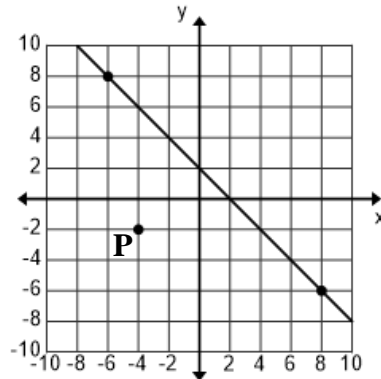


1. At Babe's in Sanger, we ordered four smoked chicken dinners for \$17.95 each, four iced teas for \$2.29 each and two slices of apple pie for \$4.25 each. The tax rate was 8.125% and I paid with one \$100 bill and one \$20 bill. I told the waitress to keep the change as a tip. How much was her tip?
- (A) \$22.79      (B) \$22.95      (C) \$23.11      (D) \$23.27      (E) \$23.43
2. Consider the line with points  $(-3, -5)$  and  $(5, 7)$ . The line contains the point  $(0, b)$ .  $b = \underline{\hspace{2cm}}$ .
- (A)  $-1.00$       (B)  $-0.75$       (C)  $-0.50$       (D)  $-0.25$       (E)  $0$
3. Joe sets the motor of his small boat to travel at its maximum speed. At this setting, he travels 36 miles upstream, against the current, in 9 hours and then turns around and travels 36 miles downstream, with the current, in 6 hours. What is the maximum speed of Joe's boat in still water?
- (A) 4.8 mph      (B) 5.0 mph      (C) 5.2 mph      (D) 5.4 mph      (E) 5.6 mph
4. Last summer, we drove from Lubbock, TX to McMinnville, OR to see relatives. On day 1, we drove 600 miles at an average speed of 62 mph. On day 2, we drove 620 miles at an average speed of 68 mph. On day 3, we drove 534 miles at an average speed of 60 mph. What was our overall average speed for the trip? (nearest tenth)
- (A) 63.0 mph      (B) 63.3 mph      (C) 63.6 mph      (D) 63.9 mph      (E) 64.2 mph
5. Jim can clean my pool in 75 min. Tom can clean my pool in 90 min. Julie can clean my pool in 60 min. If all three of them work together, how long would it take them to clean my pool? (nearest tenth)
- (A) 24.3 min      (B) 24.7 min      (C) 25.1 min      (D) 25.5 min      (E) 25.9 min
6. Consider the line  $y = f(x)$  which contains point P and is parallel to the line shown on the right. Find the value of  $f(9)$ .
- (A)  $-17$   
 (B)  $-16$   
 (C)  $-15$   
 (D)  $-14$   
 (E)  $-13$



Problem 6

9. Find the number that is  $\frac{3}{4}$  of the way from  $-1\frac{1}{2}$  to  $6\frac{5}{8}$ .

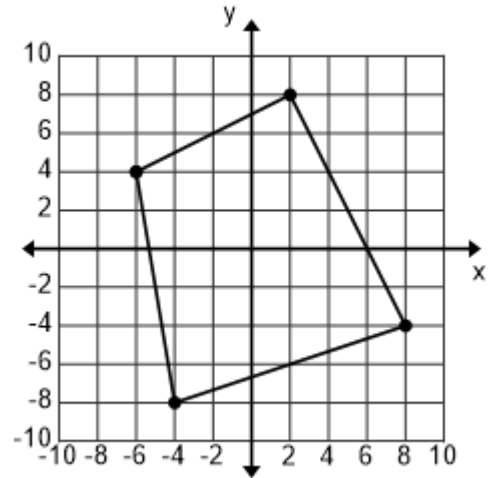
- (A)  $4\frac{19}{32}$       (B)  $4\frac{5}{8}$       (C)  $4\frac{21}{32}$       (D)  $4\frac{11}{16}$       (E)  $4\frac{23}{32}$

10. If  $f(x) = \frac{2x+5}{3-7x}$ , then  $f^{-1}(2) =$  \_\_\_\_\_.

- (A)  $\frac{1}{16}$       (B)  $\frac{1}{8}$       (C)  $\frac{1}{4}$       (D)  $\frac{1}{2}$       (E) 1

11. Find the perimeter of the polygon shown on the right. (nearest tenth)

- (A) 46.4  
(B) 46.6  
(C) 46.8  
(D) 47.0  
(E) 47.2



Problems 11, 12

12. Find the area of the polygon shown on the right.

- (A) 134  
(B) 136  
(C) 138  
(D) 140  
(E) 142

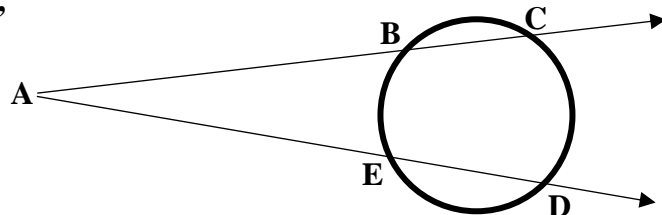
13. Consider  $\triangle ABC$  with  $AB = 18$  and  $BC = 14$ . Point  $D$  lies on  $\overline{AC}$  such that  $\overline{BD}$  bisects  $\angle ABC$ . If  $AD = 10$ , then  $DC =$  \_\_\_\_\_. (nearest tenth)

- (A) 7.2      (B) 7.4      (C) 7.6      (D) 7.8      (E) 8.0

Use the sketch on the right for problems 14 and 15.

14. If  $m\angle CAD = 19^\circ$ ,  $m\angle CD = 120^\circ$ ,  $m\angle DE = 102^\circ$ , then  $m\angle BC =$  \_\_\_\_\_.

- (A)  $52^\circ$     (B)  $54^\circ$     (C)  $56^\circ$   
(D)  $58^\circ$     (E)  $60^\circ$



Problems 14, 15

15. If  $\overline{BD}$  intersects  $\overline{CE}$  at point  $P$  (not shown) with  $BP = x + 1$ ,  $CP = 2x$ ,  $DP = 2x + 2$ , and  $EP = x + 4$ , then  $CE =$  \_\_\_\_\_. (nearest tenth)

- (A) 4.7      (B) 4.9      (C) 5.1      (D) 5.3      (E) 5.5

16. Consider a right circular cone with a base perimeter of 75 cm and a lateral area of 490 cm. Find the volume of the cone. (nearest whole number)
- (A) 787 cm<sup>3</sup>      (B) 790 cm<sup>3</sup>      (C) 793 cm<sup>3</sup>      (D) 796 cm<sup>3</sup>      (E) 799 cm<sup>3</sup>
17. Consider a circle inscribed in a square with side lengths 44.6 mm. Find the area inside the square but outside the circle. (nearest whole number)
- (A) 412 mm<sup>2</sup>      (B) 423 mm<sup>2</sup>      (C) 425 mm<sup>2</sup>      (D) 427 mm<sup>2</sup>      (E) 429 mm<sup>2</sup>
18. Sixty workers could do 9 jobs in 6 days. How many days would it take 10 workers to do 12 jobs? (nearest tenth)
- (A) 46.4 days      (B) 46.8 days      (C) 47.2 days      (D) 47.6 days      (E) 48.0 days
19. Consider the line  $y = f(x)$  such that all points on the line are equidistant from the points  $(-6, 8)$  and  $(4, -6)$ . The  $y$ -intercept of the line  $y = f(x)$  is  $(0, b)$ .  $b =$  \_\_\_\_\_.
- (A)  $\frac{8}{7}$       (B)  $\frac{10}{7}$       (C)  $\frac{12}{7}$       (D) 2      (E)  $\frac{16}{7}$
20. Find the domain of the function  $f(x) = \frac{\sqrt{3+x}}{x^2 - 9x + 20}$ .
- (A)  $x < -3, x \neq 4, 5$       (B)  $x \leq -3, x \neq 4, 5$       (C)  $x \geq -3, x \neq 4, 5$   
 (D)  $x \leq -3, x \neq -4, -5$       (E)  $x > -3, x \neq 4, 5$
21. Solve the system  $\begin{cases} \frac{2}{5}a + \frac{3}{10}c = 2\frac{1}{5} \\ -.5a + 1.5b = 2.5 \\ .75a - 2.5c = -2 \end{cases}$        $b =$  \_\_\_\_\_.
- (A) 2      (B) 3      (C) 4      (D) 5      (E) 6
22. If  $\frac{12i + 8i^4 + 12i^3}{\sqrt{-100 + 10i + 6i^4}}$  simplifies to  $\frac{a}{b} + \frac{c}{b}i$ , then  $a + b + c =$  \_\_\_\_\_.
- (A) 69      (B) 72      (C) 75      (D) 78      (E) 81
23. If  $f(x) = \sec(2x)$  and  $h(x) = \csc(3x)$ .  $f\left(\frac{5\pi}{8}\right) + h\left(\frac{11\pi}{18}\right) =$  \_\_\_\_\_.
- (nearest tenth)
- (A) -3.8      (B) -3.6      (C) -3.4      (D) -3.2      (E) -3.0

24. James has 6 calculus books and 8 physics books on his bookshelf at home. How many arrangements are possible if he keeps the calculus books together and the physics books together?
- (A) 29,030,400      (B) 36,288,000      (C) 43,545,600      (D) 50,803,200      (E) 58,060,800
25. Each of the wheels on Russell's jumbo wheel swamp buggy has a 4 ft diameter. When he is traveling 42 mph, what is the angular velocity of the wheels in revolutions per minute? (nearest whole number)
- (A) 276 rpm      (B) 282 rpm      (C) 288 rpm      (D) 294 rpm      (E) 300 rpm
26. The vertex of the parabola  $y = -4x^2 + 6x - 8$  is the point  $(a, b)$ .  $a + b =$  \_\_\_\_\_. (nearest hundredth)
- (A) -6.00      (B) -5.75      (C) -5.50      (D) -5.25      (E) -5.00
27. Multiply  $(6\text{cis}(60^\circ))(-4\text{cis}(-150^\circ))$  and express the result in rectangular form.
- (A) -24      (B) -24i      (C) 24      (D) 24i      (E)  $-24\sqrt{2}i$
28. Sarah released 36 bunnies into the woods near her house. Six months later the population had increased to 100 bunnies. Assume the bunny population is increasing exponentially and calculate the expected bunny population 21 months after the original release of 36 bunnies.
- (A) 1268      (B) 1274      (C) 1280      (D) 1286      (E) 1292
29. Devin drops a ball from a height of 24 feet. On each bounce, the ball rebounds three-fourths of the distance it fell. How far does the ball rebound on the tenth bounce? (nearest inch)
- (A) 16 in      (B) 18 in      (C) 20 in      (D) 22 in      (E) 24 in
30. Find the perimeter of a regular decagon that can be inscribed in a circle with an area of  $254 \text{ cm}^2$ . (nearest tenth)
- (A) 54.8 cm      (B) 55.2 cm      (C) 55.6 cm      (D) 56.0 cm      (E) 56.4 cm
31. Consider  $f(x) = x^3 + bx^2 + cx + d = 0$ . Two of the zeros are 5 and  $2i$ .  $|b + c + d| =$  \_\_\_\_\_.
- (A) 15      (B) 17      (C) 19      (D) 21      (E) 23
32. The vertices of the hyperbola  $16y^2 - 9x^2 - 96y - 72x - 144 = 0$  are  $(a, b)$  and  $(a, c)$ .  $b + c =$  \_\_\_\_\_.
- (A) -6      (B) -3      (C) 0      (D) 3      (E) 6
33. If  $f(x) = x^2 - 8x + 9$ , then  $\frac{f(x+h) - f(x)}{h} =$  \_\_\_\_\_.
- (A)  $2x - 8$       (B)  $\frac{x^3}{3} - 4x^2 + 9x$       (C)  $2x + h - 8, h \neq 0$       (D)  $\frac{x^3}{3} - 4x^2 + 9x + C$       (E) 9

34. Consider a parabola with vertex  $\left(\frac{3}{2}, \frac{1}{4}\right)$ . If the point  $(-2, 4)$  lies on the graph of the parabola, which of the following points also lies on the graph of the parabola? The graph is concave up.

- (A)  $(2, -2)$       (B)  $(3, 0)$       (C)  $(4, 2)$       (D)  $(5, 4)$       (E)  $(6, 6)$

35. Find the angle between the line  $3x - y = 6$  and the line  $4x + 5y = 9$ . (nearest tenth)

- (A)  $69.8^\circ$       (B)  $70.2^\circ$       (C)  $70.6^\circ$       (D)  $71.0^\circ$       (E)  $71.4^\circ$

36. The graph of the polar equation  $r = 3 - 3\cos(\theta)$  is a \_\_\_\_\_.

- (A) circle      (B) cardioid      (C) dimpled limaçon      (D) convex limaçon      (E) lemniscate

37. The graph of the parametric equations  $x = 13\cos(\theta)$  and  $y = 5\sin(\theta)$  is an ellipse with foci  $(a, b)$  and  $(c, b)$ .  $|a - c| =$  \_\_\_\_\_.

- (A) 5      (B) 10      (C) 13      (D) 24      (E) 26

38. Consider the sphere  $x^2 + y^2 + z^2 + 4x - 6y + 2z - 11 = 0$ . Find the volume of the sphere. (nearest tenth)

- (A) 523.3      (B) 523.6      (C) 523.9      (D) 524.2      (E) 524.5

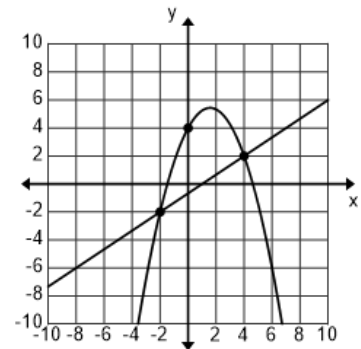
39. The unit vector orthogonal to both  $\mathbf{u} = 2\mathbf{i} - 3\mathbf{j} + 4\mathbf{k}$  and  $\mathbf{v} = -2\mathbf{i} + 5\mathbf{j} - 7\mathbf{k}$  is the vector

$$\frac{a}{\sqrt{53}}\mathbf{i} + \frac{b}{\sqrt{53}}\mathbf{j} + \frac{c}{\sqrt{53}}\mathbf{k}. \quad a + b + c = \text{_____}.$$

- (A) 5      (B) 7      (C) 9      (D) 11      (E) 13

40. The points of intersection of the curves shown on the right are P and Q.  $PQ =$  \_\_\_\_\_.  
(nearest tenth)

- (A) 6.6      (B) 6.8      (C) 7.0  
(D) 7.2      (E) 7.4



Problems 40, 41

41. Find the area bounded by the two curves shown on the right.  
the right. (nearest tenth)

- (A) 20.4      (B) 20.7      (C) 21.0      (D) 21.3      (E) 21.6

42. Consider the function  $f(x) = \frac{1}{2}\cos(2x) + \frac{3}{2}\sin(x)$ . Find the slope of the line tangent to the graph of  $y = f(x)$  when  $x = \pi$ . (nearest tenth)

- (A) -2.1      (B) -1.8      (C) -1.5      (D) -1.2      (E) -0.9

43. A balloon is rising straight up from a point on the ground 150 feet from a curious mouse. If the balloon is rising at a rate 8 ft/s, what is the rate of change of the angle of elevation of the balloon from the mouse when the balloon is 200 ft above the ground. (nearest hundredth)

- (A) 0.02 rad/s    (B) 0.04 rad/s    (C) 0.06 rad/s    (D) 0.08 rad/s    (E) 0.10 rad/s

44. A rectangular solid with a square base has a total surface area of  $330 \text{ in}^2$ . Find the maximum volume possible for such a solid. (nearest tenth)

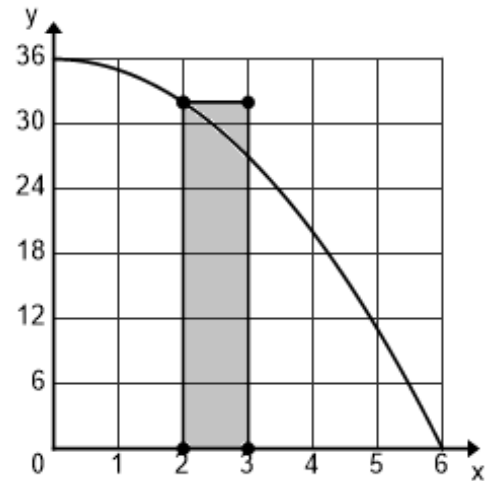
- (A)  $403.1 \text{ in}^3$     (B)  $404.3 \text{ in}^3$     (C)  $405.5 \text{ in}^3$     (D)  $406.7 \text{ in}^3$     (E)  $407.9 \text{ in}^3$

45. Find an approximation of the area bounded by the graph of  $f(x) = 36 - x^2$  and the x-axis between  $x = 1$  and  $x = 5$ . Use four rectangles of equal width and find the height of each rectangle using the left endpoint of the interval. One of the rectangles is shown on the right.

- (A) 110    (B) 112    (C) 114    (D) 116    (E) 118

46. Find the exact area of the region bounded by the graph of  $f(x) = 36 - x^2$  and the x-axis between  $x = 1$  and  $x = 5$ . (nearest tenth)

- (A) 102.0    (B) 102.7    (C) 103.4    (D) 104.1    (E) 104.8



Problems 45, 46

47. Find the derivative of  $F(x)$  if  $F(x) = \int_0^{4x} \sin(t) dt$ .

- (A)  $-\cos(4x)$     (B)  $\cos(4x)$     (C)  $\sin(4x)$     (D)  $4\sin(4x)$     (E)  $4\cos(4x)$

48. When evaluating  $\int x^2 \cos(x) dx$  using a u-substitution, the best choice for u is \_\_\_\_\_.

- (A)  $x$     (B)  $x^2$     (C)  $\cos(x)$     (D)  $\cos(x) dx$     (E)  $\sin(x)$

49. Let  $f(x) = \sin(x)$  and let  $P_5(x)$  be the fifth Maclaurin polynomial for  $f(x) = \sin(x)$ . Find the value of

$$\left| P_5\left(\frac{\pi}{6}\right) - f\left(\frac{\pi}{6}\right) \right|. \text{ (nearest ten-millionth)}$$

- (A) 0.0000021    (B) 0.0000032    (C) 0.0000043    (D) 0.0000054    (E) 0.0000065

50. Find the length of the arc from  $\theta = \frac{\pi}{6}$  to  $\theta = \frac{\pi}{3}$  for the polar curve  $r = 4 - 4\cos(\theta)$ .

(nearest tenth)

- (A) 1.0    (B) 1.2    (C) 1.4    (D) 1.6    (E) 1.8

	Math	English	Science	History	Elective 1	Elective 2
Freshman	94	92	96	98	97	95
Sophomore	93	94	97	99	95	91
Junior	95	93	98	97	96	93

Use the table above for problems 51 and 52.

The table shows the grades for Carolyn her first three years at HPHS.

51. What is Carolyn's cumulative average after three years of school? (nearest hundredth)
- (A) 95.05      (B) 95.11      (C) 95.17      (D) 95.23      (E) 95.29
52. If Carolyn needs to have a cumulative average of 95.45 or higher to graduate in the top 10, what is the minimum average required during her senior year to meet this goal? She plans to take 6 courses her senior year. (nearest hundredth)
- (A) 96.15      (B) 96.30      (C) 96.45      (D) 96.60      (E) 96.75
53. Suppose the distribution of the heights of adult males in Nevada is approximately normal with a mean height of 70 inches and a standard deviation of 2.7 inches. A height of 72 inches corresponds to what percentile in the distribution?
- (A) 73<sup>rd</sup>      (B) 75<sup>th</sup>      (C) 77<sup>th</sup>      (D) 79<sup>th</sup>      (E) 81<sup>st</sup>

	1	2	3	4	5	6	7
Time (wk)	0	2	5	8	11	14	17
Population	12	47	388	3060	24600	200000	1580000

Use the table above for problems 54 and 55.

Sam was doing research for his master's thesis at Harvard. He estimated the population of an isolated group of flies seven different times. He started at  $t = 0$  with 12 flies. He finished at  $t = 17$  weeks with 1,580,000 flies.

54. Sam entered the times into a list he called  $L_1$  and the populations into a list he called  $L_2$  on his computer. Which of the following transformation equations will linearize the data?
- (A)  $(L_1, (L_2)^3)$     (B)  $((L_1)^3, L_2)$     (C)  $(\log(L_1), L_2)$     (D)  $(L_1, \log(L_2))$     (E)  $(\log(L_1), \log(L_2))$
55. Sam was successful in using one of the transformations listed in problem 54 to calculate a regression equation that fit the data. Use this equation to predict how many days after  $t = 0$  that the population reached 100,000 flies. (nearest tenth)
- (A) 90.4 days      (B) 91.1 days      (C) 91.8 days      (D) 92.5 days      (E) 93.1 days

56. Four-hundred students at Texas Tech were randomly selected and asked if they had worked out at the Recreation Center by using a treadmill or an elliptical trainer the past week. The results showed that 75 had worked out on both, 190 had worked out on a treadmill, and 260 had worked out on an elliptical trainer. How many of the 400 students sampled had not worked out on either training device the previous week?
- (A) 15                      (B) 20                      (C) 25                      (D) 30                      (E) 35
57. Amarillo Slim was playing five card poker. He had a full house, but lost to the dealer who had a royal flush. This is where a player has the ten, jack, queen, king and ace of the same suit. Slim thought the dealer was cheating because the probability of being dealt a royal flush from a standard deck of 52 cards is only \_\_\_\_\_. (9 decimal places)
- (A) .000001539    (B) .000006156    (C) .000024625    (D) .000038477    (E) .000049250
58. Assume that Luka Doncic makes 35.3% of his 3-point shots regardless of the opponent or where the game is being played. He is unaffected by previous attempts. If he attempts ten 3-points shots in a game, what is the probability that he makes 4, 5 or 6 of the shots? (nearest thousandth)
- (A) 0.445                      (B) 0.456                      (C) 0.467                      (D) 0.478                      (E) 0.489
59. A survey asked a random sample of 500 U.S. teenagers whether music from the 1970s is superior to music from the 2020s. Of the sample, 312 responded with “yes.” Construct a 95% confidence interval for the proportion of U.S. teenagers who would say “yes” if asked this question.
- (A) (.5411, .6261)    (B) (.5512, .6362)    (C) (.5613, .6463)    (D) (.5714, .6564)    (E) (.5815, .6665)
60. The average lifetime of battery packs for the Williams Electric vehicle was 4.9 years in 2004. In 2012, they introduced a new battery pack that they believed would last longer. A simple random sample of 50 of the 2012 vehicles with the new battery packs was selected. The mean lifetime of the battery packs turned out to be 5.1 years with a standard deviation of 0.86 years. An appropriate test was performed and the resulting P-value was \_\_\_\_\_. (nearest thousandth)
- (A) 0.041                      (B) 0.045                      (C) 0.049                      (D) 0.053                      (E) 0.057