

TMATYC
PRECALCULUS EXAM
Fall 2010

1. If $f(3x - 1) = e^{4x-1}$, then $\ln(f(5)) =$

- A. 4 B. 7 C. 19 D. 55

2. If $\tan \theta = \frac{\sqrt{3}}{3}$ and $\sin \theta < 0$, then $\cos \theta =$

- A. $\frac{\sqrt{3}}{2}$ B. $-\frac{\sqrt{3}}{2}$ C. $\frac{1}{2}$ D. $-\frac{1}{2}$

3. Find all solutions to the equation $2 \sin^2(3x + 4) = 1$.

- A. $\frac{(2n+1)\pi - 16}{12}$ B. $\frac{(4n+1)\pi - 16}{12}$
C. $\frac{(8n+1)\pi - 16}{12}$ D. $\frac{(4n+1)\pi}{12}$

4. If the zeros of the polynomial function $P(x) = x^2 + bx + c$ are $\ln 2$ and π , then $b =$

- A. $\pi \ln 2$ B. $2\pi \ln 2$ C. $\ln 2 + \pi$ D. $-(\ln 2 + \pi)$

5. The path of a projectile fired at an inclination of θ degrees to the horizontal with an initial velocity of V_0 is a parabola. The range of the projectile – that is the horizontal distance that the projectile travels – is given by:

$$R = \frac{V_0^2 \sin(2\theta)}{g}$$

where g is the acceleration due to gravity. Suppose that the projectile is fired with an initial velocity of 400 ft/sec and $g = 32 \text{ ft/sec}^2$. What angle θ for $0 \leq \theta \leq 90^\circ$ should you select for the range, R to be 2500 ft.?

- A. 75° B. 15° C. 15° or 75° D. -15° or 75°

6. If $h(x) = 2x - 8$, find $h^{-1}(6)$.

- A. -4 B. $\frac{1}{4}$ C. 7 D. 11

7. The ideal gas law states that the volume V that a gas occupies is directly proportional to the product of the number m of the moles of gas and the temperature T and is inversely proportional to the pressure P (in atmospheres). Let K be the constant of proportionality, then,

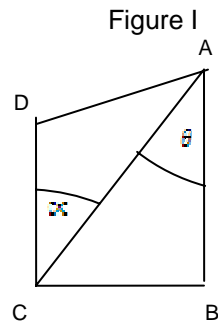
$$V = \frac{KmT}{P}$$

What is the effect on the volume V if the number of moles is doubled and both the temperature and the pressure are reduced by a factor of $\frac{1}{2}$.

- A. original volume is doubled B. no effect
 C. $\frac{1}{2}$ original volume D. volume increases by a factor of 4
8. The radiator of a car needs to contain 40 liters of a 40% antifreeze solution. The radiator now contains 40 liters of a 20% antifreeze solution. How many liters of this solution must be drained and replaced with 100% antifreeze to get the desired strength?
- A. 16 liters B. 13.3 liters C. 10 liters D. 20 liters
9. If you have an n -sided polygon inscribed in a circle of r , express the perimeter P in terms of n and r .
- A. $nr \left(\frac{360}{n}\right)^\circ$ B. $2\pi r \left(\frac{360}{n}\right)^\circ$ C. $nr \left(\frac{180}{n}\right)^\circ$ D. $2nr \sin \left(\frac{180}{n}\right)^\circ$
10. Find the sum of the x and y intercepts of the line with slope $-\frac{1}{3}$ which is the hypotenuse of a right triangular region in Quadrant I with legs the x and y axes and area $\frac{392}{3}$.
- A. $\frac{28}{3}$ B. $\frac{56}{3}$ C. 28 D. $\frac{112}{3}$
11. Circle O has equation $x^2 + y^2 = 16$. If P is (1, 0) and Q is (-1, 0) and R is any point on circle O, what is the largest possible value of $PR + QR$?
- A. 8 B. $2\sqrt{17}$ C. $6\sqrt{2}$ D. $\frac{17}{2}$
12. A horse is racing around a circular track that has a radius of 840 feet. A camera sits at the center of the circle that forms the track. What angle (to the nearest tenth of a degree) must the camera turn through in order to film the horse running 500 ft. around the track?
- A. 36.5° B. 0.8° C. 34.1° D. 53.5°

13. Two triangles $\triangle ABC$ and $\triangle ADC$ are shown below. Angles $\angle ABC$ and $\angle ADC$ are right angles of $\overline{AB} = 20$, $\overline{AD} = 8$ and $\theta = 20^\circ$, then find the angle α to the nearest degree (see figure I below).

- A. 23° B. 22° C. 24° D. 20°



14. Find an equation of the line that is perpendicular to $-2x - y = 8$ and contains $(0, 4)$.
- A. $y = \frac{1}{2}x + 4$ B. $y = -2x - 4$ C. $y = -\frac{1}{2}x - 4$ D. $y = 2x + \frac{1}{4}$
15. The equatorial radius of Earth is approximately 3963.3 miles. Find the linear speed of a point on the equator as a result of Earth's rotation (approximately).
- A. 2200 mi/hr B. 1640 mi/hr C. 1040 mi/hr D. 1260 mi/hr
16. Find an equation using the cotangent function that has the same graph as $y = \tan x$.
- A. $y = -\cot\left(x + \frac{\pi}{2}\right)$ B. $y = \cot\left(x - \frac{\pi}{2}\right)$
- C. $y = \cot(x) + \frac{\pi}{2}$ D. $y = -\cot x - \frac{\pi}{2}$
17. Find the horizontal asymptote for the graph of $f(x) = \frac{3x-1}{x^2-x-6}$, if it exists.
- A. Does not exist B. $y = -3$ C. $y = \frac{1}{3}$ D. $y = 0$

18. It has been estimated that 1000 curies of a radioactive substance introduced at a point on the surface of the open sea would spread over an area of $40,000 \text{ km}^2$ in 40 days. Assuming that the area covered by the radioactive substance is a linear function of time t and it's always circular in shape, express the radius r of the contamination of a function t .

A. $r(t) = \sqrt{\frac{1000t}{\pi}}$

B. $r(t) = \frac{1000}{2\pi} t$

C. $r(t) = t \sqrt{\frac{1000}{\pi}}$

D. $r(t) = \frac{t\sqrt{1000}}{\pi}$

19. What is $\operatorname{arccsc} \frac{5}{4} + \operatorname{arcsec} \frac{5}{4} + \operatorname{arccot} \left(\frac{5}{4}\right) + \operatorname{arccot} \left(\frac{4}{5}\right)$

A. π

B. 2π

C. $\frac{\pi}{4}$

D. $\frac{\pi}{2}$

20. Suppose $f(x) = ax + b$, $g(x) = bx + a$ (a and b integers). If $f(1) = 8$ and $|f(g(50)) - g(f(50))| = 28$ find the product of a and b .

A. 16

B. 7

C. 12

D. 182

21. As $x \rightarrow \left(\frac{\pi}{2}\right)^-$, $\sec x \rightarrow ?$

A. $-\infty$

B. π

C. $-\pi$

D. ∞

22. Given $y = 3 \cos \left(x + \frac{\pi}{6}\right)$, what is the amplitude, period and phase shift?

A. 3, 2π , $-\frac{\pi}{6}$

B. 3, $-\pi$, $\frac{\pi}{6}$

C. 3, π , $\frac{\pi}{6}$

D. 3, $\frac{\pi}{2}$, $\frac{\pi}{6}$

23. What is the horizontal asymptote of $f(x) = \left(1 + \frac{2}{x}\right)^x$?

A. $y = e$

B. $y = \frac{e}{2}$

C. $y = e^2$

D. $y = \frac{e^2}{2}$

24. Simplify the expression: $\frac{2 - \tan \theta}{2 \csc \theta - \sec \theta}$.

A. $\sin \theta$

B. $\cos \theta$

C. $\tan \theta$

D. $-\cos \theta$

25. Find the zeros of $f(x) = -x^2 e^{-x} + 2x e^{-x}$.

A. 0, 1

B. 0, 2

C. -1, 2

D. 0, -1