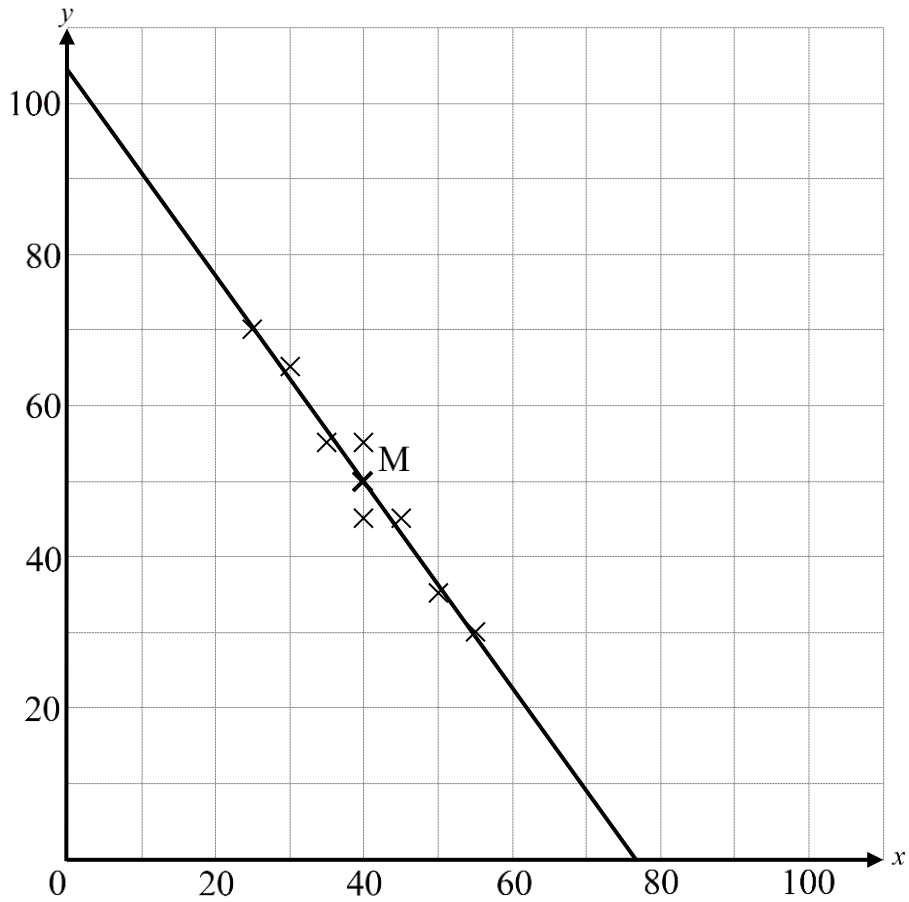


# Chapter 22 Solution

## Exercise 90

1. (a) For correct position A1  
 For labelling A1 N2

[2]



- (b) For passing through M A1  
 For extending the line to the y-axis A1 N2

[2]

- (c) Strong, negative A2 N2

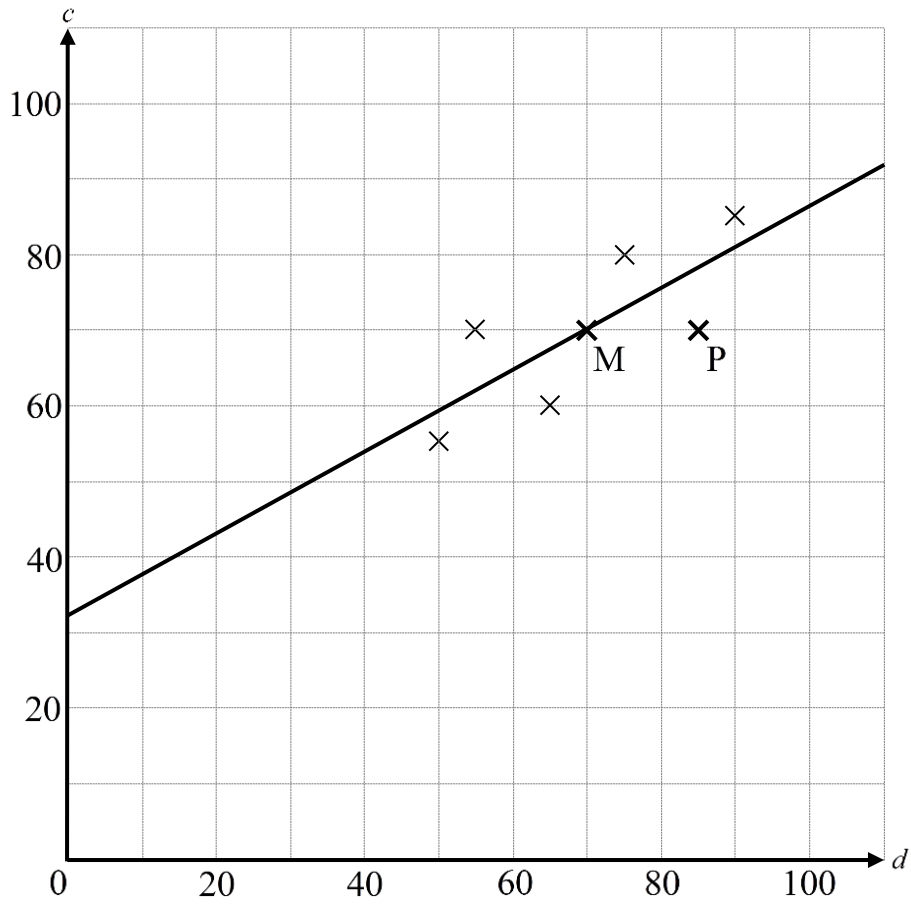
[2]

- (d) 77 A2 N2

[2]

2. (a) For correct position A1  
 For labelling A1 N2

[2]



- (b) (70, 70) A2 N2

[2]

- (c) For correct position and labelling A1 N1

[1]

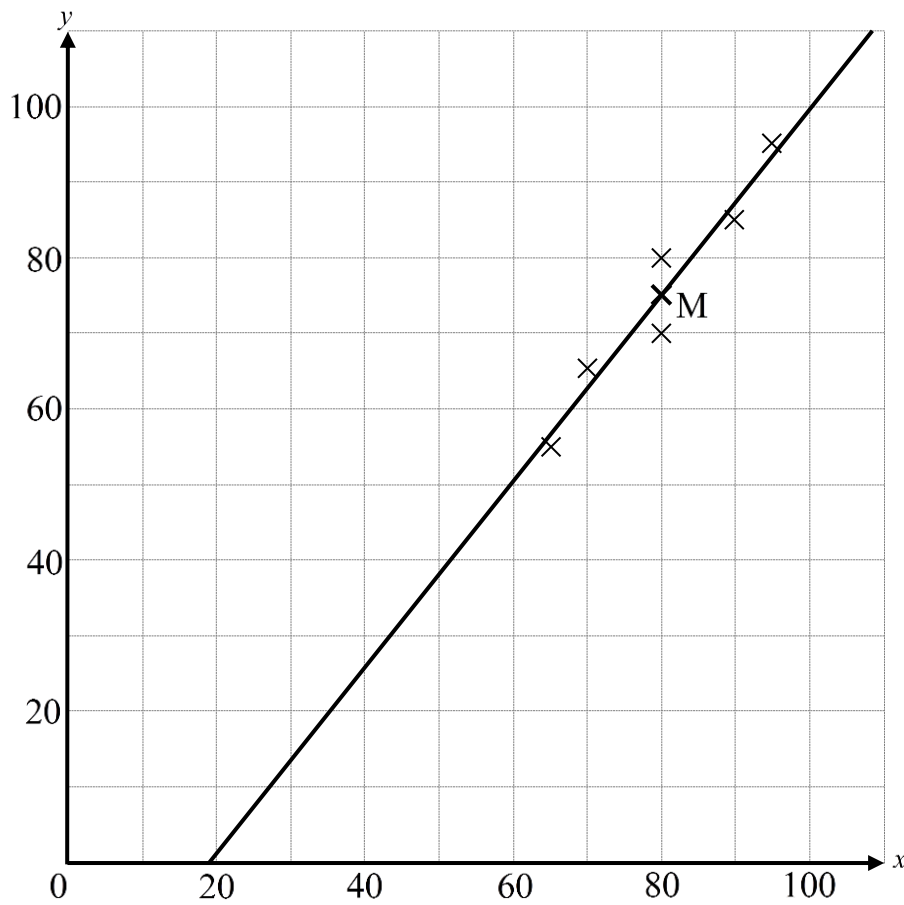
- (d) For passing through M A1  
 For extending the line to the y-axis A1 N2

[2]

3. (a) For correct position  
For labelling

A1  
A1 N2

[2]



- (b) For passing through M  
For extending the line to the  $x$ -axis

A1  
A1 N2

[2]

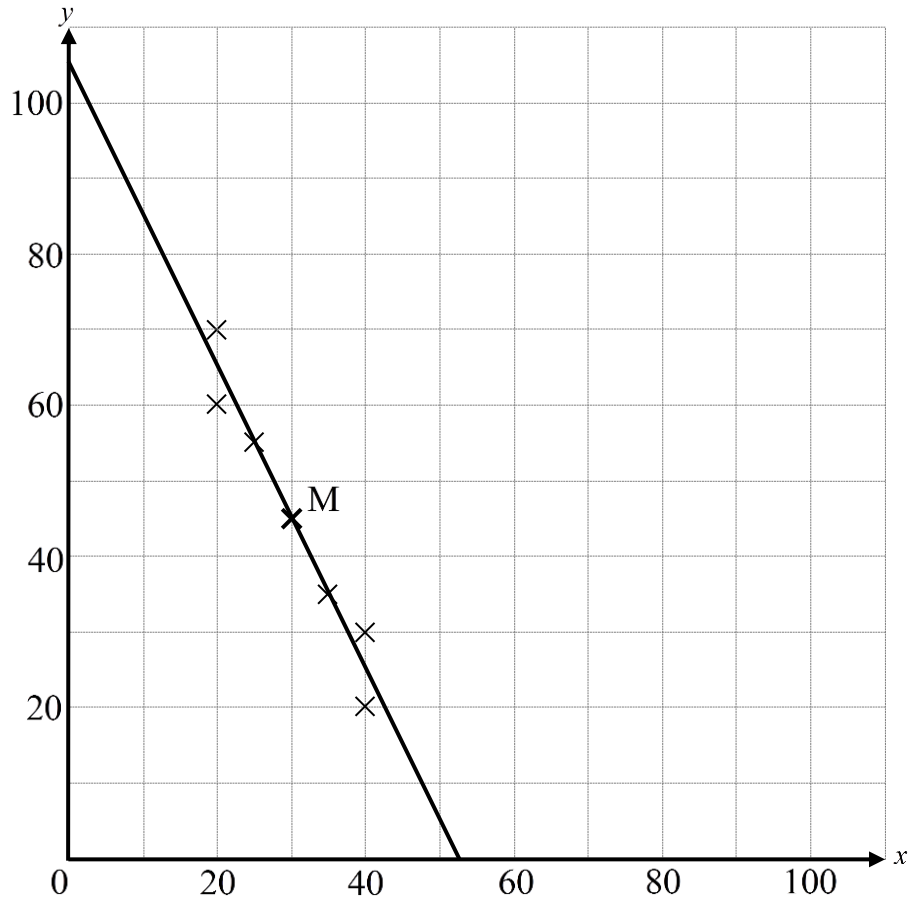
- (c)  $p = 65, q = 95$

A2 N2

[2]

4. (a) For passing through M A1  
 For extending the line to the y-axis A1 N2

[2]



- (b) 15 A2 N2  
 (c)  $p = 20, q = 40$  A2 N2

[2]

[2]

## Exercise 91

1. (a) (i)  $a = 0.2$  A1 N1  
 $b = 52.4$  A1 N1
- (ii) The estimated final exam score  
 $= 0.2(85) + 52.4$  (A1) for substitution  
 $= 69.4$  A1 N2 [4]
- (b) (i)  $r = 0.1832541665$   
 $r = 0.183$  A1 N1
- (ii) Weak, Positive A2 N2 [3]
2. (a) (i)  $a = -2.085714286$   
 $a = -2.09$  A1 N1  
 $b = 96.0952381$   
 $b = 96.1$  A1 N1
- (ii) The estimated temperature  
 $= -2.085714286(9) + 96.0952381$  (A1) for substitution  
 $= 77.32380953$   
 $= 77.3^\circ\text{C}$  A1 N2 [4]
- (b) (i)  $r = -0.6074200776$   
 $r = -0.607$  A1 N1
- (ii) Moderate, Negative A2 N2 [3]

3.	(a)	(i)	$a = 0.7121409922$			
			$a = 0.712$	A1	N1	
			$b = 7.222584856$			
			$b = 7.22$	A1	N1	
		(ii)	The estimated Physics test score			
			$= 0.7121409922(25) + 7.222584856$	(A1) for substitution		
			$= 25.02610966$			
			$= 25.0$	A1	N2	[4]
	(b)		-0.989	A1	N1	[1]
	(c)		The estimated difference			
			$= 0.18(3)$	(M1) for valid approach		
			$= 0.54$	A1	N2	[2]
4.	(a)	(i)	$r = -0.9565269783$			
			$r = -0.957$	A1	N1	
		(ii)	$a = -0.7459677419$			
			$a = -0.746$	A1	N1	
			$b = 6.748252688$			
			$b = 6.75$	A1	N1	[3]
	(b)		0.178	A1	N1	[1]
	(c)		The estimated average number of hours			
			$= 0.53(2.7)$	(A1) for substitution		
			$= 1.431$ hours	A1	N2	[2]

## Exercise 92

1. (a) (i)  $a = 0.1566210046$   
 $a = 0.157$  A1 N1  
 $b = -5.752968037$   
 $b = -5.75$  A1 N1
- (ii)  $a$  represents the average increase of university entrance mark when the public exam score is increased by 1. A1 N1 [3]
- (b) The estimated university entrance mark  
 $= 0.1566210046(180) - 5.752968037$  (A1) for substitution  
 $= 22.43881279$   
 $= 22.4$  A1 N2 [2]
2. (a) (i)  $a = 3.422857143$   
 $a = 3.42$  A1 N1  
 $b = 1.553333333$   
 $b = 1.55$  A1 N1
- (ii)  $b$  represents the expected sales in 2011. A1 N1 [3]
- (b) The estimated sales  
 $= 3.422857143(2.5) + 1.553333333$  (A1) for substitution  
 $= 10.11047619$   
 $= 10.1$  million dollars A1 N2 [2]

3. (a) (i)  $a = 5.978021978$   
 $a = 5.98$  A1 N1  
 $b = 21.58241758$   
 $b = 21.6$  A1 N1
- (ii)  $a$  represents the average increase of number of visitors when the maximum temperature is increased by 1 degree Celsius. A1 N1  
 $b$  represents the expected number of visitors when the maximum temperature is zero degree Celsius. A1 N1 [4]
- (b) The estimated number of visitors  
 $= 5.978021978(4) + 21.58241758$  (A1) for substitution  
 $= 45.49450549$   
 $= 45.5$  A1 N2 [2]
4. (a) (i)  $a = 6.845588235$   
 $a = 6.85$  A1 N1  
 $b = 24.29338235$   
 $b = 24.3$  A1 N1
- (ii)  $a$  represents the average increase of the hardness of a metal ingot when its breaking strength is increased by 1 tonne per cm. A1 N1  
 $b$  represents the expected hardness of a metal ingot when its breaking strength is zero tonne per cm. A1 N1 [4]
- (b) The estimated hardness  
 $= 6.845588235(6) + 24.29338235$  (A1) for substitution  
 $= 65.36691176$   
 $= 65.4$  A1 N2 [2]

### Exercise 93

1. (a) (i) 5.5 A1 N1  
(ii) 4.5 A1 N1 [2]
- (b)  $r_s = 0.0588235294$  (A1) for correct value  
 $r_s = 0.0588$  A1 N2 [2]
- (c) There is a weak agreement between Ravi and Yannick. A1 N1 [1]
2. (a) The average equal ranks of the horse rider D and the horse rider E in Judge 1's ranking is 7.5. (A1) for correct value  
The average equal ranks of the horse rider B and the horse rider C in Judge 2's ranking is 4.5. (A1) for correct value  
 $r_s = 0.8674698795$  (A1) for correct value  
 $r_s = 0.867$  A1 N4 [4]
- (b) There is a strong agreement between the two judges. A1 N1 [1]
3. (a)  $b = 2$ ,  $d = 3$ ,  $f = 5$  and  $g = 4$   
For any two correct answers A1  
For all correct answers A1 N2 [2]
- (b)  $r_s = 0.9047619048$  (A1) for correct value  
 $r_s = 0.905$  A1 N2 [2]
- (c) It is more likely for a team to be at a higher position in the league if it scores more goals. A1 N1 [1]

4. (a)  $r_s = 0.0857142857$  (A1) for correct value  
 $r_s = 0.0857$  A1 N2 [2]
- (b) (i)  $a = 1, e = 5$  A2 N2
- (ii)  $R_y = 0.9$  A1 N1
- (iii) The value of the Spearman's rank correlation coefficient increases. A1 N1 [4]

### Exercise 94

- |    |     |   |                              |    |     |
|----|-----|---|------------------------------|----|-----|
| 1. | (a) | The values of the first variable are not quantifiable data.   | A1                           | N1 | [1] |
|    | (b) | $r_s = 0.8$   | A2                           | N2 | [2] |
|    | (c) | It is more likely for a type of ice cream to have a higher ranking if its selling price is higher.  | A1                           | N1 | [1] |
| 2. | (a) | The values of the data are not linear.  | A1                           | N1 | [1] |
|    | (b) | $r_s = -0.8333333333$<br>$r_s = -0.833$   | (A1) for correct value<br>A1 | N2 | [2] |
|    | (c) | It is more likely to have a lower score in Geography test if the score in Chemistry test is higher. | A1                           | N1 | [1] |
| 3. | (a) | The positions of teams in the league are not quantifiable data.                                     | A1                           | N1 | [1] |
|    | (b) | $p = 5.5, q = 7$  | A2                           | N2 | [2] |
|    | (c) | $r_s = 0.9461247469$<br>$r_s = 0.946$   | (A1) for correct value<br>A1 | N2 | [2] |
|    | (d) | 1, 2, 3, 4 and 5  | A1                           | N1 | [1] |

4. (a)  $r = 0.8140243902$  (A1) for correct value  
 $r = 0.814$  A1 N2 [2]
- (b) (i)  $b = a - 2$  A1 N1
- (ii)  $g = a + 3$  A1 N1 [2]
- (c)  $r_s = 0.8928571429$  (A1) for correct value  
 $r_s = 0.893$  A1 N2 [2]
- (d) The rank of the score of the diver B awarded by the  
trainee judge is unchanged. A1 N1 [1]

## Exercise 95

1. (a) (i)  $r = 0.8597409868$  (A1) for correct value  
 $r = 0.860$  A1 N2
- (ii)  $a = 0.0036032243$   
 $a = 0.00360$  A1 N1  
 $b = -0.6258602021$   
 $b = -0.626$  A1 N1
- [4]
- (b) The estimated monthly honey production  
 $= 0.0036032243(700) - 0.6258602021$  (A1) for substitution  
 $= 1.896396808$  (A1) for correct value  
 $= 1.9$  kg A1 N3
- [3]
- (c) The monthly honey production  
 $= 1.896396808 \times (1 + 2\%)^{12}$  (M1)(A1) for substitution  
 $= 1.896396808 \times 1.02^{12}$  (A1) for simplification  
 $= 2.405089691$   
 $= 2.41$  kg A1 N4
- [4]
- (d)  $1.896396808 \times (1 + 2\%)^t = 3$  (M1) for setting equation  
 $1.896396808 \times 1.02^t - 3 = 0$  (A1) for simplification  
 By considering the graph of  
 $y = 1.896396808 \times 1.02^t - 3$ ,  $t = 23.161402$ . (A1) for correct value  
 Thus, the year is 2019. A1 N4
- [4]

2. (a) (i)  $r = 0.9822040739$  (A1) for correct value  
 $r = 0.982$  A1 N2
- (ii)  $a = 2.5625$  A1 N1  
 $b = 6.375$  A1 N1
- [4]
- (b) The estimated monthly honey production  
 $= 2.5625(24) + 6.375$  (A1) for substitution  
 $= 67.875$  (A1) for correct value  
 $= 68 \text{ kg}$  A1 N3
- [3]
- (c) The monthly consumption of chicken food  
 $= 67.875 \times (1 + 5\%)^6$  (M1)(A1) for substitution  
 $= 67.875 \times 1.05^6$  (A1) for simplification  
 $= 90.95899161$   
 $= 91.0 \text{ kg}$  A1 N4
- [4]
- (d)  $67.875 \times (1 + 5\%)^t = 100$  (M1) for setting equation  
 $67.875 \times 1.05^t - 100 = 0$  (A1) for simplification  
By considering the graph of  
 $y = 67.875 \times 1.05^t - 100$ ,  $t = 7.9422239$ . (A1) for correct value  
Thus, the time is February 2019. A1 N4
- [4]

3. (a) (i)  $r = 0.9823629148$  (A1) for correct value  
 $r = 0.982$  A1 N2
- (ii)  $a = 14.06320542$   
 $a = 14.1$  A1 N1  
 $b = 188.3205418$   
 $b = 188$  A1 N1 [4]
- (b) The estimated number of wolves  
 $= 14.06320542(11) + 188.3205418$  (A1) for substitution  
 $= 343.0158014$  (A1) for correct value  
 $= 343$  A1 N3 [3]
- (c)  $f(10) = 930$  (M1) for setting equation  
 $930 = 50(e^{0.01k(10)} + 2)$  (A1) for substitution  
 $930 - 50(e^{0.1k} + 2) = 0$   
By considering the graph of  $y = 930 - 50(e^{0.1k} + 2)$ ,  
 $k = 28.094027$ .  
 $\therefore k = 28.1$  A1 N3 [3]
- (d)  $14.06320542t + 188.3205418$   
 $= 50(e^{0.01(28.094027)t} + 2)$  (M1) for setting equation  
 $14.06320542t + 188.3205418 = 50e^{0.28094027t} + 100$  (A1) for correct working  
 $50e^{0.28094027t} - 14.06320542t - 88.3205418 = 0$   
By considering the graph of  
 $y = 50e^{0.28094027t} - 14.06320542t - 88.3205418$ ,  
 $t = 3.6593917$ . (A1) for correct value  
Thus, the year is 1984. A1 N4 [4]

4. (a) (i)  $r = -0.925877311$  (A1) for correct value  
 $r = -0.926$  A1 N2
- (ii)  $a = -1.172413793$   
 $a = -1.17$  A1 N1  
 $b = 58.75862069$   
 $b = 58.8$  A1 N1
- [4]
- (b) The estimated number of breaths per minute  
 $= -1.172413793(12) + 58.75862069$  (A1) for substitution  
 $= 44.68965517$  (A1) for correct value  
 $= 45$  A1 N3
- [3]
- (c)  $v(8) = 75$  (M1) for setting equation  
 $75 = \frac{10}{e^{8k}} + 70$  (A1) for substitution  
 $5 - \frac{10}{e^{8k}} = 0$
- By considering the graph of  $y = 5 - \frac{10}{e^{8k}}$ ,  
 $k = 0.0866434$ .  
 $\therefore k = 0.0866$  A1 N3
- [3]
- (d)  $\frac{10}{e^{0.0866434t}} + 70$  (M1) for setting equation  
 $= 1.5(-1.172413793t + 58.75862069)$
- $\frac{10}{e^{0.0866434t}} + 70 = -1.75862069t + 88.13793104$  (A1) for correct working  
 $\frac{10}{e^{0.0866434t}} + 1.75862069t - 18.13793104 = 0$
- By considering the graph of  
 $y = \frac{10}{e^{0.0866434t}} + 1.75862069t - 18.13793104$ ,  
 $t = 7.2902653$ . (A1) for correct value  
Thus, the time is after 7.29 minutes. A1 N4
- [4]