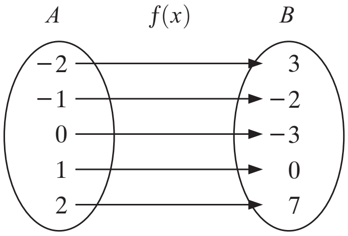
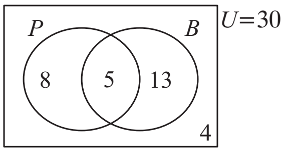
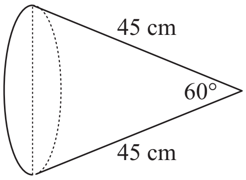
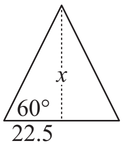
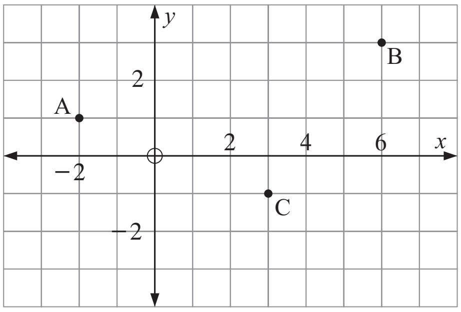
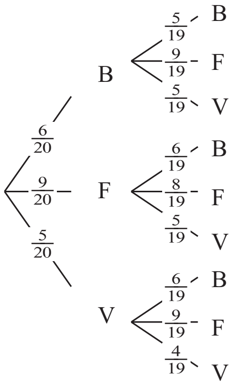
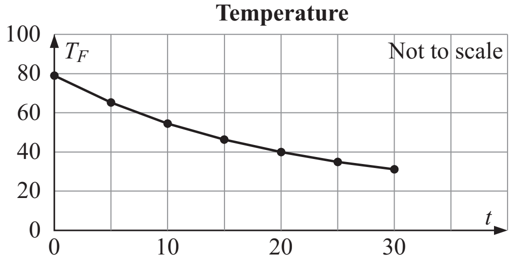
1	**a** $5, -5, \sqrt{16}$	A2	**C2**
	b $\frac{1}{3}, 5, -5, \sqrt{16}, 0.\dot{6}$	A2	**C2**
	c $5, \sqrt{16}$	A2	**C2**
			[6 marks]
2	**a** $f\colon \quad x \mapsto 2x^2 + x - 3$ 	A2	**C2**
	b **i** domain: $-2 \leqslant x \leqslant 2, \quad x \in \mathbb{Z}$	A1ftA1ft	**C2**
	ii range: $-2, -3, 0, 3, 7$	A1ftA1ft	**C2**
			[6 marks]
3	**a** Surface area $= 9.85 \times 5.90$	M1	
	$= 58.115 \text{ m}^2 \quad (= 58.1 \text{ m}^2)$	A1	**C2**
	b $10 \times 6 = 60$	A1	
	$\frac{60 - 58.115}{58.115} \times 100$	M1A1ft	
	$= 3.24\%$ (allow 3.27)	A1ft	**C4**
			[6 marks]
4	**a** $8 + 13 + 4 + x = 30$		
	5 students like both plain and chocolate milk.	A1	**C1**
	b 	A1A1 A1ft	**C3**
	c P(likes only one type of milk) $= \frac{21}{30} = \frac{7}{10} \quad (= 0.7)$	A1A1ft	**C2**
			[6 marks]
5	**a** P(ticket costs more than \$60) $= \frac{23}{50} \quad (= 0.46)$	A1	**C1**
	b Mean = \$60.70	A1	
	Standard deviation = \$25.35	A1	**C2**
	c \$60.70 + 0.722 × 25.35 = \$79.00	A1ft	
	% of tickets less than \$79 $= \frac{38}{50} \times 100 = 76\%$	M1A1ft	**C3**
			[6 marks]
6	**a** 2000×0.75	M1	
	= 1500 GBP	A1	**C2**
	b Remaining $= 1500 - 1200$	M1	
	= 300 GBP	A1ft	**C2**
	c $300 \times \frac{1}{0.80}$	M1	
	= 375 USD	A1ft	**C2**
			[6 marks]

<table>
<tr><td>7</td><td>a $u_1r^6 = 320, \quad u_1r^{10} = 5120$</td><td>M1</td><td></td></tr>
<tr><td></td><td>Divide $r^4 = 16$</td><td></td><td></td></tr>
<tr><td></td><td>$r = 2$</td><td>A1</td><td>C2</td></tr>
<tr><td></td><td>b $u_1 2^6 = 320$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$u_1 = 5$</td><td>A1ft</td><td>C2</td></tr>
<tr><td></td><td>c $u_{20} = u_1r^{19}$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$= 2\,621\,440$</td><td>A1ft</td><td>C2
[6 marks]</td></tr>
<tr><td>8</td><td>a $F_v = C\left(1+\frac{r}{100}\right)^n$</td><td></td><td></td></tr>
<tr><td></td><td>$= 20\,000\left(1+\frac{6.8}{1200}\right)^{48}$</td><td>M1A1</td><td></td></tr>
<tr><td></td><td>$= \$26\,231.59$</td><td>A1</td><td>C3</td></tr>
<tr><td></td><td>b $20\,000(1.032)^4 = \$22\,685.52$</td><td>M1A1</td><td>C2</td></tr>
<tr><td></td><td>c $26\,231.59 - 22\,685.52 = \$3546.07$</td><td>A1ft</td><td>C1
[6 marks]</td></tr>
<tr><td>9</td><td>a $Q_3 = 77, \quad Q_1 = 65$</td><td>A1A1</td><td>C2</td></tr>
<tr><td></td><td>b IQR $= 77 - 65 = 12$</td><td>A1ft</td><td>C1</td></tr>
<tr><td></td><td>c minimum $= 45$</td><td>A1</td><td></td></tr>
<tr><td></td><td>$65 - 1.5(12) = 47$</td><td>M1</td><td></td></tr>
<tr><td></td><td>minimum < 47 and hence an outlier</td><td>A1ft</td><td>C3
[6 marks]</td></tr>
<tr><td>10</td><td>a Profit $= 12.50(100) - (9.5(100) + 45)$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$= \$255$</td><td>A1</td><td>C2</td></tr>
<tr><td></td><td>b Breakeven when $12.5x = 9.5x + 45$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$3x = 45$ 15 boxes</td><td>A1</td><td>C2</td></tr>
<tr><td></td><td>c $12.50x - (9.5x + 45) > 1000$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$3x - 45 > 1000$</td><td></td><td></td></tr>
<tr><td></td><td>$x > 348.3$ 349 boxes</td><td>A1</td><td>C2
[6 marks]</td></tr>
<tr><td>11</td><td rowspan="4">a
<table>
<tr><th>$p \veebar q$</th><th>$\neg(p \wedge q) \vee q$</th><th>$(p \veebar q) \Rightarrow \neg(p \wedge q) \vee q$</th></tr>
<tr><td>F</td><td>T</td><td>T</td></tr>
<tr><td>T</td><td>T</td><td>T</td></tr>
<tr><td>T</td><td>T</td><td>T</td></tr>
<tr><td>F</td><td>T</td><td>T</td></tr>
</table></td><td>A1</td><td></td></tr>
<tr><td></td><td>A1</td><td></td></tr>
<tr><td></td><td>A1</td><td></td></tr>
<tr><td></td><td>A1</td><td>C4</td></tr>
<tr><td></td><td>b If Bozo does not have a red nose then Bozo is not a clown.</td><td>A1A1</td><td>C2
[6 marks]</td></tr>
<tr><td>12</td><td>a $\dfrac{3-(-3)}{1-(-2)} = 2$</td><td>A1</td><td></td></tr>
<tr><td></td><td>Equation AB is $2x - y = 2(1) - (3)$</td><td>M1</td><td></td></tr>
<tr><td></td><td>$2x - y + 1 = 0$</td><td>A1ft</td><td>C3</td></tr>
<tr><td></td><td>b M $= \left(-\frac{1}{2}, 0\right)$</td><td>A1</td><td></td></tr>
<tr><td></td><td>$m = -\frac{1}{2}$</td><td>A1ft</td><td></td></tr>
<tr><td></td><td>Equation of perpendicular bisector of AB is</td><td></td><td></td></tr>
<tr><td></td><td>$x + 2y = \left(-\frac{1}{2}\right) + 2(0)$</td><td></td><td></td></tr>
<tr><td></td><td>$x + 2y = -\frac{1}{2}$ or $2x + 4y = -1$</td><td>A1ft</td><td>C3
[6 marks]</td></tr>
</table>

13	**a** $f'(x) = 2ax + b$	A1	**C1**
	b $2a = 5, \quad a = 2.5 \quad b = -10$	A1ftA1ft	**C2**
	c $x = \frac{10}{5} = 2$	A1ft	
	Substitute into $f(x) \quad -4 = 2.5(2)^2 - 10(2) + d$	M1	
	$d = 6$	A1ft	**C3** **[6 marks]**
14			
	a Equilateral triangle : diameter = 45 cm	A1	**C1**
	b 		
	$\tan 60 = \frac{x}{22.5} \qquad x = 39.0$	M1A1ft	
	height of cone is 39 cm		
	Volume of cone $= \frac{1}{3}\pi r^2 h$		
	$= \frac{1}{3}\pi \times 22.5^2 \times 39$	M1A1ft	
	$= 20\,700 \text{ cm}^2$ (3 s.f.)	A1ft	**C5** **[6 marks]**
15	**a** **i** amplitude = 2	A1	
	ii period = 120^o	A1	**C2**
	b $a = 2, \quad b = \frac{360}{120} = 3, \quad c = 3$	A1A2A1	**C4** **[6 marks]**

1	**a**  Diagram reduced 50%	A1A1	2
	b **i** Gradient BC $= \frac{-1-3}{3-6} = \frac{4}{3}$	M1A1 (G2)	
	ii Parallel lines have the same gradients.	A1	
	iii $\frac{d-1}{-5+2} = \frac{4}{3}$	M1	
	$d = -3$	A1ft (G2)	5
	c **i** length AB $= \sqrt{(6--2)^2+(3-1)^2}$	M1A1	
	$= \sqrt{68}$	A1 (G2)	
	ii $\cos \angle ABC = \frac{\sqrt{68}^2+5^2-\sqrt{27}^2}{2\times\sqrt{68}\times 5}$	M1A1ft	
	$\therefore \quad \angle ABC = 36.8^o$	A1ft (G2)	6
	d Area ABCD = 2 × area triangle ABC		
	$= 2\times\frac{1}{2}\times 5\times\sqrt{68}\sin 36.8$	M1A1ft	
	$= 24.7$ units^2	A1ft (G2)	3 **(16)**
2	**a** 	A4	4
	b **i** P(B, B) $= \frac{6}{20}\times\frac{5}{19}$	M1	
	$= \frac{30}{380}$ (0.0789)	A1ft (G2)	
	ii P(B, F) + P(F, B) $= \frac{6}{20}\times\frac{9}{19} + \frac{9}{20}\times\frac{6}{19}$	M1 A1ft	
	$= \frac{108}{380}$ (0.284)	A1ft (G2)	
	iii P(both the same) = P(B, B) + P(F, F) + P(V, V)		
	$= \frac{6}{20}\times\frac{5}{19} + \frac{9}{20}\times\frac{8}{19} + \frac{5}{20}\times\frac{4}{19}$	M1A1ft	
	$= \frac{122}{380}$ (0.321)	A1ft (G2)	8
	c **i** P(V, V) $= \frac{5}{20}\times\frac{5}{20} = \frac{25}{400} = \frac{1}{16}$ (0.0625)	M1A1ftA1ft (G2)	3
	ii P(both B $\mid$ the two balls are same)		
	$= \frac{6\times 6}{6\times 6 + 9\times 9 + 5\times 5}$	M1A1ft	
	$= \frac{36}{142}$ (0.254)	A1ft (G2)	3 **(18)**

3	**a** **i** $a = 79^o, \quad b = 31.1^o$	A1A1	**2**
	ii $61 \times (0.95)^t + 18 = 25 \quad t = 42.2$ minutes	M1A1 (G2)	**2**
	b 	A1 A2ft A1	**4**
	[A1 for scale and labels, A2 for points, A1 for curve]		
	c **i** $t = 0, \quad T_F = 53 \times (0.98)^0 + 18 = 71^o$	M1A1	
	ii The heat is lost at a faster rate in the plastic cup.	A1ft	
	iii $53 \times (0.98)^t + 18 = 61 \times (0.95)^t + 18$	M1	
	$\therefore \quad t = 4.52$	A1	
	The time taken for the temperature within each cup to be equal is 4.5 minutes.	A1 (G3)	**6**
	d The temperature will approach 18°.	A2	**2**
			(16)
4	**a** **i** **a** $r = \dfrac{s_{xy}}{s_x s_y}$		
	$= \dfrac{93.7}{4.78 \times 21.4}$	M1A1	
	$= 0.916$	A1 (G2)	
	b A strong, positive relationship exists between the maximum temperature and the number of people attending the swimming pool.	A1ftA1ft	**5**
	ii $y - \overline{y} = \dfrac{s_{xy}}{{s_x}^2}(x - \overline{x})$		
	$y - 87.3 = \dfrac{93.7}{4.78^2}(x - 29.9)$	M1A1	
	$y - 87.3 = 4.1(x - 29.9)$ $y = 4.1x - 35.3$	A1A1 (G3)	**4**
	(attendance = 4.1 × max. temperature − 35.3)		
	iii **a** **i** attendance $= 4.1(20) - 35.3$	M1	
	$= 46.7$ i.e., 47 people	A1ft (G2)	
	ii attendance $= 4.1(40) - 35.3$ $= 128.7$ i.e., 129 people	A1ft	
	b The estimate for 20° is the more reliable. It is an interpolated value (within known values).	A1ftR1ft	**5**
	iv The manager's plan seems sensible given the high value for the coefficient of correlation.	A1ftR1ft	**2**
	b **i** H_0: Attendance by gender is independent of temperature.	A1	**1**
	ii p-value = 0.0950	G2	**2**
	iii Do not reject H_0: Attendance by gender and temperature are independent.	A1ft	
	$P_{\text{calc}} > 0.05$	R1ft	**2**
			(21)

5	**a** **i** $f(1) = 3(1)^3 - 4(1) + 5 = 4$	M1A1 (G2)	**2**
	ii $f'(x) = 9x^2 - 4$	A1A1	**2**
	iii $f(1) = 9(1)^2 - 4 = 5$	M1A1ft (G2)	**2**
	iv gradient $= 5$, through point (1, 4)		
	$5x - y = 5(1) - (4)$ $5x - y = 1$ $(y = 5x - 1)$	M1A1ft (G1)	**2**
	v (GDC) $(-2, -11)$	A1A1ft	**2**
	b **i** Volume $= l \times w \times h$ $V = x^2y$	A2	**2**
	ii $V = x^2 \times \frac{30\,000 - x^2}{2x} = 15\,000x - \frac{x^3}{2}$	M1A1ft (G2)	**2**
	iii $\frac{dV}{dx} = 15\,000 - \frac{3x^2}{2}$	A1A1ft	**2**
	iv minimum when $\frac{dV}{dx} = 0$	M1	
	$15\,000 - \frac{3x^2}{2} = 0$ *or* $30\,000 = 3x^2$		
	$x^2 = 10\,000$	A1	
	$x = 100$	A1ft (G2)	**3**
			(19)