

**Instructions:** This quiz has 29 questions. The use of calculators is forbidden. Click on the box with the right answer. To initialise the quiz you must click on "BEGIN QUIZ." When you finish the quiz you click on "END QUIZ" in order to see your score.

**Begin Quiz** Answer each of the following.

1. Find the sum of the infinite geometric series

$$\frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \dots$$

$$\frac{21}{64}$$

$$\frac{1}{2}$$

$$\frac{2}{7}$$

$$\frac{1}{3}$$

2. If the number  $2^{2006}$  is written out in decimal notation, how many digits does it have?

$$2006$$

$$603$$

$$604$$

$$1391$$

3. Find all the real solutions to the equation  $9^x - 3^x = 12$ .

$$x \in \{\log_3 4\}$$

$$x \in \{\log_4 3\}$$

$$x \in \{1, \log_3 4\}$$

$$x \in \{-3, 4\}$$

4. Find all the real solutions to the equation  $\log_e \log_\pi \log_e x = 0$ .

$$x \in \{e^\pi\}$$

$$x \in \{\pi^e\}$$

$$x \in \{e^{\pi^e}\}$$

$$x \in \{\pi^{e^\pi}\}$$

5. If  $a > 1$ , find the exact value of  $\log_{\sqrt{a}}(a^{a^2})$ .

$$a^2$$

$$2a^2$$

$$a$$

$$4a^2$$

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**Situation:** Questions 6 through 10 refer to the following. Assume that  $a, p, q$  are all real numbers exceeding 1. Also, assume that  $\log_a p^2 = s$  and  $\log_{a^2} q^3 = t$ .

6. Find  $\log_a p$ .

$\frac{s}{2}$	$2s$	$s^2$	$\sqrt{s}$
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7. Find  $\log_a q$ .

$\frac{t}{6}$	$6t$	$\frac{3}{2}t$	$\frac{2}{3}t$
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8. Find  $\log_a pq$ .

$2s + \frac{3}{2}t$	$2s + 6t$	$\frac{s}{2} + 6t$	$\frac{s}{2} + \frac{2}{3}t$
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9. Find  $\log_q p$ .

$\frac{4s}{3t}$	$\frac{s}{3t}$	$\frac{s}{12t}$	$\frac{3s}{4t}$
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10. Find  $\log_a \frac{p}{q}$ .

$2s - \frac{3}{2}t$	$2s - 6t$	$\frac{s}{2} - 6t$	$\frac{s}{2} - \frac{2}{3}t$
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11. Find the smallest positive solution to the equation  $\cos x^2 = 0$ .

0                       $\frac{\sqrt{2\pi}}{2}$                        $\frac{\sqrt{\pi}}{2}$                        $\frac{\pi}{2}$

12.  $\cos \frac{223\pi}{6} =$

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

13. Which of the following most resembles the graph of  $y = 1 + \cos 2x$ ?

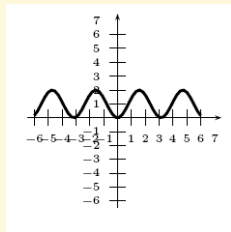


Figure 1: I

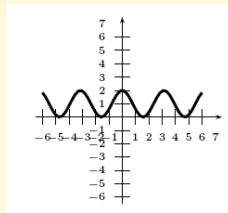


Figure 2: II

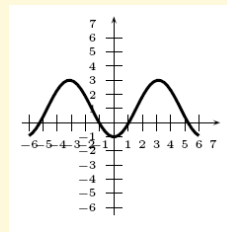


Figure 3: III

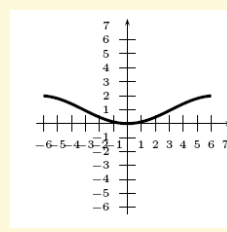


Figure 4: IV

I

II

III

IV

14. If  $2\sin^2 x - \cos x - 1 = 0$  and  $x \in [0; \pi]$  then

$x \in \left\{ \frac{\pi}{3}, \pi \right\}$

$x \in \left\{ \frac{\pi}{2}, \pi \right\}$

$x \in \left\{ \frac{\pi}{3}, \frac{\pi}{4} \right\}$

$x \in \left\{ \frac{\pi}{3}, \frac{\pi}{6} \right\}$

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**Situation:** Questions 15 through 19 refer to the following. Assume that  $\alpha$  and  $\beta$  are acute angles. Assume also that  $\tan \alpha = \frac{1}{3}$  and that  $\sec \beta = 3$ .

15. Find  $\sin \alpha$ .

$$\frac{1}{4}$$

$$\frac{3\sqrt{10}}{10}$$

$$\frac{\sqrt{10}}{30}$$

$$\frac{\sqrt{10}}{10}$$

16. Find  $\sin \beta$ .

$$\frac{1}{3}$$

$$\frac{\sqrt{10}}{3}$$

$$\frac{2\sqrt{2}}{3}$$

$$\frac{\sqrt{2}}{3}$$

17. Find  $\cos \alpha$ .

$$\frac{1}{4}$$

$$\frac{3\sqrt{10}}{10}$$

$$\frac{\sqrt{10}}{30}$$

$$\frac{\sqrt{10}}{10}$$

18. Find  $\cos \beta$ .

$$\frac{1}{3}$$

$$\frac{\sqrt{10}}{3}$$

$$\frac{2\sqrt{2}}{3}$$

$$\frac{\sqrt{2}}{3}$$

19. Find  $\cos(\alpha + \beta)$ .

$$\frac{\sqrt{10}}{10} - \frac{2\sqrt{5}}{15}$$

$$\frac{\sqrt{10}}{10} + \frac{2\sqrt{5}}{15}$$

$$\frac{2\sqrt{5}}{5} - \frac{\sqrt{10}}{30}$$

$$\frac{2\sqrt{5}}{5} + \frac{\sqrt{10}}{30}$$

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**Situation:** Questions 20 through 25 refer to the following.  $\triangle ABC$  is right-angled at  $A$ ,  $a = 4$  and  $\sec B = 4$ . Assume standard labelling.

20. Find  $\sin C$ .

$$\frac{1}{4}$$

$$\frac{3\sqrt{15}}{15}$$

$$\frac{\sqrt{15}}{4}$$

$$\frac{4\sqrt{15}}{15}$$

21. Find  $\angle C$ , in radians.

$$\arcsin \frac{1}{4}$$

$$\arccos \frac{1}{4}$$

$$\arcsin \frac{\sqrt{15}}{4}$$

$$\arccos \frac{4}{\sqrt{15}}$$

22. Find  $b$ .

$$1$$

$$\sqrt{15}$$

$$4$$

$$16$$

23. Find  $R$ , the radius of the circumscribed circle to  $\triangle ABC$ .

$$2$$

$$\frac{\sqrt{15}}{2}$$

$$2\sqrt{15}$$

$$\sqrt{15}$$

24. Find the area of  $\triangle ABC$ .

$$2$$

$$\frac{\sqrt{15}}{2}$$

$$2\sqrt{15}$$

$$\sqrt{15}$$

25. Find  $r$ , the radius of the inscribed circle to  $\triangle ABC$ .

$$\frac{\sqrt{15}}{2\sqrt{15}+10}$$

$$\frac{\sqrt{15}}{\sqrt{15}+5}$$

$$\frac{\sqrt{15}+5}{\sqrt{15}}$$

$$2$$

**Situation:** Questions 26 through 29 refer to the following. In figure 5, a **regular hexagon** is inscribed in a circle of radius 1.

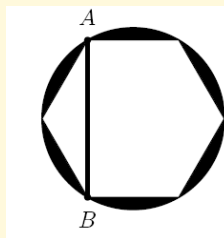


Figure 5: Problems 26 through 29.

26. Find the area of the hexagon.

$$\frac{3}{2}$$

$$3\sqrt{2}$$

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

$$\frac{3\sqrt{3}}{2}$$

27. Find the perimeter of the hexagon.

$$6$$

$$6\sqrt{3}$$

$$3\sqrt{3}$$

$$3$$

28. Find the length of the line segment  $AB$ .

$$2$$

$$\sqrt{5}$$

$$3\sqrt{3}$$

$$\sqrt{3}$$

29. Find the shaded area outside the hexagon but inside the circle.

$$\pi - \frac{3}{2}$$

$$\pi - 3\sqrt{2}$$

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

$$\pi - \frac{3\sqrt{3}}{2}$$

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