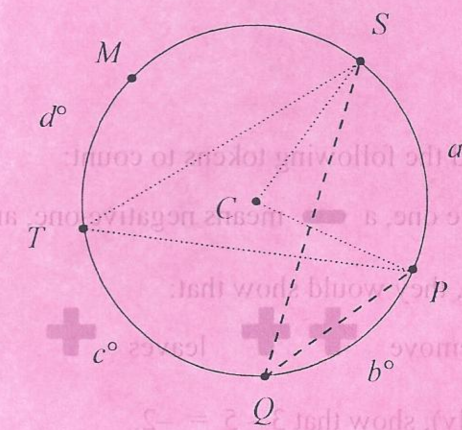
QUESTIONS. **RECORD ALL ANSWERS ON ANSWER SHEET at end.**

1. Find, in degrees the values of $m\angle PQS$ and $m\angle MQS$, given:

$a° = 72°$
$b° = 52°$
$c° = 82°$
$d° = 39°$



a. $m\angle PQS =$

b. $m\angle MQS =$

2. At an archeological site is a square-based pyramid.
Each side of the base B has length $s = 190$ feet.
The vertical height of the pyramid is $h = 228$ feet.

Compute the values below:

a. Area of base B =

b. Lateral Area (L.A.) =

c. Surface Area (S.A.) =

d. Volume (V) =

3. Given these three surfaces in the (x,y,z) coordinate system:

$$x^2 + (y-8)y = 0, \qquad y(8-y) = 4z^2, \qquad 4x^2 + (y-4)^2 + 2z^2 = 16$$

Find any points at which all three intersect.

4. Find the exact solution to the following system of equations. Use only Rational Numbers to express your answer and reduce to lowest terms.

$$2x + 4y + 8z = 16$$
$$3x + 9y + 27z = 81$$
$$4x + 16y + 64z^2 = 262$$

5. An ancient culture used the following tokens to count:

✚ means positive one, a ▬ means negative one, and this group ✚ ▬ totals zero.

To show that 3 – 2 = 1, they would show that:

✚✚✚ remove ✚✚ leaves ✚.

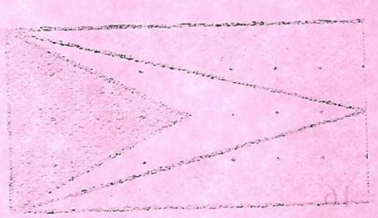
Using their tokens (only), show that 3 – 5 = –2.

6. A river flows through a flat coastal plain. Superimposing a coordinate system on the plain, the area is seen to be 4 miles wide in the x-direction and 3 miles wide in the y-direction. The path of the river is well-modeled by

$$y = \frac{1}{3}x^{3/2}.$$

Find the length of the river in the coastal plain.

7. The rectangle below is 8 units wide and 4 units high. What fraction of the rectangle is shaded?



8. A ship at sea has high-quality optical sighting equipment 23 meters above the sea-level. Away from the ship, over the horizon is an incoming missile flying 4.5 meters above sea-level at 0.92 of the speed of sound.
   - The ship is stationary.
   - The sea is calm (flat).
   - The missile is flying directly toward the ship and maintaining constant altitude of 4.5 meters above sea-level.
   - The speed of sound near sea level that day is approximately 344 meters / second.
   - Assume the radius of the earth $r = 6.367 \times 10^6$ meters.
   - Assume ideal weather conditions for optics.
   - Ignore reflection, refraction, and lensing effects of the atmosphere and ocean surface.
   - Ignore the rotation of the earth (the ship and missile are bound to the earth's rotation).
   - Do not ignore curvature of the earth
   - Assume that at distances over 1 kilometer, the optical equipment cannot determine objects within 3 meters of the ocean surface, nor can optical rays passing through this region be recognized (due to water vapor).

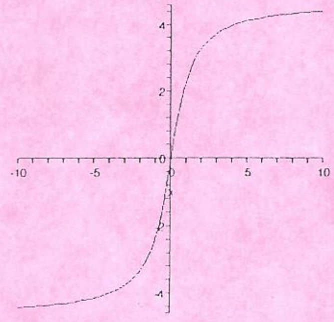
   a. What is the straight-line distance l from the optical equipment to the missile at the first possible moment of sighting?

   b. From the first possible moment of optical sighting, how much time t will elapse before the missile reaches the ship?

9. Determine which # graph below matches the given functions.

   a. $f(x)$ ____ b. $\frac{d}{dx} f(x)$ ____ c. $\frac{d^2}{dx^2} f(x)$ ____

#1



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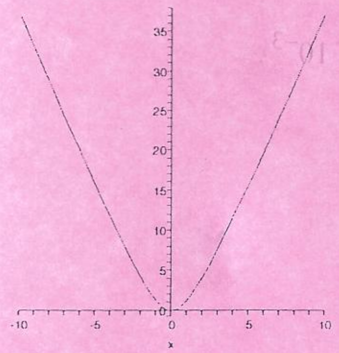

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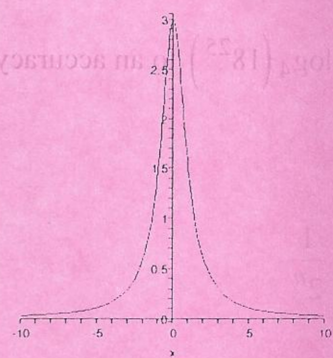

10. A mass is undergoing exponential decay at the constant rate of $\lambda = 0.0025$ per second.

How many seconds will elapse before only ¼ of the mass is left?

11. Reduce $\frac{2+3i}{2-5i}$ to lowest rational terms, where $i \equiv \sqrt{-1}$.

12. A standard deck of playing cards has 52 cards. There are 4 "suits" in one deck, each with an equal number of cards. A "Royal Flush" involves 5 cards from the same suit, and there is only one possible "royal flush" per suit.

A deck of cards is placed face down in random order. What is the odds of drawing the first five cards and receiving a Royal Flush?

13. Solve, if possible: $\lim_{x \to 1} \frac{1-x^3}{x^2-1}$

14. For this function: $f(x) = -3x^2 + 16x - 2x \cdot \sqrt{9x^2 + 6x + 1}$

a. What are the x-intercepts?
b. What are the y-intercepts?

15. Evaluate $\log_4\left(18^{25}\right)$ to an accuracy of 10^{-3}.

16. Find $\sum_{n=1}^{\infty} \frac{1}{2^n}$

17. Solve $x^2 - 2x - 3 > 1$

18. The *mod* function is defined: $\text{mod}_m(n) \equiv$ the remainder of $(n \div m)$ generally over the domain of integers. For example, $\text{mod}_5(7) = 2$.

Find the first integer $n > 4$ such that $\text{mod}_4(n) - \text{mod}_{18}(n) = 0$.

19. Solve: $\begin{pmatrix} 1 & -2 \\ -3 & 6 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$.

20. Solve: $\left|\frac{1}{x-1}\right| < \left|\frac{1}{x}\right|$