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VCE Mathematical Methods ½

Circular Functions I [4.1]

Test Solutions

23 Marks. 1 Minute Reading. 23 Minutes Writing.

Results:

|                |            |
|----------------|------------|
| Test Questions | _____ / 23 |
|----------------|------------|



## Section A: Test Questions (23 Marks)

### Question 1 (3 marks)

Tick whether the following statements are **True** or **False**.

| Statement                                                                                                                    | True                                | False                               |
|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|
| a. The values of sine and cosine functions are always between $-1$ and $1$ .                                                 | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| b. The tangent function is defined as $\tan(x) = \frac{\sin(x)}{\cos(x)}$ .                                                  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| c. The period of the sine, cosine, and tangent functions is $2\pi$ .                                                         | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| d. The tangent function is undefined at values where the cosine function equals $0$ .                                        | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| e. $\cos(\pi - x) = \cos(x)$ for all $x$ .                                                                                   | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| f. If $\sin(x) = \frac{4}{5}$ and $x$ is in the first quadrant, then $\tan\left(\frac{3\pi}{2} - x\right) = \frac{4}{3} 0$ . | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |

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**Question 2** (2 marks)

a. Convert  $360^\circ, 1^\circ, 90^\circ, 135^\circ$  to radians. (1 mark)

Convert  $360^\circ, 1^\circ, 90^\circ, 135^\circ$  to radians.

$$360^\circ = 2\pi, \quad 1^\circ = 1^\circ \times \frac{\pi}{180^\circ} = \frac{\pi}{180}, \quad 90^\circ = 90^\circ \times \frac{\pi}{180^\circ} = \frac{\pi}{2}$$

$$135^\circ = 135^\circ \times \frac{\pi}{180^\circ} = \frac{3\pi}{4}$$

b. Convert  $\pi, 1, \frac{\pi}{3}, \frac{7\pi}{6}$  radians to degrees. (1 mark)

Convert  $\pi, 1, \frac{\pi}{3}, \frac{7\pi}{6}$  radians to degrees.

$$\pi \equiv 180^\circ, \quad 1 \times \frac{180}{\pi} = \frac{180}{\pi}^\circ, \quad \frac{\pi}{3} = \frac{\pi}{3} \times \frac{180}{\pi} = 60^\circ$$

$$\frac{7\pi}{6} = \frac{7\pi}{6} \times \frac{180}{\pi} = 210^\circ$$

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**Question 3** (6 marks)

a. Evaluate  $\cos\left(\frac{5\pi}{6}\right)$ . (1 mark)

$$\cos\left(\frac{5\pi}{6}\right) \overset{Q2}{=} -\cos\frac{\pi}{6} = -\frac{\sqrt{3}}{2}$$

b. Evaluate  $\sin\left(\frac{4\pi}{3}\right)$ . (1 mark)

$$\sin\left(\frac{4\pi}{3}\right) \overset{Q3}{=} -\sin\frac{\pi}{3} = -\frac{\sqrt{3}}{2}$$

c. Evaluate  $\tan\left(\frac{3\pi}{4}\right)$ . (1 mark)

$$\tan\left(\frac{3\pi}{4}\right) \overset{Q2}{=} -\tan\frac{\pi}{4} = -1$$

d. Evaluate  $\sin\left(\frac{11\pi}{6}\right)$ . (1 mark)

$$\sin\left(\frac{11\pi}{6}\right) \overset{Q4}{=} -\sin\frac{\pi}{6} = -\frac{1}{2}$$

e. Evaluate  $\tan\left(-\frac{\pi}{4}\right)$ . (1 mark)

$$\tan\left(-\frac{\pi}{4}\right) \overset{Q4}{=} -\tan\frac{\pi}{4} = -1$$

f. Evaluate  $\cos\left(-\frac{2\pi}{3}\right)$ . (1 mark)

$$\cos\left(-\frac{2\pi}{3}\right) \overset{Q3}{=} -\cos\frac{\pi}{3} = -\frac{1}{2}$$

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**Question 4** (4 marks)

If  $\sin(x) = 0.4$ ,  $\cos(y) = 0.5$ , and  $\tan(z) = 0.6$ , find the value of:

a.  $\sin(\pi + x)$ . (1 mark)

$$\sin(\pi + x) = -\sin(x) = -0.4$$

b.  $\tan(\pi - z)$ . (1 mark)

$$\tan(\pi - z) = -\tan(z) = -0.6$$

c.  $\cos\left(\frac{\pi}{2} - x\right)$ . (1 mark)

$$\cos\left(\frac{\pi}{2} - x\right) = \sin(x) = 0.4$$

d.  $\sin\left(\frac{3\pi}{2} + y\right)$ . (1 mark)

$$\sin\left(\frac{3\pi}{2} + y\right) = -\cos(y) = -0.5$$

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**Question 5** (3 marks)

If  $\sin(x) = \frac{1}{3}$  and  $x$  is in the second quadrant, find the value of:

a.  $\cos(5\pi - x)$ . (2 marks)

$$\left(\frac{1}{3}\right)^2 + \cos^2(x) = 1 \Rightarrow \cos(x) = -\frac{2\sqrt{2}}{3}. \text{ Since, } x \text{ is in } 2^{\text{nd}} \text{ quadrant.}$$

$$\cos(5\pi - x) = \cos(\pi - x) = -\cos(x) = \frac{2\sqrt{2}}{3}$$

b.  $\tan\left(x + \frac{\pi}{2}\right)$ . (1 mark)

$$2\sqrt{2}$$

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**Question 6** (5 marks)

Solve the following equations for  $x$  over the specified domain.

a.  $2 \cos\left(x - \frac{\pi}{4}\right) = 1$ , for  $x \in [0, 2\pi]$ . (2 marks)

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```
In[163]:= Solve[2 Cos[x - Pi / 4] == 1 && 0 ≤ x ≤ 2 Pi]
```

```
Out[163]= {{x -> 7 Pi / 12}, {x -> 23 Pi / 12}}
```

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b.  $\sqrt{3} \tan\left(2x + \frac{\pi}{3}\right) - 1 = 0$ , for  $x \in \left[-\pi, \frac{\pi}{2}\right]$ . (3 marks)

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```
In[167]:= Solve[Sqrt[3] Tan[2 x + Pi / 3] == 0 && -Pi ≤ x ≤ Pi / 2]
```

```
Out[167]= {{x -> -2 Pi / 3}, {x -> -Pi / 6}, {x -> Pi / 3}}
```

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