Exam Booklet

1

(a)
- Area of 3 trapeziums: Strip $1 \approx 30$, Strip $2 \approx 80$, Strip $3 \approx 112.5$ **M1**
- Sum of areas: $30 + 80 + 112.5 = 222.5$ (approx) **M1**
- Final answer in range $220 - 225$ **A1**

(b)
- The distance travelled in the first 15 seconds. **B1**

(Total for question 1 is 4 marks)

2

(a)
- acceleration = gradient **M1**
- $\frac{\text{change in } y}{\text{change in } x} = \frac{9-1}{2-0} = \frac{8}{2} = 4$ **A1**
- Final answer: $4\ \text{ms}^{-2}$

(b)
- total distance = area under graph **M1**
- Area of trapezium + Area of rectangle: $\frac{1+9}{2} \times 2 + (10-2) \times 9 = 10 + 72 = 82$ **A1**
- Final answer: $82\ \text{m}$

(Total for question 2 is 4 marks)

3

(a)
- Width $= 2$s. Heights at $t = 0, 2, 4, 6, 8, 10$ are $0, 7.2, 11.6, 14.4, 16.2, 17.0$ **M1**
- Area $\approx 2 \times [\frac{0+7.2}{2} + \frac{7.2+11.6}{2} + \frac{11.6+14.4}{2} + \frac{14.4+16.2}{2} + \frac{16.2+17.0}{2}]$ **M1**
- Area $\approx 7.2 + 18.8 + 26.0 + 30.6 + 33.2 = 115.8$ **A1**

(b)
- Underestimate. The curve is concave down, so the straight lines of the trapeziums lie below the curve. **B1**

(Total for question 3 is 4 marks)

4

(a)
- Average acceleration $= \frac{\text{Total change in velocity}}{\text{Total time}}$ **M1**
- $\frac{30-0}{50} = 0.6\ \text{m s}^{-2}$ **A1**

(b)
- Draw a tangent parallel to the chord (average acceleration line) **M1**
- Identify the time at the point of tangency: 12 seconds (accept 11-13) **A1**

(Total for question 4 is 4 marks)

5

(a)
- Draw a tangent at $t = 8$ **M1**
- Calculate the gradient of the tangent: e.g., $\frac{-6}{4} = -1.5$ **A1**

(b)
- Width of each strip = 2s. Heights at $t = 0, 2, 4, 6, 8, 10$ are $0, 5, 12, 15, 14, 10$ **M1**
- Area $\approx 2 \times [\frac{0+5}{2} + \frac{5+12}{2} + \frac{12+15}{2} + \frac{15+14}{2} + \frac{14+10}{2}]$ **M1**
- Area $\approx 2 \times [2.5 + 8.5 + 13.5 + 14.5 + 12] = 102$ **A1**

(Total for question 5 is 5 marks)

6
- Convert 0.8 km to 800 m **B1**
- Area for first 60 s $= \frac{1}{2}(10)(10) + (50)(10) = 50 + 500 = 550$ m **M1**
- Area of final deceleration phase = $800 - 550 = 250$ m. $\frac{1}{2}(T - 60)(10) = 250 \Rightarrow 5(T - 60) = 250 \Rightarrow T - 60 = 50 \Rightarrow T = 110$ **A1**

(Total for question 6 is 3 marks)

7

(a)
- Total area = 600 m **M1**
- Let v be max speed. Area = $\frac{6v}{2} + (40.2 - 6)v = 600$ **M1**
- $3v + 34.2v = 600 \Rightarrow 37.2v = 600$ **M1**
- $v = \frac{600}{37.2} = 16.1$ ms^{-1} (3sf) **A1**

(b)
- Area of triangle = $\frac{1}{2} \times$ base $\times$ height **M1**
- $\frac{6 \times 16.129...}{2} = 48.4$ m (3sf) **A1**

(Total for question 7 is 6 marks)

Worksheet

1

(a)
- Area of 3 trapeziums: Strip $1 \approx 1.2$, Strip $2 \approx 3.1$, Strip $3 \approx 4.2$ **M1**
- Sum of areas: $1.2 + 3.1 + 4.2 = 8.5$ (approx) **M1**
- Final answer in range $8.4 - 8.6$ **A1**

(b)
- The distance travelled in the first 3 seconds. **B1**

(Total for question 1 is 4 marks)

2

(a)

- acceleration = gradient **M1**
- $\frac{\text{change in } y}{\text{change in } x} = \frac{8-2}{6-0} = \frac{6}{6} = 1$ **A1**
- Final answer: $1\ \text{ms}^{-2}$

(b)

- total distance = area under graph **M1**
- Area of trapezium + Area of rectangle: $\frac{2+8}{2} \times 6 + (10-6) \times 8 = 30 + 32 = 62$ **A1**
- Final answer: $62\ \text{m}$

(Total for question 2 is 4 marks)

3

(a)

- Width = 5s. Heights are $0, 14, 22, 27, 30, 32$ **M1**
- Area $\approx 5 \times [\frac{0+14}{2} + \frac{14+22}{2} + \frac{22+27}{2} + \frac{27+30}{2} + \frac{30+32}{2}]$ **M1**
- Area $\approx 35 + 90 + 122.5 + 142.5 + 155 = 545$ **A1**

(b)

- Underestimate. The straight edges of the trapeziums lie below the curve since the rate of increase of speed is decreasing (concave down). **B1**

(Total for question 3 is 4 marks)

4

(a)

- Draw a tangent at $t = 5$ **M1**
- Calculate the gradient of the tangent: e.g., $\frac{10}{8} = 1.25$ **A1**

(b)

- Width of each strip = 4s. Heights at $t = 0, 4, 8, 12, 16, 20$ are $0, 10, 15, 12, 6, 0$ **M1**
- Area $\approx 4 \times [\frac{0+10}{2} + \frac{10+15}{2} + \frac{15+12}{2} + \frac{12+6}{2} + \frac{6+0}{2}]$ **M1**
- Area $\approx 4 \times [5 + 12.5 + 13.5 + 9 + 3] = 172$ **A1**

(Total for question 4 is 5 marks)
