

1

- (a)
- Use cosine rule: $x^2 = 12^2 + 15^2 - 2(12)(15) \cos(60)$ (M1)
 - $x^2 = 189$ (M1)
 - $x = 13.7 \text{ cm}$ (3sf) (A1)
- (b)
- Use area formula: $\text{Area} = \frac{1}{2}(12)(15) \sin(60)$ (M1)
 - $\text{Area} = 77.9 \text{ cm}^2$ (3sf) (A1)

(Total for question 1 is 5 marks)

2

- (a)
- Use cosine rule: $\cos \theta = \frac{8^2 + 7^2 - 6^2}{2(8)(7)}$ (M1)
 - $\cos \theta = \frac{11}{16}$ (M1)
 - $\theta = 46.6^\circ$ (3sf) (A1)
- (b)
- Use area formula: $\text{Area} = \frac{1}{2}(8)(7) \sin(46.567)$ (M1)
 - $\text{Area} = 20.3 \text{ cm}^2$ (3sf) (A1)

(Total for question 2 is 5 marks)

3

- (a)
- Use $\sin^2 \theta + \cos^2 \theta = 1$ or right-angled triangle: $x^2 + 2^2 = 3^2 \Rightarrow x = \sqrt{5}$ (M1)
 - $\cos(DEF) = \frac{\sqrt{5}}{3}$ (A1)
- (b)
- Use cosine rule: $DF^2 = 5^2 + 6^2 - 2(5)(6) \left(\frac{\sqrt{5}}{3}\right)$ (M1)
 - $DF^2 = 61 - 20\sqrt{5}$ (M1)
 - $DF^2 = 16.2786\dots$ (M1)
 - $DF = 4.03 \text{ cm}$ (3sf) (A1)
- (c)
- Use sine rule: $\frac{\sin \theta}{5} = \frac{2/3}{4.03}$ (M1)
 - $\sin \theta = 0.826\dots$ (M1)
 - $\theta = 55.7^\circ$ (3sf) (A1)

(Total for question 3 is 9 marks)

4

- (a)
- $30 = \frac{1}{2}(9)(10) \sin P \Rightarrow \sin P = \frac{2}{3}$ (M1)
 - $P = 41.8^\circ$ (M1)
 - $QR^2 = 9^2 + 10^2 - 2(9)(10) \cos(41.8)$ (M1)
 - $QR^2 = 46.8359$ (M1)
 - $QR = 6.84 \text{ cm}$ (A1)
- (b)
- $\frac{\sin Q}{10} = \frac{\sin(41.8)}{6.84}$ (M1)
 - $\sin Q = 0.974$ (M1)
 - $Q = 76.9^\circ$ (A1)

(Total for question 4 is 8 marks)

5

- $\frac{\sin C}{13} = \frac{\sin 30}{10} \Rightarrow \sin C = \frac{13}{20}$ (M1)
- $C = 40.54^\circ$ or 139.46° (M1)
- For $C = 40.54$, $B = 180 - 30 - 40.54 = 109.46^\circ$ (M1)
- For $C = 139.46$, $B = 180 - 30 - 139.46 = 10.54^\circ$ (M1)
- 10.54° and 109.46° (A2)

(Total for question 5 is 6 marks)

6

- $(x+2)^2 = (x+3)^2 + x^2 - 2(x+3)(x) \cos(60)$ (M1)
- $x^2 + 4x + 4 = x^2 + 6x + 9 + x^2 - (x^2 + 3x)$ (M1)
- $x^2 + 4x + 4 = x^2 + 3x + 9$ (M1)
- $x = 5$ (A2)

(Total for question 6 is 5 marks)

7

- (a)
- $18 = \frac{1}{2}(6)(10) \sin \theta$ (M1)
 - $\sin \theta = \frac{18}{30} = \frac{3}{5}$ (A1)
 - $\theta = 36.9^\circ$ or 143.1° (A2)
- (b)
- Longest side implies largest angle, so $\theta = 143.1^\circ$ (M1)
 - $x^2 = 6^2 + 10^2 - 2(6)(10) \cos(143.1)$ (M1)
 - $x^2 = 232$ (M1)
 - $x = 15.2 \text{ cm}$ (A1)

(Total for question 7 is 8 marks)

8

- (a)
- $\frac{1}{2}(2x)(3x) \sin 30 = 12$ (M1)
 - $3x^2(0.5) = 12 \Rightarrow 1.5x^2 = 12$ (M1)
 - $x^2 = 8 \Rightarrow x = \sqrt{8}$ or $2\sqrt{2}$ (A1)
- (b)
- $AB = 4\sqrt{2}$, $AC = 6\sqrt{2}$ (M1)
 - $BC^2 = (4\sqrt{2})^2 + (6\sqrt{2})^2 - 2(4\sqrt{2})(6\sqrt{2}) \cos(30)$ (M1)
 - $BC = 4.57$ cm (A1)

(Total for question 8 is 6 marks)

9

- (a)
- $\frac{\sin \theta}{12} = \frac{\sin 25}{8} \Rightarrow \sin \theta = 0.6339...$ (M1)
 - $\theta = 39.3^\circ$ or 140.7° (M1)
 - ABD is obtuse from diagram, so 140.7° (A1)
- (b)
- $\angle BDC = 180 - 2(25) = 130$ (incorrect logic in solution, solution uses $\angle ADC = 115.7$) (M1)
 - $\angle ADC = 180 - 25 - 39.3 = 115.7^\circ$ (M1)
 - $\frac{AC}{\sin 115.7} = \frac{8}{\sin 25} \Rightarrow AC = 17.1$ cm (A1)

(Total for question 9 is 6 marks)

10

- (a)
- Area of triangle $ABC = 27.5$ (M1)
 - $27.5 = \frac{1}{2}(5)(12) \sin x \Rightarrow \sin x = \frac{11}{12}$ (M1)
 - $x = 66.44^\circ$ or 113.56° . Obtuse $\therefore 113.56^\circ$ (A1)
- (b)
- $AC^2 = 5^2 + 12^2 - 2(5)(12) \cos(113.6)$ (M1)
 - $AC = 14.7$ cm (A1)

(Total for question 10 is 5 marks)

11

- (a)
- $\frac{\sin C}{12} = \frac{\sin 40}{10} \Rightarrow \sin C = 0.7713...$ (M1)
 - $C = 50.5^\circ$ (A1)
 - $C = 180 - 50.5 = 129.5^\circ$ (A2)
- (b)
- $\frac{1}{2}(BC)(12) \sin 40 = 75\sqrt{2}$ (M1)
 - $BC = \frac{75\sqrt{2}}{6 \sin 40} = 27.5$ cm (A1)

(Total for question 11 is 6 marks)

- 12
- $\angle B = 180 - 24 - 39 = 117^\circ$ (M1)
 - $\frac{x}{\sin 24} = \frac{40}{\sin 117} \Rightarrow x = 18.26$ (M1)
 - $\text{Area} = \frac{1}{2}(40)(18.26) \sin 39 = 230 \text{ cm}^2$ (A1)

(Total for question 12 is 3 marks)

- 13
- Sine curve shape (B1)
 - Shifted up by 1 unit (starts at (0,1), max at (90,2), min at (270,0)) (B2)

(Total for question 13 is 3 marks)

- 14
- Cosine curve shape (B1)
 - Shifted left by 90 degrees (starts at (0,0), min at (90,-1), max at (270,1)) (B2)

(Total for question 14 is 3 marks)

- 15
- (a)
- $13^2 = AC^2 + 15^2 - 2(AC)(15) \cos(60)$ (M1)
 - $169 = AC^2 + 225 - 15AC \Rightarrow AC^2 - 15AC + 56 = 0$ (M1)
 - $(AC - 8)(AC - 7) = 0 \Rightarrow AC = 8 \text{ or } 7$. From diagram AC is the longer segment, so $AC = 8$ (A1)
- (b)
- AB is the other root of the quadratic: $AB = 7 \text{ cm}$ (B1)

(Total for question 15 is 4 marks)

- 16
- $BC^2 = 5^2 + 8^2 - 2(5)(8) \cos(60) = 49 \Rightarrow BC = 7$ (M1)
 - $\angle BDC = 180 - 75 - 60 = 45^\circ$ (M1)
 - $\frac{BD}{\sin 60} = \frac{7}{\sin 45}$ (M1)
 - $BD = \frac{7 \times \sqrt{3}/2}{\sqrt{2}/2} = \frac{7\sqrt{3}}{\sqrt{2}} = \frac{7\sqrt{6}}{2}$ (A1)

(Total for question 16 is 4 marks)

17

- (a)
- $\frac{1}{2}xy \sin 60 = 2\sqrt{3}(x + y)$ (M1)
 - $\frac{1}{2}xy(\frac{\sqrt{3}}{2}) = 2\sqrt{3}(x + y) \Rightarrow \frac{\sqrt{3}}{4}xy = 2\sqrt{3}(x + y)$ (M1)
 - $xy = 8(x + y) \Rightarrow xy = 8x + 8y$ (A1)
- (b)
- AC is diameter $\Rightarrow \angle ABC = 90^\circ$ (M1)
 - $\cos 60 = \frac{x}{y} \Rightarrow \frac{1}{2} = \frac{x}{y} \Rightarrow y = 2x$ (M1)
 - $x(2x) = 8x + 8(2x) \Rightarrow 2x^2 = 24x$ (M1)
 - $x = 12, y = 24$ (A1)

(Total for question 17 is 7 marks)

18

- (a)
- $AB^2 = 8^2 + 8^2 - 2(8)(8) \cos(35)$ (M1)
 - $AB = 4.81 \text{ cm}$ (A1)
- (b)
- Area of sector $= \frac{35}{360} \times \pi \times 8^2 = 19.547\dots$ (M1)
 - Area of triangle $= \frac{1}{2}(8)(8) \sin 35 = 18.354\dots$ (M1)
 - Segment $= 19.547 - 18.354 = 1.19 \text{ cm}^2$ (A1)

(Total for question 18 is 5 marks)

19

- (a)
- $\cos C = \frac{7^2 + 9^2 - 5^2}{2(7)(9)}$ (M1)
 - $\cos C = \frac{105}{126} = \frac{5}{6}$ (A1)
- (b)
- $\sin C = \sqrt{1 - (5/6)^2} = \frac{\sqrt{11}}{6}$ (M1)
 - Area $= \frac{1}{2}(7)(9)(\frac{\sqrt{11}}{6})$ (M1)
 - Area $= \frac{21\sqrt{11}}{4} \text{ cm}^2$ (A1)

(Total for question 19 is 5 marks)

20

- Area $= \frac{1}{2}(9)(12) \sin(107)$ (M1)
- Area $= 51.6 \text{ cm}^2$ (A1)

(Total for question 20 is 2 marks)