Calculator Free
The Unit Circle, Radian Measure and Trigonometric Equations

Time: 45 minutes
Total Marks: 45
Your Score: / 45

Question One: [1, 2 = 3 marks]

(a) Explain what relationship radian measure represents.

(b) Hence or otherwise explain what 1 radian looks like on a circle with radius 5 cm. Draw a diagram to assist your explanation.

Question Two: [1, 2, 1, 2 = 6 marks]

Express each of these angles as radians, in terms of π, leaving your answers as exact values.

(a) 180°

(b) 210°

(c) 60°

(d) 330°

Question Three: [1, 1, 2, 2 = 6 marks]

Express each of these angles in degrees, leaving answers in terms of π where necessary:

(a) 2π

(b) $\frac{\pi}{4}$

(c) 2^R

(d) $\frac{7\pi}{10}$

Question Four: [1, 1 , 1, 1, 2, 2 = 8 marks]

Use the unit circle diagram below to approximate the value of:

(a) $\sin 115^\circ$

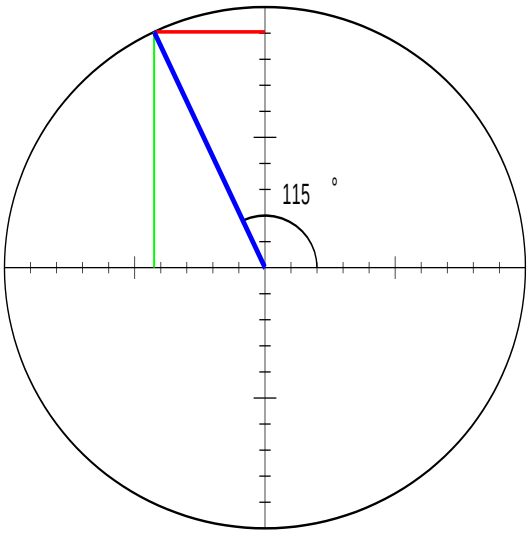
(b) $\cos 115^\circ$

(c) $\sin 65^\circ$

(d) $\cos 295^\circ$

(e) $\cos 25^\circ$

(f) $\tan 245^\circ$



Question Five: [1, 1, 1, 1, 1, 3 = 8 marks]

Express each of the following as a simplified exact value:

(a) $\sin 45^\circ$

(b) $\cos \frac{\pi}{6}$

(c) $\tan \frac{5\pi}{6}$

(d) $\cos \frac{7\pi}{4}$

(e) $\sin \frac{8\pi}{3}$

(f) $\sin \frac{7\pi}{6} + \tan \frac{\pi}{3}$

Question Six: [2, 2, 3, 3, 4 = 14 marks]

Solve each of the following trigonometric equations over the given domain.

(a) $\sin\theta = -\frac{1}{2};\ 0^\circ \le \theta \le 360^\circ$

(b) $\cos\theta = \frac{1}{2};\ -\pi \le \theta \le \pi$

(c) $3\tan\theta = \sqrt{3};\ 0 \le \theta \le 2\pi$

(d) $\cos 2\theta = -\frac{1}{\sqrt{2}};\ 0 \le \theta \le 2\pi$

(e) $(\sin\theta)^2 = \frac{3}{4};\ -\pi \le \theta \le 2\pi$

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SOLUTIONS
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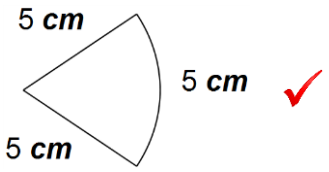
Question One: [1, 2 = 3 marks]

(a) Explain what relationship radian measure represents.

The ratio between the arc length and the radius. ✓

(b) Hence or otherwise explain what 1 radian looks like on a circle with radius 5 cm. Draw a diagram to assist your explanation. ✓

The sector drawn has radius 5cm and an arc length of 5 cm if the angle measure is 1 radian.



✓

Question Two: [1, 2, 1, 2 = 6 marks]

Express each of these angles as radians, in terms of π, leaving your answers as exact values.

(a) 180°

π ✓

(b) 210°

$= \frac{210}{180} \times \pi$ ✓

$= \frac{7\pi}{6}$ ✓

(c) 60°

$= \frac{\pi}{3}$ ✓

(d) 310°

$= \frac{330}{180} \times \pi$ ✓

$= \frac{11\pi}{6}$ ✓

Question Three: [1, 1, 2, 2 = 6 marks]

Express each of these angles in degrees, leaving answers in terms of π where necessary:

(a) 2π

360° ✓

(b) $\frac{\pi}{4}$

45° ✓

(c) 2^R

$= \frac{2}{\pi} \times 180$ ✓

$= \frac{360}{\pi}$ ✓

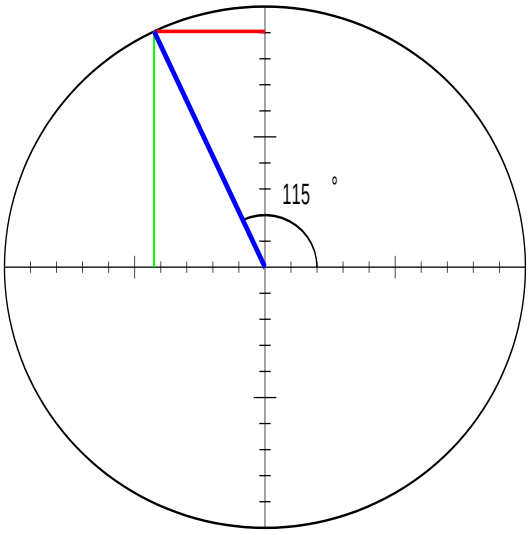
(d) $\frac{7\pi}{10}$

$= \frac{7\pi}{10} \times \frac{180}{\pi}$ ✓

$= 126^\circ$ ✓

Question Four: [1, 1 , 1, 1, 2, 2 = 8 marks]

Use the unit circle diagram below to approximate the value of:



(a) $\sin 115^\circ$

≈ 0.9 ✓

(b) $\cos 115^\circ$

≈ -0.42 ✓

(c) $\sin 65^\circ$

≈ 0.9 ✓

(d) $\cos 295^\circ$

≈ 0.42 ✓

(e) $\cos 25^\circ$

≈ 0.9 ✓ ✓

(f) $\tan 245^\circ$

$= \frac{\sin 245}{\cos 245}$ ✓

$= \frac{-0.9}{-0.42}$

$= \frac{90}{42}$ ✓

Question Five: [1, 1, 1, 1, 1, 3 = 8 marks]

Express each of the following as a simplified exact value:

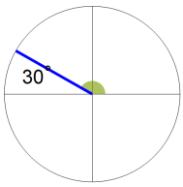
(a) $\sin 45^\circ$

$= \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$ ✓

(b) $\cos \frac{\pi}{6}$

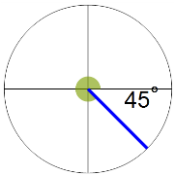
$= \frac{\sqrt{3}}{2}$ ✓

(c) $\tan \frac{5\pi}{6}$



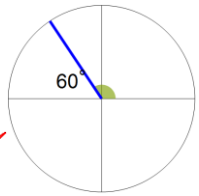
$= \frac{-1}{\sqrt{3}}$ ✓

(d) $\cos \frac{7\pi}{4}$



$= \frac{1}{\sqrt{2}} = \frac{\sqrt{2}}{2}$ ✓

(e) $\sin \frac{8\pi}{3}$



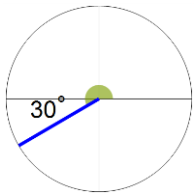
$= \sin \frac{2\pi}{3} = \frac{\sqrt{3}}{2}$ ✓

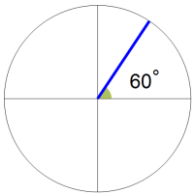
(f) $\sin \frac{7\pi}{6} + \tan \frac{\pi}{3}$

✓ $= \frac{-1}{2} + \sqrt{3}$ ✓

$= \frac{2\sqrt{3} - 1}{2}$

✓

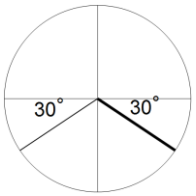




Question Six: [2, 2, 3, 3, 4 = 14 marks]

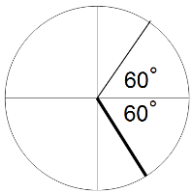
Solve each of the following trigonometric equations over the given domain.

(a) $\sin\theta = -\frac{1}{2};\ 0^\circ \le \theta \le 360^\circ$



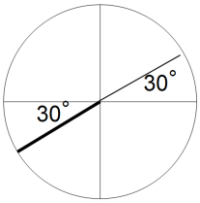
$\theta = 210^\circ, 330^\circ$ ✓ ✓

(b) $\cos\theta = \frac{1}{2};\ -\pi \le \theta \le \pi$



$\theta = \frac{-\pi}{3}, \frac{\pi}{3}$ ✓ ✓

(c) $3\tan\theta = \sqrt{3};\ 0 \le \theta \le 2\pi$



$\tan\theta = \frac{\sqrt{3}}{3}$

$\tan\theta = \frac{1}{\sqrt{3}}$ ✓

$\theta = \frac{\pi}{6}, \frac{7\pi}{6}$ ✓

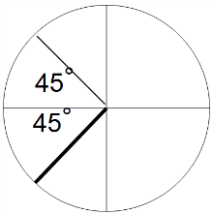
✓

(d) $\cos 2\theta = -\frac{1}{\sqrt{2}};\ 0 \le \theta \le 2\pi$

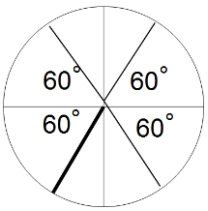
✓ ✓

$2\theta = \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}, \frac{9\pi}{4}$

$\theta = \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{11\pi}{8}, \frac{13\pi}{8}$ ✓



(e) $(\sin\theta)^2 = \frac{3}{4};\ -\pi \le \theta \le 2\pi$



$\sin\theta = \pm\frac{\sqrt{3}}{2}$ ✓

$\theta = \pm\frac{\pi}{3}, \pm\frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

✓ ✓ ✓