

# Markscheme

**May 2022**

**Mathematics:  
applications and interpretation**

**Standard level**

**Paper 2**

1. (a) (i) 0.58 (s) A1  
 (ii) 0.7 – 0.42 (A1)(M1)

**Note:** Award **A1** for correct quartiles seen, **M1** for subtraction of their quartiles.

0.28 s A1  
[4 marks]

- (b) 9 (people have reaction time  $\leq 0.4$ ) (A1)  
 31 (people have reaction time  $> 0.4$ ) A1  
[2 marks]

- (c)  $(90\% \times 40 =) 36$  **OR** 4 (A1)  
 0.8 s A1  
[2 marks]

- (d) (i)  $(a =) 6$  A1  
 (ii)  $(b =) 4$  A1  
[2 marks]

- (e)  $0.6 < t \leq 0.8$  A1  
[1 mark]

- (f) 0.55 s A2  
[2 marks]

- (g) the mean will increase A1  
 because the incorrect reaction times are moving from a lower interval  
 to a higher interval which will increase the numerator of the mean calculation R1  
  
 the median will stay the same A1  
 because the median or middle of the data is greater than both intervals  
 being changed R1

**Note:** Do not award **A1R0**.

[4 marks]  
**Total [17 marks]**

2. (a) (i) EITHER

$$115.5 = u_1 + (3-1) \times d \quad (115.5 = u_1 + 2d)$$

$$108 = u_1 + (8-1) \times d \quad (108 = u_1 + 7d) \quad (M1)(A1)$$

**Note:** Award **M1** for attempting to use the arithmetic sequence term formula, **A1** for both equations correct. Working for **M1** and **A1** can be found in parts (i) or (ii).

$$(d = -1.5)$$

1.5 (cups/day) **A1**

**Note:** Answer must be written as a positive value to award **A1**.

OR

$$(d =) \frac{115.5 - 108}{5} \quad (M1)(A1)$$

**Note:** Award **M1** for attempting a calculation using the difference between term 3 and term 8; **A1** for a correct substitution.

$$(d =) 1.5 \text{ (cups/day)} \quad \mathbf{A1}$$

(ii)  $(u_1 =) 118.5 \text{ (cups)}$  **A1**

[4 marks]

(b) attempting to substitute their values into the term formula for arithmetic sequence equated to zero **(M1)**

$$0 = 118.5 + (n-1) \times (-1.5)$$

$$(n =) 80 \text{ days} \quad \mathbf{A1}$$

**Note:** Follow through from part (a) only if their answer is positive.

[2 marks]

(c)  $(t_5 =) 625 \times 1.064^{(5-1)}$  **(M1)(A1)**

**Note:** Award **M1** for attempting to use the geometric sequence term formula; **A1** for a correct substitution

$$\text{\$ } 801 \quad \mathbf{A1}$$

**Note:** The answer must be rounded to a whole number to award the final **A1**.

[3 marks]

continued...

Question 2 continued

(d) (i)  $(S_{10} =)$  (\$) 8390 (8394.39...) **A1**

(ii) **EITHER**

the total cost (of dog food) **R1**  
 for 10 years beginning in 2021 **OR** 10 years before 2031 **R1**

**OR**

the total cost (of dog food) **R1**  
 from 2021 to 2030 (inclusive) **OR** from 2021 to (the start of) 2031 **R1**

**[3 marks]**

(e) **EITHER**

According to the model, the cost of dog food per year will eventually be too high to keep a dog.

**OR**

The model does not necessarily consider changes in inflation rate.

**OR**

The model is appropriate as long as inflation increases at a similar rate.

**OR**

The model does not account for changes in the amount of food the dog eats as it ages/becomes ill/stops growing.

**OR**

The model is appropriate since dog food bags can only be bought in discrete quantities.

**R1**

**Note:** Accept reasonable answers commenting on the appropriateness of the model for the specific scenario. There should be a reference to the given context. A reference to the geometric model must be clear: either “model” is mentioned specifically, or other mathematical terms such as “increasing” or “discrete quantities” are seen. Do not accept a contextual argument in isolation, e.g. “The dog will eventually die”.

**[1 mark]**

**Total [13 marks]**

3. (a)  $\left(\frac{2+6}{2}, \frac{2+0}{2}\right)$  (M1)  
 (4, 1) A1

**Note:** Award **A0** if parentheses are omitted in the final answer.

[2 marks]

- (b) attempt to substitute values into gradient formula (M1)  
 $\left(\frac{0-2}{6-2} = -\frac{1}{2}\right)$  (A1)  
 therefore the gradient of perpendicular bisector is 2 (M1)  
 so  $y-1 = 2(x-4)$  ( $y = 2x-7$ ) A1

[4 marks]

- (c) identifying the correct equations to use: (M1)  
 $y = 2 - x$  and  $y = 2x - 7$   
 evidence of solving their correct equations or of finding intersection point graphically (M1)  
 (3, -1) A1

**Note:** Accept an answer expressed as " $x = 3, y = -1$ ".

[3 marks]

- (d) attempt to use distance formula (M1)  
 $YZ = \sqrt{(7 - (-1))^2 + (7 - 3)^2}$   
 $= \sqrt{80}$  ( $4\sqrt{5}$ ) A1

[2 marks]

- (e) **METHOD 1 (cosine rule)**  
 length of XZ is  $\sqrt{80}$  ( $4\sqrt{5}, 8.94427\dots$ ) (A1)

**Note:** Accept 8.94 and 8.9.

- attempt to substitute into cosine rule (M1)  
 $\cos \hat{X}YZ = \frac{80 + 32 - 80}{2 \times \sqrt{80} \sqrt{32}}$  (= 0.316227...) (A1)

**Note:** Award **A1** for correct substitution of XZ, YZ,  $\sqrt{32}$  values in the cos rule. Exact values do not need to be used in the substitution.

- $(\hat{X}YZ =) 71.6^\circ$  ( $71.5650\dots^\circ$ ) A1

**Note:** Last **A1** mark may be lost if prematurely rounded values of XZ, YZ and/or XY are used.

continued...

Question 3 continued

**METHOD 2 (splitting isosceles triangle in half)**

length of XZ is  $\sqrt{80}$  ( $4\sqrt{5}$ , 8.94427...) **(A1)**

**Note:** Accept 8.94 and 8.9.

required angle is  $\cos^{-1}\left(\frac{\sqrt{32}}{2\sqrt{80}}\right)$  **(M1)(A1)**

**Note:** Award **A1** for correct substitution of XZ (or YZ),  $\frac{\sqrt{32}}{2}$  values in the cos rule.  
Exact values do not need to be used in the substitution.

$(\hat{X}\hat{Y}\hat{Z} =) 71.6^\circ$  ( $71.5650^\circ$ ) **A1**

**Note:** Last **A1** mark may be lost if prematurely rounded values of XZ, YZ and/or XY are used.

**[4 marks]**

(f) (area =)  $\frac{1}{2}\sqrt{80}\sqrt{32}\sin 71.5650\dots$  **OR** (area =)  $\frac{1}{2}\sqrt{32}\sqrt{72}$  **(M1)**

= 24 km<sup>2</sup> **A1**  
**[2 marks]**

(g) *Any sensible answer such as:*  
There might be factors other than proximity which influence shopping choices.  
A larger area does not necessarily result in an increase in population.  
The supermarkets might be specialized / have a particular clientele who visit even if other shops are closer.  
Transport links might not be represented by Euclidean distances.  
etc.

**R1**  
**[1 mark]**  
**Total [18 marks]**

4. (a) (i) an attempt to find the amplitude (M1)  
 $\frac{61.8}{2}$  OR  $\frac{64.5-2.7}{2}$   
 (a =) 30.9 m A1

**Note:** Accept an answer of (a =) -30.9 m.

- (ii) (period =  $\frac{60}{1.5}$  =) 40 (s) (A1)  
 ((b =)  $\frac{360^\circ}{40}$ )  
 (b =) 9 A1

**Note:** Accept an answer of (b =) -9.

- (iii) attempt to find  $d$  (M1)  
 (d =)  $30.9 + 2.7$  OR  $\frac{64.5 + 2.7}{2}$   
 (d =) 33.6 m A1  
[6 marks]

- (b)  $12 \times 1.5$  OR  $\frac{12 \times 60}{40}$  (M1)  
 18 (revolutions per ride) A1  
[2 marks]

- (c) (i)  $0 \leq t \leq 720$  A1  
 (ii)  $2.7 \leq h \leq 64.5$  A1A1

**Note:** Award **A1** for correct endpoints of domain and **A1** for correct endpoints of range. Award **A1** for correct direction of both inequalities.

[3 marks]

- (d) graph of  $h(t)$  and  $y = 16.7$  OR  $h(t) = 16.7$  (M1)  
 6.31596... and 33.6840... (A1)  
 27.4 (s) (27.3680...) A1  
[3 marks]

continued...

Question 4 continued

(e) (i)  $d$  **A1**

(ii) **EITHER**  
 $d + 30.9 = 65.2$  **(A1)**

**OR**  
 $65.2 - (61.8 + 2.7) = 0.7$  **(A1)**

**OR**  
3.4 (new platform height) **(A1)**

**THEN**  
 $(d =) 34.3 \text{ m}$  **A1**

**[3 marks]**  
**Total [17 marks]**



5. (a) attempt to expand given expression **(M1)**

$$C = \frac{xk^2}{10} - \frac{3x^3}{1000}$$

$$\frac{dC}{dx} = \frac{k^2}{10} - \frac{9x^2}{1000}$$

**M1A1**

**Note:** Award **M1** for power rule correctly applied to at least one term and **A1** for correct answer.

**[3 marks]**

- (b) equating their  $\frac{dC}{dx}$  to zero **(M1)**

$$\frac{k^2}{10} - \frac{9x^2}{1000} = 0$$

$$x^2 = \frac{100k^2}{9}$$

$$x = \frac{10k}{3}$$

**(A1)**

substituting their  $x$  back into given expression

**(M1)**

$$C_{\max} = \frac{10k}{30} \left( k^2 - \frac{300k^2}{900} \right)$$

$$C_{\max} = \frac{2k^3}{9} (0.222\dots k^3)$$

**A1**

**[4 marks]**

- (c) (i) substituting 20 into given expression and equating to 426 **M1**

$$426 = \frac{20}{10} \left( k^2 - \frac{3}{100} (20)^2 \right)$$

$$k = 15$$

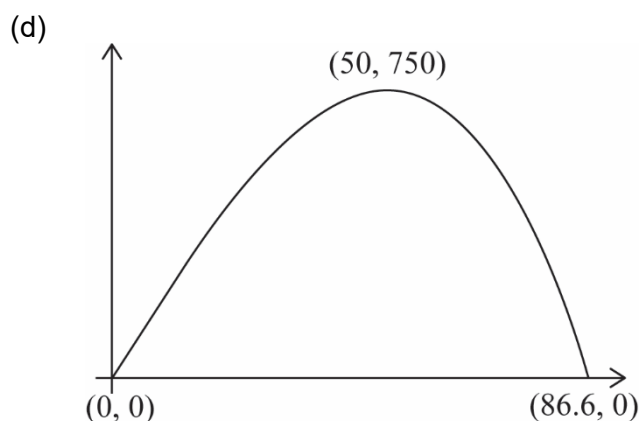
**A1**

- (ii) 50 **A1**

**[3 marks]**

*continued...*

Question 5 continued



**A1A1A1**

**Note:** Award **A1** for graph drawn for positive  $x$  indicating an increasing and then decreasing function, **A1** for maximum labelled and **A1** for graph passing through the origin and 86.6, marked on the  $x$ -axis or whose coordinates are given.

**[3 marks]**

(e) setting their expression for  $C$  to zero **OR** choosing correct  $x$ -intercept on their graph of  $C$

$x_{\max} = 86.6$  (86.6025...) litres

**(M1)**

**A1**

**[2 marks]**

**Total [15 marks]**

---