Qu №	Answer	Solutions	Marks		AO	Spec.
1		$x-2y=7$ (1) $5x-2y=51$ (2)			1.3b	A19
		Either: Rearrange (1) to make x the subject $x-2y=7$ $[-2y]$ $x=7+2y$ (3) Substitute (3) into (2) to find y $5x-2y=51 \rightarrow 5(7+2y)-2y=51$ $\rightarrow (5\times7)+(5\times2y)-2y=5$ $\rightarrow 35+10y-2y=51$ $\rightarrow 35+8y=51$ $[-35]$ $8y=16$ $[\div8]$ $y=2$ **Or:** $(2)-(1)$ [to eliminate y and find x] $(5x-2y)-(x-2y)=51$ $\rightarrow 4x=44$ $[\div4]$ $x=11$	M1 method to eliminate 1 variable			
		Either: Substitute $y=2$ into (1) to find x $x-2y=7 \rightarrow x-(2\times2)=7$ $\rightarrow x-4=7$ $[+4]$ $x=11$ **Or:** Substitute $x=11$ into (1) to find y $x-2y=7$ $\rightarrow 11-2y=7$ $[+2y]$ $11=7+2y$ $[-7]$ $4=2y$ $[\div2]$ $2=y \rightarrow y=2$	M1 substituting			
		$y=2$ $x=11$	A1 both values correct	3		
2		5 adult tickets and 3 child tickets costs £240 2 adult tickets and 6 child tickets costs £216 Let a = 1 adult ticket; Let c = 1 bag of child ticket Write as equations: $5a+3c=240$ (1) $2a+6c=216$ (2)	M1 forming equations		3.1d 1.3b	A21
		Either: Divide (2) by 2 to make coefficient of a equal 1 $2a+6c=216$ $[\div2]$ $a+3c=108$ Rearrange to make a the subject $a+3c=108$ $[-3c]$ $a=108-3c$ (3) Substitute (3) into (1) $5a+3c=240 \rightarrow 5(108-3c)+3c=240$ $\rightarrow 540-15c+3c=240$ $\rightarrow 540-12c=240$ $[+12c]$ $540=240+12c$ $[-240]$ $300=12c$ $[\div12]$ $c=25$ **Or:** Multiply (1) by 2 to make c coefficients equal $5a+3c=240$ $[\times2]$ $10a+6c=480$ Rearrange to make $6c$ the subject $10a+6c=480$ $[-10a]$ $6c=480-10a$ (3) Substitute (3) into (2) $2a+6c=216 \rightarrow 2a+(480-10a)=216$ $\rightarrow 480-8a=216$ $[+8a]$ $480=216+8a$ $[-216]$ $264=8a$ $[\div8]$ $a=33$	M1 method to eliminate 1 variable			
		Either: Substitute c = 25 into (1) to find a $5a+3c=240 \rightarrow 5a+(3\times25)=240$ $\rightarrow 5a+75=240$ $[-75]$ $5a=165$ $[\div5]$ $a=33$ **Or:** Substitute a = 33 into (2) to find c $2a+6c=216 \rightarrow (2\times33)+6c=216$ $\rightarrow 66+6c=216$ $[-66]$ $6c=150$ $[\div6]$ $c=25$	M1 substituting found variable			
		1 adult ticket costs £33. 1 child ticket costs £25.	A1 both correct values	4		

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Qu №	Answer	Solutions	Marks		AO	Spec.
3a		***Working must be shown*** Volume of prism = cross-sectional area × depth Cross-section of water tank is trapezium Area of trapezium = $\frac{a+b}{2} \times h$ Cross-sectional area of water tank is $\frac{3.4+4.6}{2} \times 3 = 12$ m^2 Depth of water tank is 1.8m Volume of water tank is 12 × 1.8 = 21.6 m^3	M1		3.1d 1.3b	G16 R9 R1 N2
		The water tank can be filled to 90% of its maximum volume 90% of 21.6 m^3 is 21.6 × 0.9 = 19.44 m^3	M1			
		1 litre = 0.001 m^3 ∴ 1 m^3 = 1000 litres ∴ 19.44 m^3 = 19.44 × 1000 = 19440 litres	M1			
		The water flows into the tank at 400 litres per minute The time taken to fill the tanks to 90% of its maximum volume is 19440 ÷ 400	M1			
	48.6 minutes [with working]	= 48.6 minutes	A1			
b	Any suitable explanation	**e.g.** if the rate of flow changes, the time taken to fill the tank will also change	A1	**6**	3.5	R11
4		Area of a semicircle = $\frac{\pi r^2}{2}$ Diameter of each semicircle is 36 ÷ 2 = 18 cm Radius of each semicircle is 18 ÷ 2 = 9 cm	M1		3.1b 1.3b	G17 N15
		Area of 3 semicircles is 3 × $\frac{\pi(8)^2}{2} = 3 \times \frac{64\pi}{2} = 3 \times 32\pi = 96\pi$ cm^2	M1			
		The sides BC and AD of the rectangle are 9 + 9 = 18 cm long Area of rectangle is 36 × 18 = 648 cm^2	M1			
		Area of shaded section = area of rectangle − area of 3 semicircles Area of shaded section is 648 − 96π	M1			
	266 cm^2	= 266.29… cm^2 = 266 cm^2 correct to 3 significant figures	A1	**5**		
5	**'Prove That' Qu** *working must be shown*	***Working must be shown*** Let $n = 0.1\dot{7}\dot{2} = 0.172727272...$ $1000n = 172.7272727...$ $10n = 1.72727272...$ $1000n - 10n = 171.00000...$ $990n = 171$	M1		1.3a	N10
		$n = \frac{171}{990} = \frac{19}{110}$ $0.1\dot{7}\dot{2} = \frac{19}{110}$	A1	**2**		

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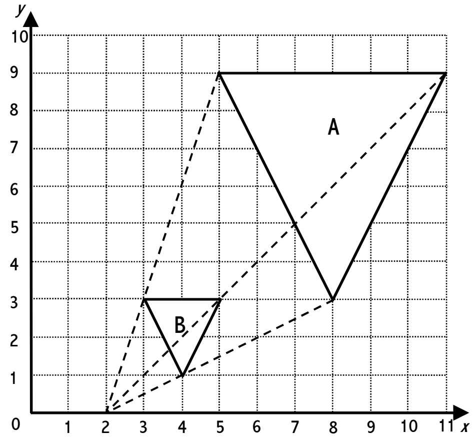
Qu №	Answer	Solutions	Marks		AO	Spec.
6	Enlargement by scale factor $\frac{1}{3}$, centre (2,0)		A1 enlargement A1 scale factor $\frac{1}{3}$ A1 centre (2, 0)	3	2.3a	G7
7		a is inversely proportional to b so $a = \frac{k}{b}$ Find the value of k: When b = 40, a = 9 ∴ $9 = \frac{k}{40}$ [×40] $k = 360$	M1		1.3b	R10 R13
		∴ $a = \frac{360}{b}$ When b = 70, $a = \frac{360}{75}$	M1			
	a = 4.8	= 4.8	A1	3		
8	–8	$y = mx + c$ where m is the gradient and c is the y-intercept For the equation $y = 5 - 8x$, –8 is the gradient.	A1	1	1.2	A10
9		**Either:** Normal bottles contain 650 ml. Option 1: 25% off the normal price = 100 – 25 = 75% of the normal price. Customers get 650 × 0.25 = 162.5 ml for free **Or:** Normal bottles contain 650 ml. Let normal cost of the drink = £p Option 1: 25% off the normal price = 100 – 25 = 75% of the normal price = £0.75p Price per ml of the drink is 0.75p ÷ 650 = £0.00115p (to 3 significant figures)	M1		3.1d 1.3a 3.3	R9
		Option 2: 35% extra drink for the same price Total amount of drink is 650 × 1.35 = 877.5 ml. The drink is sold at the normal price. Customers get 877.5 – 650 ml = 227.5 ml for free **Or:** Option 2: 35% extra drink for the same price The total amount of drink is 650 × 1.35 = 877.5 ml. The price per ml of the drink is p ÷ 877.5 = 0.00113p (to 3 significant figures)	M1			
	Option 2 [with working]	227.5 ml > 162.5 ml ∴ option 2 gives the customer the best value for money **Or:** 0.00113 < 0.00115 ∴ option 2 gives the customer the best value for money	A1	3		

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Qu №	Answer	Solutions	Marks		AO	Spec.
10		***Working must be shown*** $\frac{6+4\sqrt{3}}{3+\sqrt{3}}$ [rationalise the denominator] $=\frac{6+4\sqrt{3}}{3+\sqrt{3}}\times\frac{3-\sqrt{3}}{3-\sqrt{3}}$	M1 rationalising denominator		1.3a	N8
	'Show That' Qu *working must be shown*	$=\frac{(6+4\sqrt{3})(3-\sqrt{3})}{(3+\sqrt{3})(3-\sqrt{3})}$ [expand the brackets] $=\frac{18-6\sqrt{3}+12\sqrt{3}-12}{9+\sqrt{3}-\sqrt{3}-3}$ [simplify]	M1 $\sqrt{3}\times\sqrt{3}=$			
		$=\frac{6+6\sqrt{3}}{6}$ $=1+\sqrt{3}$	A1	**3**		
11		Area of room = 5 × 3 = 15 m² Area of rug $=\frac{\pi ab}{4}=\frac{5\times3\times\pi}{4}=\frac{15\pi}{4}$ m²	M1		1.3b	R9 G17
		Percentage of floor covered $=\frac{\text{area of rug}}{\text{area of room}}\times100$ $=\frac{\left(\frac{15\pi}{4}\right)}{15}\times100=\frac{100\pi}{4}=25\pi$	M1			
	78.5%	= 78.5398… = 78.5% (1 dp)	A1	**3**		
12a		Volume $V=\frac{4}{3}\pi r^3$ [substitute in values] $=\frac{4}{3}\pi\times6^3$	M1		1.3a	G17
	905 cm³	= 904.778… = 905 cm³ (3 sf)	A1			
b		Minimum length = 4 spheres = 8 × sphere radius 8 × 6 = 48 cm	M1		1.3a 3.1a	G16
		Minimum height and width = 1 sphere = 2 × sphere radius 2 × 6 = 12 cm	M1			
		Minimum volume = 48 × 12 × 12	M1			
	6,912 cm³	= 6,912 cm³	A1	**6**		
13a		**Either:** $2x^2-8x+7$ $=2(x^2-4x)+7$ **Or:** $a(x-b)^2+c$ $=a(x^2-2bx+b^2)+c$ $=ax^2-2abx+ab^2+c$	M1 rearrange one side in form of the other		1.3b	A4 A18
		Either: $=2\left[(x-2)^2-4\right]+7$ $=2(x-2)^2-1$ **Or:** $a=2$ $-2ab=-8$ $ab^2+c=7$	M1			
	$a=2,\ b=2,\ c=-1$	**Either:** $2(x-2)^2-1=a(x-b)^2+c$ $a=2,\ b=2,\ c=-1$ **Or:** $-2\times2b=-8;\ b=2$ $2\times2^2+c=7;\ c=-1$	A1			

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Qu №	Answer	Solutions		Marks		AO	Spec.
b		**Either:** $2x^2-8x+7=-1$ [use (a)] $2(x-2)^2-1=-1$ [+1]	**Or:** $2x^2-8x+7=-1$ [+1] $2x^2-8x+8=0$ [÷2]	M1		1.3b 2.2	A4 A18
		$2(x-2)^2=0$ [÷2] $(x-2)^2=0$ [sq. root]	$x^2-4x+4=0$ [factorise] $(x-2)^2=0$ [sq. root]	M1			
	$x=2$	$x-2=0$; $x=2$	$x-2=0$; $x=2$	A1	**6**		
14a		**Either:** $f(x)=4x,\ g(x)=3x-4$ $f(5)=4\times5=20$	**Or:** $f(x)=4x,\ g(x)=3x-4$ $gf(x)=g(4x)$ $=3(4x)-4=12x-4$	B1		1.3b	A2 A4 A7
	56	$gf(5)=g(20)=3\times20-4$ $=60-4=56$	$gf(5)=12\times5-4$ $=60-4=56$	B1			
b		$fg(x)=32$ $fg(x)=f(3x-4)=4(3x-4)$ [expand brackets]		M1		1.3b	A4 A7
		$=12x-16$		A1			
		$\therefore 12x-16=32$ [+ 16]		M1			
	$x=4$	$12x=48$ [÷ 12] $x=4$		A1	**6**		
15		Frequency = frequency density × class width For 30 – 40 category, 12 = frequency density × 10 So frequency density = 1.2 1.2 = 48 squares on y-axis So one square on y-axis = $\frac{1.2}{48}$ = 0.025 frequency density		M1		1.3b 2.3a 3.1d	S3
		For 0–20 houses, frequency density = 0.025 × 12 squares = 0.3 Frequency = 0.3 × 20 = 6 For 20–30 houses, frequency density = 0.025 × 36 squares = 0.9 Frequency = 0.9 × 10 = 9		M1			
	15	Total frequency = 6 + 9 = 15		A1	**3**		

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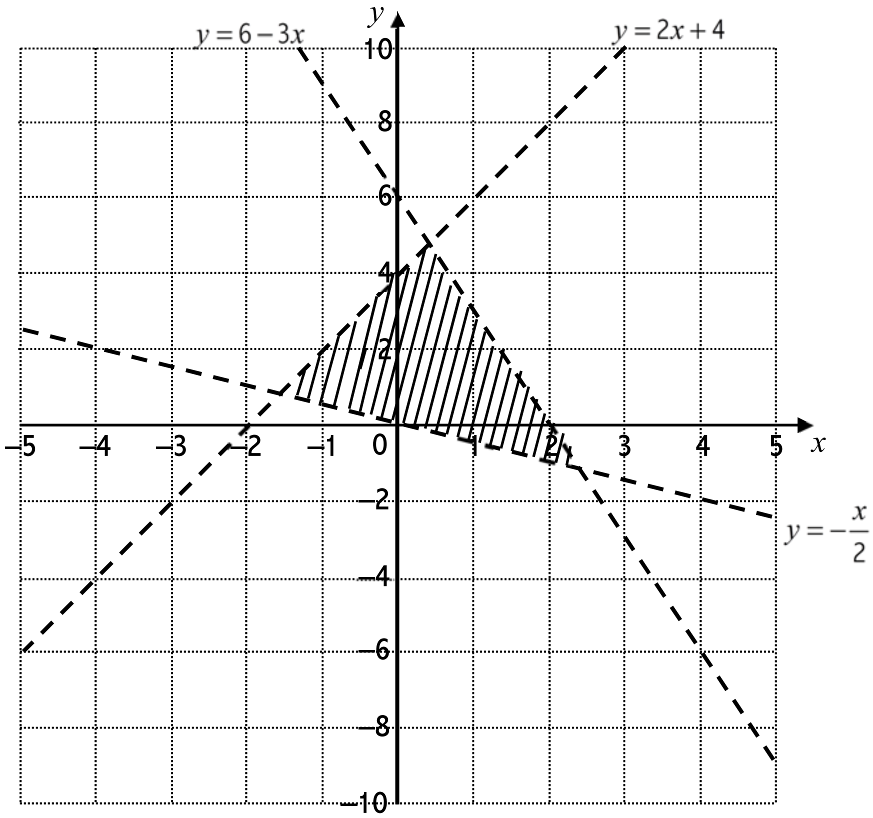
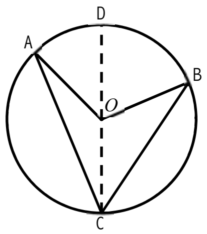
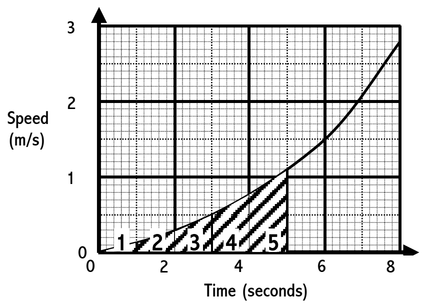
Qu №	Answer	Solutions	Marks		AO	Spec.
16			M1 one line drawn correctly M1 more than one line drawn correctly A1 region shaded correctly between two correct lines A1 all lines and shaded region correct	4	2.3b	A9 A22
17		There are 4 times as many pink flowers as purple flowers ∴ the ratio of pink to purple flowers is 4 : 1 There are 3 times as many purple flours as white flowers ∴ the ratio of purple to white flowers is 3 : 1 Pink : Purple Purple : White 4 : 1 3 : 1 12 : 3 [×3]	M1		1.3a	R7 R4
	12 : 3 : 1	The ratio of pink to purple to white flowers is 12 : 3 : 1	A1	2		
18	**'Prove That' Qᵘ** *Reasoning must be shown*	***Reasons for each statement must be given*** Draw line AD which passes through the origin. Let angle OCA = x & angle OCB = y Angle OCA = angle OAC = x [OA & OC are both radii ∴ OA = OC ∴ triangle OAC is isosceles ∴ acute angles are equal] Angle OCB = angle OBC = y [OB & OC are both radii ∴ OB = OC ∴ triangle OAC is isosceles ∴ acute angles are equal]	M1		2.2 2.4b	G3 G6 G10
		Angle AOC = 180 – x – x = 180 – 2x [angles in a triangle sum to 180°] Angle BOC = 180 – y – y = 180 – 2y [angles in a triangle sum to 180°]	M1			
		Angle AOC = 360 – (180 – 2x) – (180 – 2y) = 2x + 2y [angles at a point sum to 360°]	M1			
		Angle ACB = angle OCA + angle OCB = x + y The angle at the centre (AOC) is double the angle at the circumference (ACB).	A1	4		

Qu №	Answer	Solutions	Marks		AO	Spec.
19a	2700	$R = 2700 \times 1.03^t$ where R is the number of rabbits and t is the number of years after 2015 At the beginning of 2015, $t = 0 \therefore R = 2700 \times 1.03^0 = 2700$	A1		1.3a	R16
b	Any suitable explanation	**e.g.** The number of rabbits is being multiplied by 1.03 which is greater than 1, so the number of rabbits is increasing	A1		1.3a	R16
c	3%	The number of rabbits is multiplied by 1.03 for each year This is a percentage increase of 3%	A1		1.3a	R9
d		2019 is 2019 − 2015 = 4 years after 2015 $\therefore t = 4$ The number of rabbits that live in the field in 2019 is 2700 × 1.03^4	M1		1.3b	R16
	3039	= 3038.873… This rounds up to 3039 (cannot have less than a whole rabbit & 3038 is not enough)	A1	**5**		
20		Frequency = frequency density × class width For 90 ≤ score < 100, 4 = frequency density × 10 [÷ 10] Frequency density = 0.4	M1		1.3b 2.3a 3.1d	S3
		0.4 represented by 8 squares on y-axis $\therefore$ one square on y-axis represents frequency density $\frac{0.4}{8} = 0.05$	M1			
		For 45 ≤ score < 70, frequency density = 12 × 0.05 = 0.6 Class width = 25	M1			
	15	Frequency = 0.6 × 25 = 15 students	A1	**4**		
21a	2.25 m	Distance = speed × time = area under the graph  Area of a trapezium = $\frac{a+b}{2} \times w$ where a and b are side lengths and w is width of the trapezium Distance in the first section is $\frac{1}{2} \times 0.15 \times 1 = 0.075$ m	M1 starting to find area under curve		1.3a 2.3a 3.1c	A15
		Distance in the second section is $\frac{0.15+0.3}{2} \times 1 = 0.225$ m Distance in the third section is $\frac{0.3+0.5}{2} \times 1 = 0.4$ m Distance in the fourth section is $\frac{0.5+0.75}{2} \times 1 = 0.625$ m Distance in the fifth section is $\frac{0.75+1.1}{2} \times 1 = 0.925$ m	M1 method to find area under curve (at least 2 sections)			
		An estimate for the total distance covered in 5 seconds is 0.075 + 0.225 + 0.4 + 0.625 + 0.925 = 2.25 m	A1			
b	Overestimate [with reason]	**e.g.** The diagonal edges of the triangle and trapeziums are slightly above the curve therefore the estimate from part (a) is and overestimate.	A1	**4**	3.4b	A15
			Total Marks:	**80**		