

Chapter 11 Solution

Exercise 33

1. (a) The coordinates of C
 $= \left(\frac{0+0}{2}, \frac{6+24}{2} \right)$ (A1) for substitution
 $= (0, 15)$ A1 N2 [2]
- (b) 0 A1 N1 [1]
- (c) $y = 15$ A1 N1 [1]
- (d) The distance between A and D is equal to the distance between B and D. A1 N1 [1]
2. (a) (i) (100, 0) A1 N1
- (ii) (0, 50) A1 N1
- (iii) The coordinates of C
 $= \left(\frac{100+0}{2}, \frac{0+50}{2} \right)$ (A1) for substitution
 $= (50, 25)$ A1 N2 [4]
- (b) 2 A1 N1 [1]
- (c) The equation of the perpendicular bisector of AB :
 $y - 25 = 2(x - 50)$ (M1) for substitution
 $y - 25 = 2x - 100$
 $y = 2x - 75$ A1 N2 [2]

3. (a) (i) $\frac{3}{4}$ A1 N1
- (ii) The equation of AB:
 $y - (-6) = \frac{3}{4}(x - 12)$ (M1) for substitution
 $y = \frac{3}{4}x - 15$ A1 N2
- (b) $\frac{3}{4}x - 15 = -\frac{4}{3}x + 35$ (M1) for substitution
 $9x - 180 = -16x + 420$
 $25x = 600$
 $x = 24$
 $y = \frac{3}{4}(24) - 15$ (M1) for substitution
 $y = 3$
Thus, the required coordinates are (24, 3). A1 N3
- (c) Let (a, b) be the coordinates of A.
 $\frac{a+12}{2} = 24$
 $a = 36$
 $\frac{b+(-6)}{2} = 3$
 $b = 12$
Thus, the coordinates of A are (36, 12). A1 N2

[3]

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4. (a) (i) $\frac{4}{3}$ A1 N1
- (ii) The equation of AB:
 $y - 20 = \frac{4}{3}(x - 0)$ (M1) for substitution
 $y = \frac{4}{3}x + 20$ A1 N2
- (b) $\frac{4}{3}b + 20$ A1 N1 [3]
- (c) (i) 25 A1 N1 [1]
- (ii) BC = AC
 $\sqrt{(b - 25)^2 + \left(\left(\frac{4}{3}b + 20\right) - 20\right)^2} = 25$ (A1) for correct equation
 $\sqrt{(b - 25)^2 + \frac{16}{9}b^2} - 25 = 0$
 By considering the graph of
 $y = \sqrt{(b - 25)^2 + \frac{16}{9}b^2} - 25, b = 0$ (*Rejected*)
 or $b = 18$. A1 N2 [3]

Exercise 34

1. (a) The required area

$$= \frac{(3+8)(5)}{2}$$

$$= 27.5 \text{ km}^2$$
(M1) for valid approach
A1 N2 [2]
- (b) (i) The gradient of L

$$= \frac{7-5}{5-1}$$

$$= \frac{1}{2}$$
(M1) for valid approach
A1 N2
- (ii) The equation of L :

$$y-5 = \frac{1}{2}(x-1)$$

$$y = \frac{1}{2}x + \frac{9}{2}$$
(M1) for substitution
A1 N2 [4]
- (c) So Yeon's home is on the boundary separating the Voronoi cells of the restaurant B and the restaurant C, which is equidistant to them.
A1 N1 [1]
2. (a) (i) The gradient of L

$$= \frac{10-7}{6-5}$$

$$= 3$$
(M1) for valid approach
A1 N2
- (ii) The equation of L :

$$y-7 = 3(x-5)$$

$$y = 3x-8$$
(M1) for substitution
A1 N2 [4]
- (b) The police station B
A1 N1 [1]
- (c) $5 < x \leq 10$
A1 N1 [1]

3.	(a)	(i)	<p>The required distance</p> $= \sqrt{(4.15 - 4)^2 + (4 - 2)^2}$ $= 2.005617112$ $= 2.01$	(M1) for valid approach	A1	N2			
		(ii)	2.15		A1	N1			
		(iii)	1.85		A1	N1	[4]		
	(b)	The school C			A1	N1	[1]		
4.	(a)	<p>The mid-point of AC</p> $= \left(\frac{2.5 + 7.5}{2}, \frac{2.5 + 7.5}{2} \right)$ $= (5, 5)$		(A1) for substitution	A1	N2	[2]		
	(b)	$2.5 < x < 5$			A1	N1	[1]		
	(c)	<p>The distance from the park to the fire station A</p> $= \sqrt{(5.5 - 2.5)^2 + (6.5 - 2.5)^2}$ $= 5$ <p>The distance from the park to the fire station B</p> $= \sqrt{(5.5 - 7.5)^2 + (6.5 - 7.5)^2}$ $= 2.236067977$ < 5 <p>Thus, the park lies in the Voronoi cell of the fire station B.</p>		M1	M1	R1	AG	N0	[3]

Exercise 35

1. (a) $x = 5$ A1 N1 [1]
- (b) (i) $(7, 4)$ A1 N1
- (ii) $7 - 2(4) + k = 0$ (M1) for substitution
 $k = 1$ A1 N2
- (iii) $5 - 2y + 1 = 0$ (M1) for substitution
 $6 = 2y$
 $y = 3$
 Thus, the required coordinates are $(5, 3)$. A1 N2 [5]
2. (a) (i) The mid-point of AB
 $= \left(\frac{4+8}{2}, \frac{8+4}{2} \right)$ (A1) for substitution
 $= (6, 6)$ A1 N2
- (ii) $y = x$ A1 N1 [3]
- (b) (i) $x = 5$ A1 N1
- (ii) $(5, 5)$ A1 N1
- (iii) The radius
 $= \sqrt{(5-2)^2 + (5-4)^2}$ (M1) for valid approach
 $= 3.16227766$
 $= 3.16$ A1 N2 [4]

3. (a) (i) The mid-point of AB

$$= \left(\frac{2+8}{2}, \frac{2+8}{2} \right)$$

$$= (5, 5)$$
(A1) for substitution
A1 N2
- (ii) $5+5=k$
 $k=10$
(M1) for substitution
A1 N2
- (b) $x+(-0.5x+9.5)=10$
 $0.5x=0.5$
 $x=1$
 $1+y=10$
 $y=9$
Thus, the required coordinates are (1, 9).
(M1) for substitution
A1 N3
- (c) Every position in the Voronoi cell of B has B to be the nearest supermarket.
A1 N1
4. (a) (i) $x=5$ A1 N1
- (ii) $y=5$ A1 N1
- (b) (i) (6, 6) A1 N1
- (ii) $\frac{k-6}{5-6} = \frac{k-5}{5-k}$
 $\frac{k-6}{-1} = -1$
 $k-6=1$
 $k=7$
(A1) for correct equation
A1 N2
- (iii) The decrease in the area
 $= \frac{(7-5)(7-5)}{2}$
 $= 2$
(M1)(A1) for correct formula
A1 N3

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[1]

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[6]

Exercise 36

1. (a) (i) The radius
 $= \sqrt{(5 - 4.125)^2 + (8 - 5)^2}$ (M1) for valid approach
 $= 3.125$ km A1 N2
- (ii) 3 km A1 N1
- (iii) E A1 N1 [4]
- (b) 13 km A1 N1 [1]
2. (a) (i) The radius
 $= \sqrt{(7 - 5)^2 + (8 - 7.75)^2}$ (M1) for valid approach
 $= 2.015564437$
 $= 2.02$ km A1 N2
- (ii) The radius
 $= \sqrt{(5 - 4)^2 + (4.5 - 3)^2}$ (M1) for valid approach
 $= 1.802775638$
 $= 1.80$ km A1 N2
- (iii) The hotel at E A1 N1 [5]
- (b) The difference
 $= 2\pi(2.015564437) - 2\pi(1.802775638)$ (M1) for valid approach
 $= 1.336991457$
 $= 1.34$ km A1 N2 [2]

3. (a) (i) The radius
 $= \sqrt{(4-2)^2 + (5-2)^2}$ (M1) for valid approach
 $= 3.605551275$
 $= 3.61 \text{ km}$ A1 N2
- (ii) The radius
 $= \sqrt{(8-5)^2 + \left(8 - \frac{17}{3}\right)^2}$ (M1) for valid approach
 $= 3.80058475$
 $= 3.80 \text{ km}$ A1 N2
- (iii) Q A1 N1 [5]
- (b) The farm at B A1 N1 [1]
4. (a) The radius
 $= \sqrt{\left(\frac{14}{3} - 2\right)^2 + \left(\frac{9}{2} - 1\right)^2}$ (M1) for valid approach
 $= 4.400126261$
 $= 4.40 \text{ km}$ A1 N2 [2]
- (b) 4 km A1 N1 [1]
- (c) The percentage error
 $= \left| \frac{4 - \frac{\sqrt{185}}{4}}{\frac{\sqrt{185}}{4}} \right| \times 100\%$ (A1) for correct substitution
 $= 17.63433954\%$
 $= 17.6\%$ A1 N2 [2]