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PAPER 1

1 5 Omega. The standard deviation of the marks of 5 Omega is the lowest among the three classes.

2 (*a*) $S = \{(H, H), (H, T), (T, H), (T, T)\}$

(*b*) $X = 0, 1, 2$

3 (*a*) Number of different ways $= 5!$

$= 120$

(*b*) Number of different ways $= 3 \times 3! \times 2$

$= 3 \times 6 \times 2 = 36$

4 (*a*) Probability $= \left(\frac{3}{7} \times \frac{3}{7}\right) + \left(\frac{4}{7} \times \frac{4}{7}\right) = \frac{25}{49}$

(*b*) Probability $= \left(\frac{4}{7} \times \frac{3}{7} \times \frac{3}{7}\right) + \left(\frac{3}{7} \times \frac{4}{7} \times \frac{3}{7}\right)$

$= \frac{72}{343}$

5

$$\int_1^h (2x - 6)\,dx = -4$$

$$\left[\frac{2x^2}{2} - 6x\right]_1^h = -4$$

$$h^2 - 6h - (1 - 6) + 4 = 0$$

$$h^2 - 6h + 9 = 0$$

$$(h - 3)(h - 3) = 0$$

$$h - 3 = 0$$

$$h = 3$$

6 $V = 125$

Let the length of side be x cm.

$$x^3 = 125 = 5^3$$
$$x = 5$$
$$A = 6x^2$$
$$\frac{dA}{dx} = 12x^2 = 12 \times 5^2 = 300$$
$$\frac{dA}{dt} = \frac{dA}{dx} \cdot \frac{dx}{dt}$$
$$15 = 300 \times \frac{dx}{dt}$$
$$\frac{dx}{dt} = \frac{15}{300} = \frac{1}{20} \text{ cm s}^{-1}$$

7 (*a*) At P, $y = 0$,
$$\frac{2x-6}{x+2} = 0$$
$$2x = 6$$
$$x = 3$$
$$P = (3, 0)$$

$$y = \frac{2x-6}{x+2}$$
$$\frac{dy}{dx} = \frac{(x+2)2 - (2x-6)1}{(x+2)^2}$$
$$= \frac{2x+4-2x+6}{(x+2)^2}$$
$$= \frac{10}{(x+2)^2}$$
At P, $\frac{dy}{dx} = \frac{10}{(3+2)^2} = \frac{2}{5}$
$$\frac{dy}{dx} = 2q$$
$$\frac{2}{5} = 2q$$
$$q = \frac{1}{5}$$

8 $(0, 5k) : x = 0, y = 5k$
$$2y = 3x + h + k$$
$$2(5k) = 0 + h + k$$
$$10k - k = h$$
$$h = 9k$$

9 (*a*) $m_1 m_2 = -1$ $\quad 3 \times q = -1$
$$q = -\frac{1}{3}$$

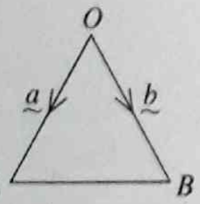
(*b*) $y = 3x + 4$ .... ①

$y = -\frac{1}{3}x - 6$ .... ②

$$3x + 4 = -\frac{1}{3}x - 6$$
$$9x + 12 = -x - 18$$
$$10x = -30$$
$$x = -3$$
$$y = = -9 + 4 = -5$$
$$F = (-3, -5)$$

10 (*a*) $\overrightarrow{AC} + \overrightarrow{CE} + \overrightarrow{CB} = \overrightarrow{AE} + \overrightarrow{EF} = \overrightarrow{AF}$

(*b*) $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$
$$= \underset{\sim}{b} - \underset{\sim}{a}$$
$$|\overrightarrow{AB}| = 3 \text{ units}$$



Unit vector in the direction of $\overrightarrow{AB}$
$$= \frac{\overrightarrow{AB}}{|\overrightarrow{AB}|}$$
$$= \frac{1}{3}(\underset{\sim}{b} - \underset{\sim}{a})$$

11 (*a*)
$$f(x) = x$$
$$3x - 2 = x$$
$$3x - x = 2$$
$$2x = 2$$
$$x = 1$$

(*b*)
$$f(x) = 3x - 2$$
$$f(2-h) = 3(2-h) - 2$$
$$= 6 - 3h - 2$$
$$= 8 - 3h$$
$$8 - 3h = 4h$$
$$7h = 8$$
$$h = \frac{8}{7} = 1\frac{1}{7}$$

12 $m(x) = px + 1$, $h(x) = 3x - 5$
$$mh(x) = m(3x - 5)$$
$$= p(3x-5) + 1$$
$$= 3px - 5p + 1$$
Given $mh(x) = 3px + q$

$3px - 5p + 1 = 3px + q$

Comparing both sides of the equation,
$$q = -5p + 1$$
$$5p = 1 - q$$
$$p = \frac{1-q}{5}$$

13 (*a*) $3x + 1 = y$
$$3x = y - 1$$
$$x = \frac{y-1}{3}$$
$$g^{-1}(x) = \frac{x-1}{3}$$

(*b*) $fg(x) = 9x^2 + 6x - 4$

$f(3x + 1) = 9x^2 + 6x - 4$

Let $3x + 1 = u$, then $x = \dfrac{u - 1}{3}$

$$f(u) = 9\left(\frac{u-1}{3}\right)^2 + 6\left(\frac{u-1}{3}\right) - 4$$

$$= \frac{9(u-1)^2}{9} + 2(u - 1) - 4$$

$$= u^2 - 2u + 1 + 2u - 2 - 4$$

$f(u) = u^2 - 5$

$f(x) = x^2 - 5$

14 (*a*) $\log_a 49 = \log_a 7^2$

$= 2 \log_a 7 = 2r$

(*b*) $\log_7 343\, a^2 = \log_7 343 + \log_7 a^2$

$= \log_7 7^3 + 2 \log_7 a$

$$= 3 \log_7 7 + 2\left(\frac{1}{\log_a 7}\right) = 3 + \frac{2}{r}$$

15 $3^p = 5^q$

$\log 3^p = \log 5^q$

$p \log 3 = q \log 5$

$\log 3 = \dfrac{q}{p} \log 5$ .... ①

$5^q = 15^r$

$5^q = (3 \times 5)^r$

$5^q = 3^r \times 5^r$

$\log 5^q = \log (3^r \times 5^r)$

$= \log 3^r + \log 5^r$

$q \log 5 = r \log 3 + r \log 5$ .... ②

Substitute ① into ②:

$$q \log 5 = r\left(\frac{q \log 5}{p}\right) + r \log 5$$

$$q = \frac{rq}{p} + r$$

$pq = rq + rp$

$pq = r(q + p)$

$$r = \frac{pq}{p + q}$$

16 $y = 2x^2 - \dfrac{q}{x}$

$xy = 2x^3 - q$

$Y = mX + c$

$m = 2, c = -q$

$$m = \frac{13 - 3}{h - 0}$$

$$2 = \frac{10}{h}$$

$2h = 10$

$h = 5$

$c = 3$

$-q = 3$

$q = -3$

17 $3x^2 + 8x + 7 = 0$

$a = 3, b = 8, c = 7$

$$\alpha + \beta = -\frac{b}{a} = -\frac{8}{3}$$

$$\alpha\beta = \frac{c}{a} = \frac{7}{3}$$

Sum of new roofs $= 3\alpha + 3\beta$

$= 3(\alpha + \beta)$

$= 3\left(-\dfrac{8}{3}\right)$

$= -8$

Product of new roots $= 3\alpha \times 3\beta$

$= 9\alpha\beta$

$= 9\left(\dfrac{7}{3}\right)$

$= 21$

The equation is $x^2 - (-8)x + 21 = 0$

$x^2 + 8x + 21 = 0$

18 $f(x) = x^2 + 2wx + 3w - 2$

$a = 1, b = 2w, c = 3w - 2$

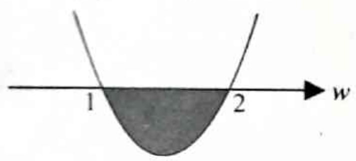
$b^2 - 4ac < 0$

$(2w)^2 - 4(1)(3w - 2) < 0$

$4w^2 - 12w + 8 < 0$

$w^2 - 3w + 2 < 0$

$(w - 1)(w - 2) < 0$



$1 < w < 2$

$p < w < q$

Thus, $p = 1, q = 2$

19 (*a*) Length of arc $AB = 16$ cm

$r \times \theta = 16$

$8 \times \theta = 16$

$\theta = 2$ radians

(*b*) $\theta + x = 2\pi$

$x = 2\pi - \theta$

$= 2(3.142) - 2 = 4.284$ radians

Area of major sector $OAB = \dfrac{1}{2} r^2 x$

$= \dfrac{1}{2} \times 8^2 \times 4.284$

$= 137.088$

$= 137.1 \text{ cm}^2$

20 $\tan \alpha = 4 - 3 \cot \alpha$

$$\tan \alpha = 4 - \frac{3}{\tan \alpha}$$

$\tan^2 \alpha = 4 \tan \alpha - 3$

$$\tan^2 \alpha - 4 \tan \alpha + 3 = 0$$
$$(\tan \alpha - 1)(\tan \alpha - 3) = 0$$
$$\tan \alpha = 1$$
$$\alpha = 45°$$
or $\tan \alpha = 3$
$$\alpha = 71° 34'$$
Thus, $\alpha = 45°, 71° 34'$

21 Condensed milk: 70, 65, 60, …

$a = 70, d = -5$ $\quad T_n = a + (n - 1)d$
$$= 70 + (n - 1)(-5)$$
$$= 70 - 5n + 5$$
$$= 75 - 5n \quad \text{..........} ①$$

Evaporated milk: 48, 45, 42, …

$a = 48, d = -3$ $\quad T_n = a + (n - 1)d$
$$= 48 + (n - 1)(-3)$$
$$= 48 - 3n + 3$$
$$= 51 - 3n \quad \text{..........} ②$$

① = ②: $75 - 5n = 51 - 3n$
$$75 - 51 = 5n - 3n$$
$$2n = 24$$
$$n = 12$$

After 12 days, the remainder numbers of cans are the same.

22 (*a*) $\dfrac{2x - 7}{x + 1} = \dfrac{1}{2}$
$$2(2x - 7) = x + 1$$
$$4x - 14 = x + 1$$
$$4x - x = 14 + 1$$
$$3x = 15$$
$$x = 5$$

(*b*) $T_{12} = x + 1$
$$ar^{11} = 5 + 1$$
$$a \times \left(\frac{1}{2}\right)^{11} = 6$$
$$a \times \frac{1}{2\,048} = 6$$
$$a = 12\,288$$

23 4, 4.5, 5.0625, …

$a = 4, r = 1.125, n = 15$
$$S_n = \frac{a(r^n - 1)}{r - 1}$$
$$S_{15} = \frac{4(1.125^{15} - 1)}{1.125 - 1}$$
$$= 155.3 \text{ minutes}$$
$$= 2.588 \text{ hours}$$

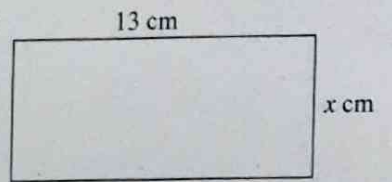
Since the time taken is more than 2 hours, Mohan did not qualify.

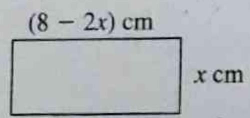
24 (*a*) $n = 3, \quad P(X = r) = {}^3C_r p^r (1 - p)^{3-r}$
$$P(X = 3) = {}^3C_3 p^3 (1 - p)^0$$
$$\frac{27}{64} = 1 \times p^3 \times 1$$
$$p^3 = \left(\frac{3}{4}\right)^3$$
$$p = \frac{3}{4}$$

(*b*) P(lifespan more than 6 months) $= 1 - p$
$$= 1 - \frac{3}{4}$$
$$= \frac{1}{4}$$

Number of bulbs $= 20 \times \dfrac{1}{4} = 5$

25





Total area = 20 cm²
$$2(13 \times x) + 2x(8 - 2x) = 20$$
$$26x + 16x - 4x^2 - 20 = 0$$
$$4x^2 - 42x + 20 = 0$$
$$2x^2 - 21x + 10 = 0$$
$$(2x - 1)(x - 10) = 0$$
$$2x - 1 = 0$$
$$x = \frac{1}{2}$$
or $x - 10 = 0$
$$x = 10 \text{ (rejected)}$$

The width of the wood is $\dfrac{1}{2}$ cm.

PAPER 2

Section A

1 (a)

Mass	Number of watermelons (f)	Midpoint x	fx
1.0 – 1.4	6	1.2	7.2
1.5 – 1.9	10	1.7	17
2.0 – 2.4	n	2.2	$2.2n$
2.5 – 2.9	14	2.7	37.8
3.0 – 3.4	8	3.2	25.6
	$n + 38$		$2.2n + 87.6$