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VCE Mathematical Methods ¾

Circular Functions I [3.2]

Test Solutions

23.5 Marks. 1 Minute Reading. 19 Minutes Writing

Results:

Test Questions	________ / 23.5

Section A: Test Questions (23.5 Marks)

Question 1 (3.5 marks)

Tick whether the following statements are **true** or **false**.

	True	False
a. On the unit circle, the value of sin is represented by the y-value of the unit circle whereas the value of tan is represented by the gradient of the projection.	✓	
b. If you change the value of x by the period in a tan function, the angle changes by 2π.		✓
c. In a supplementary relationship, the values of sin change to values of cos and vice versa.		✓
d. For a particular solution, the trigonometric equation must have a restricted domain.	✓	
e. For a general solution, the trigonometric equation must **NOT** have a restricted domain.	✓	
f. Angle θ reflected in the x-axis, y-axis and $y = x$ is given by $\frac{3\pi}{2} +$ It should be negative.		✓
g. $\tan\left(\frac{7\pi}{2} + \theta\right) = -\frac{1}{\tan(\theta)}$.	✓	

Space for Personal Notes

Question 2 (5 marks)

It is known that $\cos(a) = -\frac{1}{7}$ where a is a second quadrant angle.

Evaluate the following:

a. $\cos(\pi + a)$. (1 mark)

$$\frac{1}{7}$$

b. $\sin(\pi + a)$. (2 marks)

$$\frac{-4\sqrt{3}}{7}$$

c. $\sin\left(\frac{3\pi}{2} + a\right)$. (2 marks)

$$\frac{1}{7}$$

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Question 3 (2 marks)

State the smallest positive value of k such that $x = \frac{3\pi}{4}$ is a solution of $\tan(x) = \cos(kx)$.

$\tan\left(\frac{3\pi}{4}\right) = \cos\left(k \times \frac{3\pi}{4}\right)$

$-1 = \cos\left(\frac{3k\pi}{4}\right)$

$\rightarrow \frac{3k\pi}{4} = \pi \pm 2n\pi, n \in \mathbb{Z}$

$\therefore$ At $n = 0$, $\frac{3k\pi}{4} = \pi$

$k = \frac{4}{3}$

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Question 4 (2 marks)

Solve $\sin\left(2x + \frac{\pi}{4}\right) = 1$ for $x \in [0, 2\pi]$.

```
In[65]:= Reduce[Sin[2 x + Pi / 4] == 1 && 0 ≤ x ≤ 2 Pi, x]
```

Out[65]= $x == \frac{\pi}{8} \; || \; x == \frac{9\pi}{8}$

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Question 5 (6 marks)

a. Find the general solution to the equation below. (3 marks)

$$5\tan\left(4x - \frac{\pi}{3}\right) + 2 = -3$$

```
In[58]:= Solve[5 Tan[4 x - Pi / 3] + 2 == -3, x] // Expand
```

Out[58]= $\left\{\left\{x \to \frac{\pi}{48} + \frac{\pi c_1}{4} \text{ if } c_1 \in \mathbb{Z}\right\}\right\}$

Let $f(x) = 5\tan\left(4x - \frac{\pi}{3}\right) + 5$ and $g(x) = 5\tan\left(4x - \frac{\pi}{3}\right) - 5$.

b. Find the smallest horizontal distance between any two roots of f and g. (2 marks).

Corresponding roots are half a period away from each other.
Period is $\frac{\pi}{4}$.
Therefore, smallest distance is $\frac{\pi}{8}$.

c. Hence, give a general formula for the distance between any two roots of f and g. (1 mark).

$$\frac{n\pi}{8}, n \in Z^{+}.$$

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Question 6 (5 marks)

Consider the equation below:

$$-2\sin^2\left(x+\frac{\pi}{3}\right)+3\cos\left(x+\frac{\pi}{3}\right)=0$$

Evaluate the following:

a. Find the general solution for x. (4 marks)

Equivalent to the equation:

$$2\cos^2\left(x+\frac{\pi}{3}\right)+3\cos\left(x+\frac{\pi}{3}\right)-2=0$$

```
In[53]:= Solve[-2 (Sin[x + Pi / 3])^2 + 3 Cos[x + Pi / 3] == 0, x, Reals]
Out[53]= {{x → -2 π c1 if c1 ∈ ℤ}, {x → -2π/3 - 2 π c1 if c1 ∈ ℤ}}
```

$x=2n\pi$ OR $x=-\frac{2\pi}{3}+2n\pi, n\in Z.$

b. Hence, find the values of $x\in[0,2\pi]$ that satisfy the equation. (1 mark)

$$x=0,\frac{4\pi}{3},2\pi$$

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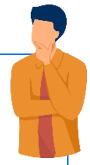

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