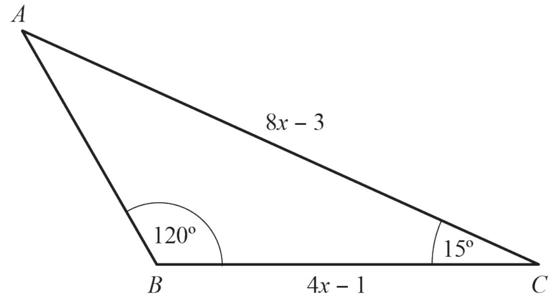
1 The diagram shows ΔABC with $AC = 8x - 3$, $BC = 4x - 1$, $\angle ABC = 120^\circ$ and $\angle ACB = 15^\circ$.

Figure 1

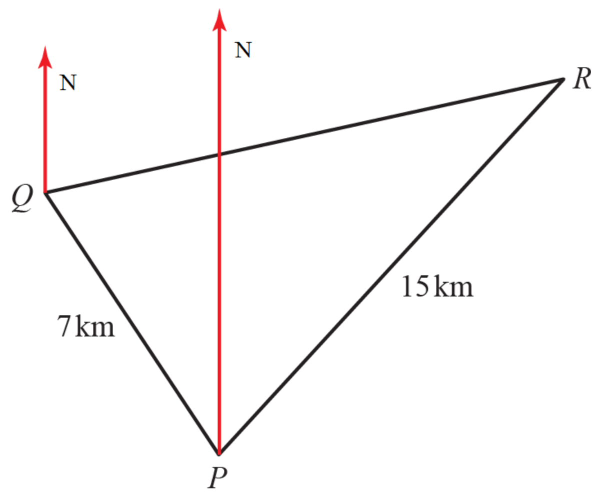


a Show that the exact value of x is $\dfrac{9+\sqrt{6}}{20}$. **(7 marks)**

b Find the area of ΔABC giving your answer to 2 decimal places. **(3 marks)**

2 The diagram shows the position of three boats, P, Q and R. Boat Q is 7 km from boat P on a bearing of 327°. Boat R is 15 km from boat P on a bearing of 041°.

Figure 2



a Find the distance between boats Q and R to 1 decimal place. **(5 marks)**

b Find the 3 figure bearing of boat R from boat Q. **(5 marks)**

3 Find all the solutions, in the interval $0 \leqslant x \leqslant 360°$, to the equation $8 - 7\cos x = 6\sin^2 x$, giving solutions to 1 decimal place where appropriate. **(6 marks)**

4 **a** Calculate the value of $-2\tan(-120°)$. **(1 mark)**

b On the same set of axes sketch the graphs of $y = 2\sin(x - 60°)$ and $y = -2\tan x$, in the interval $-180° \leqslant x \leqslant 180°$, showing the coordinates of points of intersection with the coordinate axes in exact form. **(7 marks)**

c Explain how you can use the graph to identify solutions to the equations $y = 2\sin(x - 60°) + 2\tan x = 0$ in the interval $-180° \leqslant x \leqslant 180°$. **(1 mark)**

d Write down the number of solutions of the equation $y = 2\sin(x - 60°) + 2\tan x = 0$ in the interval $-180° \leqslant x \leqslant 180°$. **(1 mark)**

5 Find, to 1 decimal place, the values of θ in the interval $0 \leqslant \theta \leqslant 180°$ for which $4\sqrt{3}\sin\left(3\theta + 20^\circ\right) = 4\cos\left(3\theta + 20^\circ\right)$. **(6 marks)**

6 A teacher asks one of her students to solve the equation $2\cos 2x + \sqrt{3} = 0$ for $0 \leqslant x \leqslant 180°$. The attempt is shown below.

$2\cos 2x = -\sqrt{3}$

$\cos 2x = -\frac{\sqrt{3}}{2}$

$2x = \cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

$2x = 150°$

$x = 75°$

w or $x = 360° - 75° = 295°$ so reject as out of range.

a Identify the mistake made by the student. **(1 mark)**

b Write down the correct solutions to the equation. **(2 marks)**

7 A buoy is a device which floats on the surface of the sea and moves up and down as waves pass. For a certain buoy, its height, above its position in still water, y in metres, is modelled by a sine function of the form $y = \frac{1}{2}\sin\left(180t^\circ\right)$, where t is the time in seconds.

a Sketch a graph showing the height of the buoy above its still water level for $0 \leqslant t \leqslant 10$ showing the coordinates of points of intersection with the t-axis. **(3 marks)**

b Write down the number of times the buoy is 0.4 m above its still water position during the first 10 seconds. **(1 mark)**

c Give one reason why this model might not be realistic. **(1 mark)**