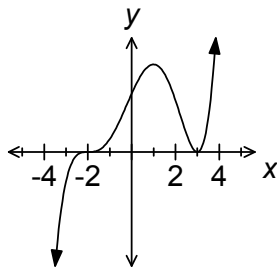


PART I
Total Value: 50%

Answer all items. Shade the letter of the correct answer on the computer scorable answer sheet.

1. Given the graph below, which is true of the polynomial function?

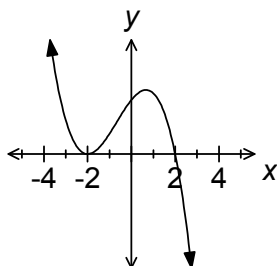


	Degree	Value of leading coefficient
(A)	3	negative
(B)	3	positive
(C)	5	negative
(D)	5	positive

2. Given a polynomial function $P(x)$ with $P(2) = 0$, which is a factor of $P(x)$?

- (A) -2
- (B) 2
- (C) $x - 2$
- (D) $x + 2$

3. Which polynomial function best represents the graph shown below?



- (A) $f(x) = -(x - 2)(x + 2)^2$
- (B) $f(x) = -(x - 2)^2(x + 2)$
- (C) $f(x) = (x - 2)(x + 2)^2$
- (D) $f(x) = (x - 2)^2(x + 2)$

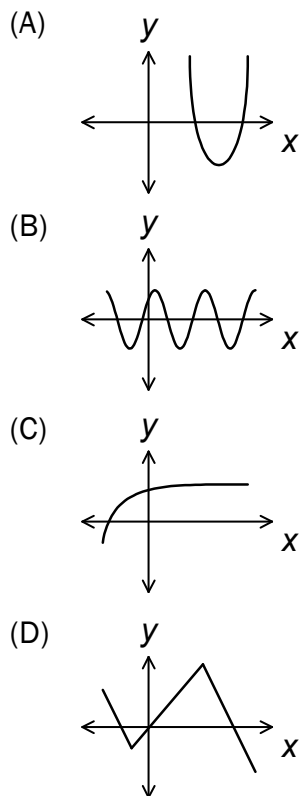
4. Which polynomial equation has a single root at $x = -3$ and a double root at $x = 2$?

- (A) $x^3 - 4x^2 - 3x + 18 = 0$
- (B) $x^3 - x^2 - 8x + 12 = 0$
- (C) $x^3 + x^2 - 8x - 12 = 0$
- (D) $x^3 + 4x^2 - 3x - 18 = 0$

5. What are the x-intercepts of the graph of the function $f(x) = 2x^3 + 3x^2 - 2x - 3$?
- (A) $\{-\frac{3}{2}, -1, 1\}$
 (B) $\{-\frac{3}{2}, 1, 1\}$
 (C) $\{-1, -1, \frac{3}{2}\}$
 (D) $\{-1, 1, \frac{3}{2}\}$
6. When the function $f(x) = x^5 + 4x^2 + 8$ is divided by $(x - 2)$, what is the remainder?
- (A) -40
 (B) -8
 (C) 24
 (D) 56
7. Which is true of the function $y + 2 = -3f(4x + 8)$?

	Horizontal stretch	Vertical stretch
(A)	$\frac{1}{4}$	-3
(B)	$\frac{1}{4}$	3
(C)	4	-3
(D)	4	$\frac{1}{3}$

8. Which graph has an inverse that is also a function?



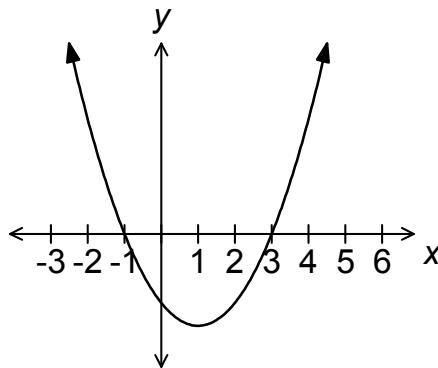
9. The point $(2, -3)$ is on the graph of $y = f(x)$. What is its image point under the transformation $y + 1 = -2f(x - 3)$ of the graph of $f(x)$?

- (A) $(-1, 7)$
- (B) $(5, \frac{1}{2})$
- (C) $(5, \frac{5}{2})$
- (D) $(5, 5)$

10. What is the inverse of $y = 2x^2 - 8$?

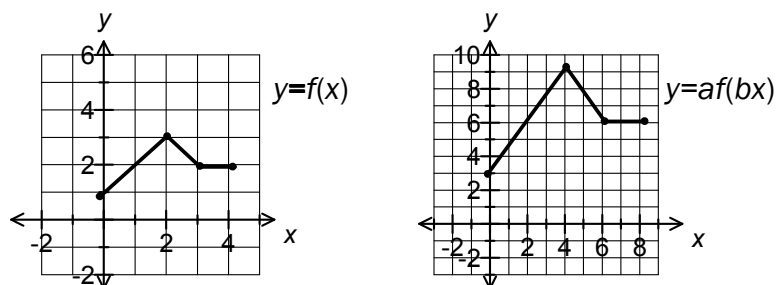
- (A) $x = \pm \sqrt{\frac{y+8}{2}}$
- (B) $x = \pm \sqrt{\frac{1}{2}y+8}$
- (C) $y = \pm \sqrt{\frac{x+8}{2}}$
- (D) $y = \pm \sqrt{\frac{1}{2}x+8}$

11. What are the zeros of the function $y = f(x)$ after the transformation $f(-\frac{1}{2}x)$?



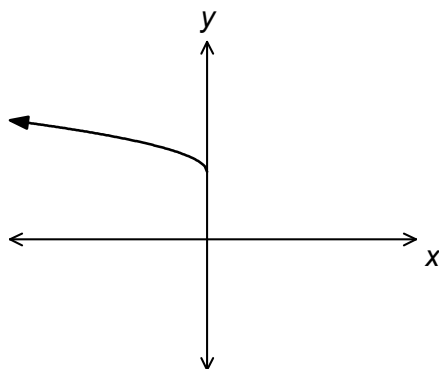
- (A) $\{-6, 2\}$
- (B) $\{-2, 6\}$
- (C) $\{-\frac{3}{2}, \frac{1}{2}\}$
- (D) $\{-\frac{1}{2}, \frac{3}{2}\}$

12. What is the horizontal stretch of $y = af(bx)$ as compared to $y = f(x)$?



- (A) $\frac{1}{3}$
- (B) $\frac{1}{2}$
- (C) 2
- (D) 3

13. Which function best represents the graph shown below?



- (A) $y = \sqrt{-x} - 3$
- (B) $y = \sqrt{-x} + 3$
- (C) $y = -\sqrt{x} - 3$
- (D) $y = -\sqrt{x} + 3$

14. What are all of the invariant points for the graphs of $f(x) = 4x^2 + 3x$ and $y = \sqrt{f(x)}$?

- (A) $(-1, 1), (-\frac{3}{4}, 0), (0, 0), (\frac{1}{4}, 1)$
- (B) $(-1, 1), (\frac{1}{4}, 1)$
- (C) $(-\frac{3}{4}, 0), (0, 0)$
- (D) $(0, 0), (1, 7)$

15. The graph of the function $y = \sqrt{x}$ is stretched horizontally by a factor of 2 and translated 3 units left. What is the domain of the transformed function?

- (A) $\{x \mid x \geq -3, x \in R\}$
- (B) $\{x \mid x \geq -\frac{3}{2}, x \in R\}$
- (C) $\{x \mid x \geq -1, x \in R\}$
- (D) $\{x \mid x \geq \frac{3}{2}, x \in R\}$

16. Which graph represents an angle measuring $\frac{5\pi}{3}$?

- (A)
- (B)
- (C)
- (D)

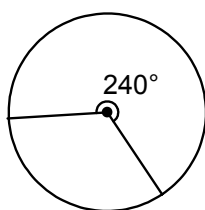
17. In which quadrant is $\csc \theta > 0$ and $\cos \theta < 0$?

- (A) I
- (B) II
- (C) III
- (D) IV

18. What is 440° written in radian measure?

- (A) $\frac{11\pi}{9}$
- (B) $\frac{22\pi}{9}$
- (C) $\frac{44\pi}{9}$
- (D) $\frac{88\pi}{9}$

19. What is the length of the arc cut by a 240° sector in a circle having diameter 10 cm?



- (A) $\frac{10\pi}{3}$
- (B) $\frac{20\pi}{3}$
- (C) $\frac{30\pi}{3}$
- (D) $\frac{40\pi}{3}$

20. Given $P(7, -24)$ are the coordinates on the terminal arm of an angle θ in standard position, what is $\csc \theta$?

- (A) $-\frac{25}{24}$
- (B) $-\frac{24}{25}$
- (C) $\frac{7}{25}$
- (D) $\frac{25}{7}$

21. Solve for x : $\sqrt{3} \sec x + 2 = 0$, where $0 \leq x < 2\pi$.

- (A) $\frac{\pi}{6}, \frac{11\pi}{6}$
- (B) $\frac{\pi}{3}, \frac{5\pi}{3}$
- (C) $\frac{2\pi}{3}, \frac{4\pi}{3}$
- (D) $\frac{5\pi}{6}, \frac{7\pi}{6}$

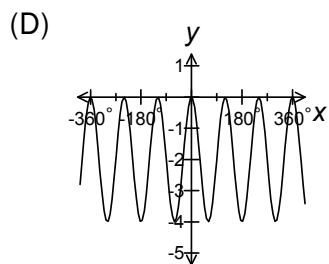
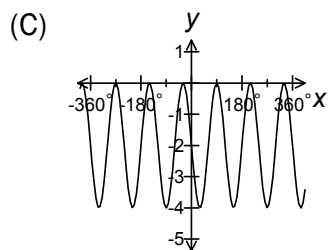
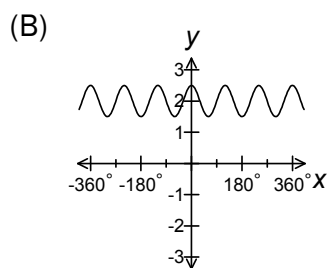
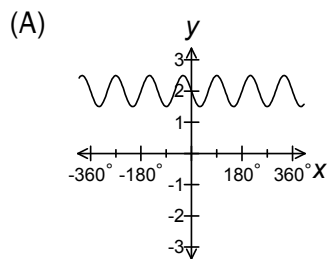
22. What is the domain of $y = \tan x$?

- (A) $\{x \mid x \neq \frac{\pi}{4} + \pi n, n \in I, x \in R\}$
- (B) $\{x \mid x \neq \frac{\pi}{4} + 2\pi n, n \in I, x \in R\}$
- (C) $\{x \mid x \neq \frac{\pi}{2} + \pi n, n \in I, x \in R\}$
- (D) $\{x \mid x \neq \frac{\pi}{2} + 2\pi n, n \in I, x \in R\}$

23. What is the period of $y = 4 \cos \frac{1}{2}(x - 45^\circ)$?

- (A) $\frac{\pi}{2}$
- (B) π
- (C) 4π
- (D) 8π

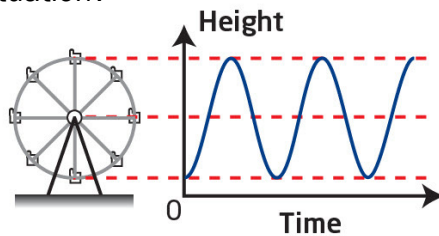
24. Which graph best represents the sinusoidal function $y = -2 \sin 3(x - 30^\circ) - 2$?



25. What is the range of the function $y = \frac{1}{4} \cos 2\left(x - \frac{\pi}{4}\right) - 3$?

- (A) $\{y \mid -7 \leq y \leq 1, y \in R\}$
- (B) $\{y \mid -\frac{13}{4} \leq y \leq -\frac{11}{4}, y \in R\}$
- (C) $\{y \mid -1 \leq y \leq 7, y \in R\}$
- (D) $\{y \mid \frac{11}{4} \leq y \leq \frac{13}{4}, y \in R\}$

26. A Ferris wheel with a radius of 6 m rotates once every 30 seconds. Passengers get on board at a point 1 m above the ground at the bottom of the Ferris wheel. Which function models this situation?



- (A) $y = -6 \cos \frac{\pi}{15} x + 7$
- (B) $y = -6 \cos \frac{15}{\pi} x + 7$
- (C) $y = -\frac{1}{6} \cos \frac{\pi}{15} x + 7$
- (D) $y = -\frac{1}{6} \cos \frac{\pi}{15} x + 7$
27. What are the non-permissible values of x for the equation $\sec x \cdot \sin x = \tan x$?
- (A) $x \neq 0 + \frac{\pi}{2}n, n \in I$
- (B) $x \neq 0 + \pi n, n \in I$
- (C) $x \neq \frac{\pi}{2} + \frac{\pi}{2}n, n \in I$
- (D) $x \neq \frac{\pi}{2} + \pi n, n \in I$
28. Which is $2 \sin \frac{\pi}{6} \cos \frac{\pi}{6}$ expressed as a single trigonometric function?
- (A) $\cos \frac{\pi}{3}$
- (B) $\sin \frac{\pi}{3}$
- (C) $1 - 2 \sin^2 \frac{\pi}{6}$
- (D) $2 \cos^2 \frac{\pi}{6} - 1$
29. Which is a true identity?
- (A) $2 \sin \theta = 1$
- (B) $2 \cos^2 \theta - 1 = 0$
- (C) $\sin \theta \cot \theta = \cos \theta$
- (D) $\sin^2 \theta = \cos^2 \theta - 1$
30. Which is the simplified form of the trigonometric expression $\frac{\csc \theta - \sin \theta}{\cot^2 \theta}$?
- (A) $-\tan^2 \theta$
- (B) $\frac{1}{1 - \cos \theta}$
- (C) $\frac{\cos^4 \theta}{\sin^3 \theta}$
- (D) $\sin \theta$

31. What is the exact value of $\cos 75^\circ$?

- (A) 0
- (B) $\frac{1}{2}$
- (C) $\frac{\sqrt{6} - \sqrt{2}}{4}$
- (D) $\frac{\sqrt{6} + \sqrt{2}}{4}$

32. Given that $\cos \theta = \frac{5}{13}$, where $\frac{\pi}{2} \leq \theta \leq \pi$, what is the exact value of $\cos 2\theta$?

- (A) $-\frac{120}{169}$
- (B) $-\frac{119}{169}$
- (C) $\frac{119}{169}$
- (D) $\frac{120}{169}$

33. In which step is there an error when simplifying the expression $\frac{\tan x + \tan x \cos^2 x}{\sin^3 x}$?

Step 1: $\frac{\tan x(1 - \cos^2 x)}{\sin^3 x}$

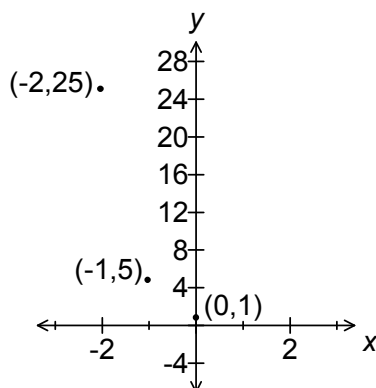
Step 2: $\frac{\tan x(1 - \cos^2 x)}{(1 - \cos^2 x)\sin x}$

Step 3: $\frac{\tan x}{\sin x}$

Step 4: $\sec x$

- (A) Step 1
- (B) Step 2
- (C) Step 3
- (D) Step 4

34. Which function of the form $y = c^x$ best represents the graph shown below?



- (A) $y = -(5)^x$
- (B) $y = -\left(\frac{1}{5}\right)^x$
- (C) $y = \left(\frac{1}{5}\right)^x$
- (D) $y = (5)^x$

35. Solve for x: $\sqrt{5} = 25^x$

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

36. Solve for x: $\left(\frac{1}{3}\right)^{2x-1} = 81^{3-x}$

- (A) $\frac{11}{6}$
- (B) $\frac{13}{6}$
- (C) $\frac{11}{2}$
- (D) $\frac{13}{2}$

37. What is the y-intercept of the function $y = -2(3)^{2(x+1)} - 4$?

- (A) -22
- (B) -6
- (C) 14
- (D) 32

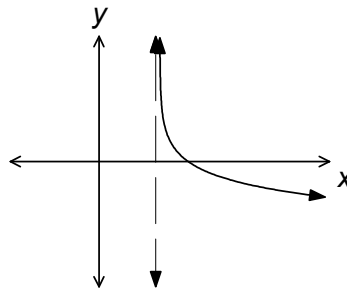
38. Which transformations of $y = 5^x$ produce the function $y = (5)^{0.2x-1}$?

	Horizontal Translation	Horizontal Stretch Factor
(A)	1 unit right	$\frac{1}{5}$
(B)	1 unit right	5
(C)	5 units right	$\frac{1}{5}$
(D)	5 units right	5

39. What is the x-intercept of $y = \log_2(x + 4)$?

- (A) -4
- (B) -3
- (C) 2
- (D) 16

40. What function best represents the graph shown below?



- (A) $y = -\log_4(x - 2)$
- (B) $y = -\log_4(x + 2)$
- (C) $y = \log_4(x - 2)$
- (D) $y = \log_4(x + 2)$

41. Which is $m \log_p n = q$ written in exponential form?

- (A) $p^m = n^q$
- (B) $p^q = n^m$
- (C) $p^q = mn$
- (D) $p^{qm} = n$

42. Solve for x : $\log_5(3x) + \log_5(x - 3) = \log_5 30$

- (A) 2
- (B) $\frac{10}{3}$
- (C) 5
- (D) $\frac{33}{4}$

43. Solve for x : $5^{x+1} = 2(3^{2x})$

- (A) $\frac{-\log 5}{1 - 2\log 6}$
- (B) $\frac{-\log 5}{\log 5 - 2\log 6}$
- (C) $\frac{\log 2 - \log 5}{1 - 2\log 3}$
- (D) $\frac{\log 2 - \log 5}{\log 5 - 2\log 3}$

44. A group of 24 people are in a Math League. A four person committee is to be formed from within this group; however, two of the 24 people in the group must be on the committee. Which represents the number of ways this four person committee is formed?
- (A) ${}_{22}C_2$
 (B) ${}_{22}P_2$
 (C) ${}_{24}C_2$
 (D) ${}_{24}P_2$
45. Which equation is true?
- (A) ${}_6C_9 = {}_3C_6$
 (B) ${}_6C_9 = {}_6C_3$
 (C) ${}_9C_6 = {}_3C_9$
 (D) ${}_9C_6 = {}_9C_3$
46. If the eighth row of Pascal's Triangle is given as 1 7 21 35 35 21 7 1, what is the coefficient of the x^5y^2 term in the expansion of $(x + y)^7$?
- (A) 1
 (B) 7
 (C) 21
 (D) 35
47. How many different 11-letter arrangements can be made using the letters of the word POSSIBILITY?
- (A) 3 326 400
 (B) 6 652 800
 (C) 19 958 400
 (D) 39 916 800
48. In how many ways can four people stand in a circle?
- (A) 4
 (B) 6
 (C) 20
 (D) 24
49. What is the 5th term in the expansion of $(3n + 1)^6$?
- (A) $90n^2$
 (B) $135n^2$
 (C) $270n^2$
 (D) $3240n^2$

50. John is purchasing a new vehicle. He can choose between a car, an SUV or a truck. The vehicle can be automatic or standard transmission. The choices for the colour of the vehicle are red, silver, black and white. How many choices does he have?

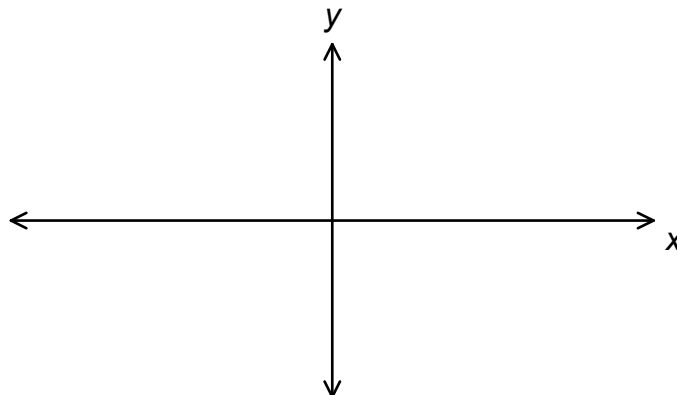
- (A) 9
- (B) 10
- (C) 24
- (D) 36

PART II
Total Value: 50%

Answer **ALL** items in the space provided. Show **ALL** workings.

Value

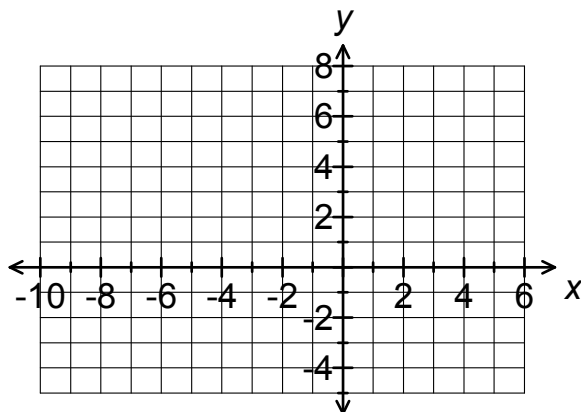
- 4 51.(a) Sketch the graph of the function $y = 2x^3 - 5x^2 - 4x + 3$ and clearly label the x-intercept(s) and the y-intercept.



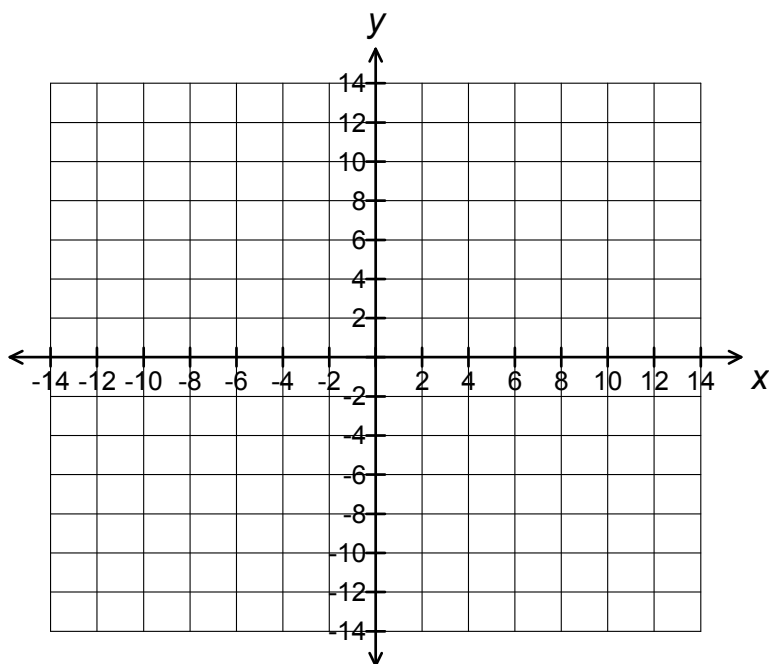
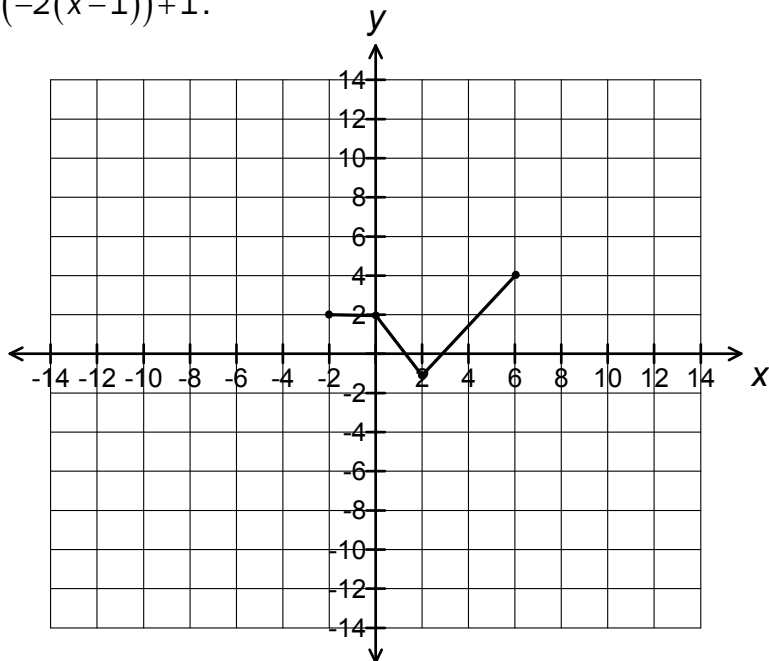
- 2 51.(b) The dimensions of a rectangular prism are given by $x + 2$, $x - 4$ and $x - 1$. Write an equation representing the volume in the form $f(x) = ax^3 + bx^2 + cx + d$. Identify and justify all inadmissible values for x .

Value

- 3 52.(a) The graph of $y = f(x)$ with points $A(5, 3)$, $B(3, 6)$, $C(-1, -3)$ is transformed so that $A'(-9, -1)$, $B'(-5, 0)$, $C'(3, -3)$. Plot the points and determine the equation of the image function in the form $y = af(b(x-h))+k$.

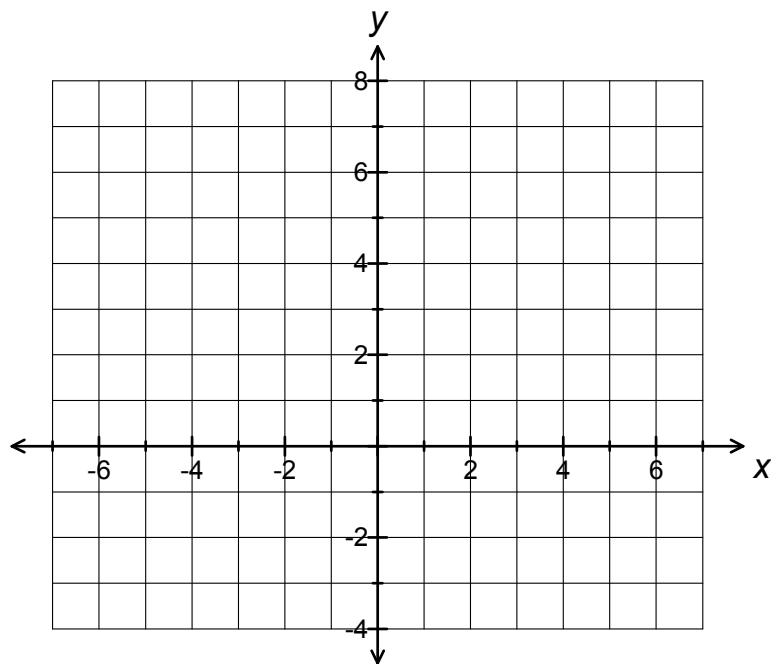


- 2 52.(b) Given the graph of the function $y = f(x)$ below, sketch the inverse graph of $y = 3f(-2(x-1))+1$.



Value

2 53.(a) Solve graphically: $\sqrt{25 - x^2} = 4$



2 53.(b) Use $f(x) = -px + q$ to answer the questions below.

(i) Determine the invariant points for $y = f(x)$ and $y = \sqrt{f(x)}$.

(ii) State the domain and range of $y = \sqrt{f(x)}$.

Value

4

54. Algebraically determine the exact value of:
(simplify completely)

$$\frac{\sec\left(\frac{11\pi}{6}\right) + \cot\left(\frac{8\pi}{3}\right)}{\sin(-150^\circ)}$$

4

- 55.(a) Determine all solutions, in radian measure, for the equation:

$$\sin\left[\frac{1}{2}\left(\theta - \frac{\pi}{2}\right)\right] = -\frac{\sqrt{2}}{2}$$

Value

- 3 56.(a) $\angle A$ and $\angle B$ are both in Quadrant II, $\cos A = -\frac{5}{13}$ and $\sin B = \frac{3}{5}$. Determine the exact value of $\cos(A+B)$.

- 3 56.(b) Verify the trigonometric identity: $\frac{\sin 2x}{1 - \cos 2x} = \cot x$

Value

3 56.(c) Solve the trigonometric equation shown below for $0 \leq x \leq 2\pi$:

$$\sin 3x \cos x - \cos 3x \sin x = -\frac{\sqrt{3}}{2}$$

2 57.(a) Algebraically solve for x : $243^{2x-1} = 3(81)^{x+4}$

Value

- 4 57.(b) A vehicle purchased for \$32,000 depreciates at a rate of 75% every 6 years. Another vehicle purchased for \$16,000 depreciates at a rate of 50% every 4 years. Create an exponential function for each situation, and use the functions to algebraically determine the amount of time it would take for the vehicles to be equal in value.

- 3 58.(a) Algebraically solve for x : $\log_5(x^2 - 5x + 6) - \log_5(x - 2) = 1$

Value

- 3 58.(b) Sound intensity, A , in decibels is defined as $A = 10\log\left(\frac{I}{I_0}\right)$ where I is the intensity of the sound measured in watts per square metre (W/m^2) and I_0 is 10^{-12} W/m^2 , the threshold of hearing. What is the sound intensity of a fire truck siren that has a decibel level of 112 dB?

- 4 59.(a) Expand $\left(a - \frac{3}{a^2}\right)^6$ using the Binomial Theorem.

Value

2 59.(b) Algebraically solve for n : ${}_nC_3 = 3({}_nP_2)$