2 & 4 \\ 4 & 6 \end{bmatrix} - \begin{bmatrix} 0 & 2 \\ 2 & 4 \\ 4 & 6 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix},$$

$$2 \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} -1 & 1 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}.$$

$$\text{Q3 } A \begin{bmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \end{bmatrix} = \begin{bmatrix} m & n & o & p \\ q & r & s & t \end{bmatrix}$$

$2 \times 3 \quad 3 \times 4 \quad 2 \times 4$

$$\text{Q4 } \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}, a + b = 0, a = 1, c + d = 1, c = 1$$

$\therefore b = -1, d = 0$

$$\text{Q5 } \text{Inverse of } \begin{bmatrix} 1 & -1 \\ 1 & -2 \end{bmatrix} \text{ is } \frac{1}{1 \times -2 - 1 \times 1} \begin{bmatrix} -2 & 1 \\ -1 & 1 \end{bmatrix}$$

$$= -1 \times \begin{bmatrix} -2 & 1 \\ -1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 1 & -1 \end{bmatrix}$$

$$\text{Q6 } \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1 & -2 \\ -3 & 4 \end{bmatrix} \begin{bmatrix} -\frac{1}{2} \\ \frac{1}{4} \end{bmatrix} = \begin{bmatrix} -1 \\ \frac{5}{2} \end{bmatrix}$$

$$\text{Q7 } \begin{bmatrix} 0.95 & 0.30 \\ 0.05 & 0.70 \end{bmatrix}$$

$$\text{Q8 } \text{Second night: } \begin{bmatrix} 0.50 & 0.50 \\ 0.50 & 0.50 \end{bmatrix} \begin{bmatrix} 120 \\ 60 \end{bmatrix} = \begin{bmatrix} 90 \\ 90 \end{bmatrix},$$

third night: $\begin{bmatrix} 0.50 & 0.50 \\ 0.50 & 0.50 \end{bmatrix} \begin{bmatrix} 90 \\ 90 \end{bmatrix} = \begin{bmatrix} 90 \\ 90 \end{bmatrix}$, steady state, 90 working light globes.

Q9 $3y = 2, y = 5x - 1 \therefore 0x + 3y = 2, 5x - y = 1$

$$\therefore \begin{bmatrix} 0 & 3 \\ 5 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$$

Please inform mathline@itute.com re conceptual, mathematical and/or typing errors