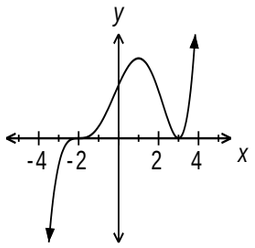
## PART I
## Total Value: 50%

**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?

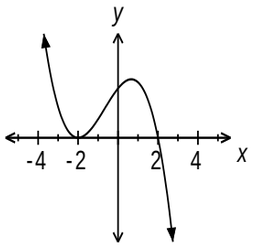



| | Degree | Value of leading coefficient |
|---|---|---|
| (A) | 3 | negative |
| (B) | 3 | positive |
| (C) | 5 | negative |
| (D) | 5 | positive |

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) $\left\{-\frac{3}{2}, -1, 1\right\}$

(B) $\left\{-\frac{3}{2}, 1, 1\right\}$

(C) $\left\{-1, -1, \frac{3}{2}\right\}$

(D) $\left\{-1, 1, \frac{3}{2}\right\}$

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

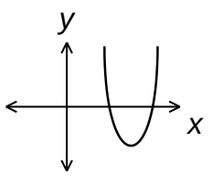
(D) 56

7. Which is true of the function $y + 2 = -3f(4x + 8)$?

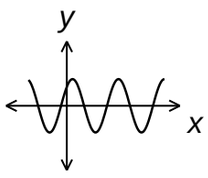
| | Horizontal stretch | Vertical stretch |
|---|---|---|
| (A) | $\frac{1}{4}$ | $-3$ |
| (B) | $\frac{1}{4}$ | 3 |
| (C) | 4 | $-3$ |
| (D) | 4 | $\frac{1}{3}$ |

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

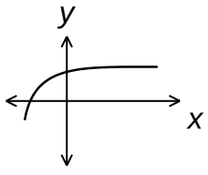
(A)



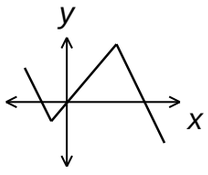

(B)




(C)




(D)



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) $\left(5,\frac{1}{2}\right)$

(C) $\left(5,\frac{5}{2}\right)$

(D) $(5,5)$

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

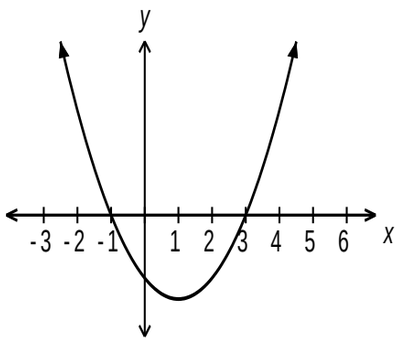
(A) $x=\pm\sqrt{\dfrac{y+8}{2}}$

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

(C) $y=\pm\sqrt{\dfrac{x+8}{2}}$

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

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



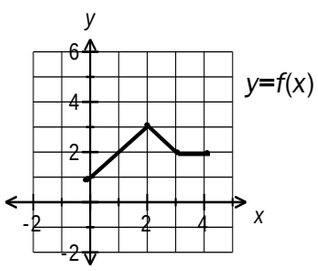

(A) $\{-6,2\}$

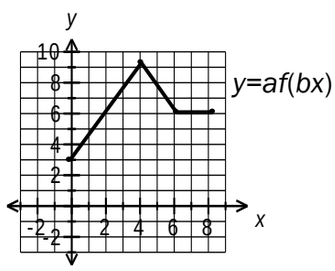
(B) $\{-2,6\}$

(C) $\left\{-\frac{3}{2},\frac{1}{2}\right\}$

(D) $\left\{-\frac{1}{2},\frac{3}{2}\right\}$

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



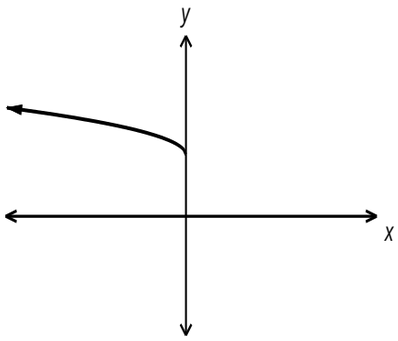

(A) $\frac{1}{3}$

(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) $\{x | x \geq -3, x \in R\}$

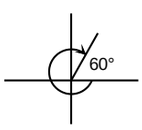
(B) $\{x | x \geq -\frac{3}{2}, x \in R\}$

(C) $\{x | x \geq -1, x \in R\}$

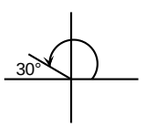
(D) $\{x | x \geq \frac{3}{2}, x \in R\}$

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

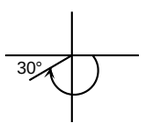
(A)



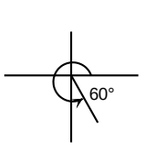

(B)




(C)




(D)



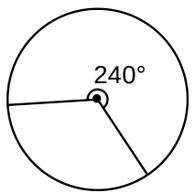
17. In which quadrant is $\csc\theta > 0$ and $\cos\theta < 0$?

(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 $0 \le x < 2\pi$.

(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) $\left\{x \middle| x \neq \frac{\pi}{4} + \pi n, n \in I, x \in R\right\}$
(B) $\left\{x \middle| x \neq \frac{\pi}{4} + 2\pi n, n \in I, x \in R\right\}$
(C) $\left\{x \middle| x \neq \frac{\pi}{2} + \pi n, n \in I, x \in R\right\}$
(D) $\left\{x \middle| x \neq \frac{\pi}{2} + 2\pi n, n \in I, x \in R\right\}$

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

(A) $\frac{\pi}{2}$

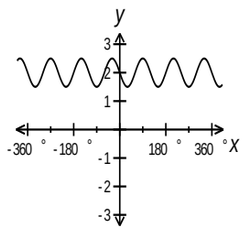
(B) $\pi$

(C) $4\pi$

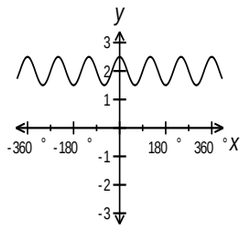
(D) $8\pi$

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

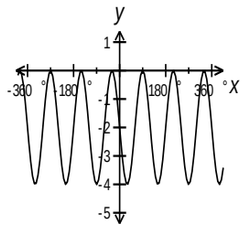
(A)



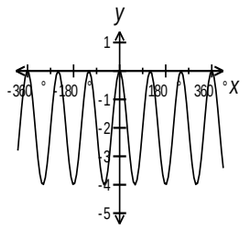

(B)




(C)




(D)




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

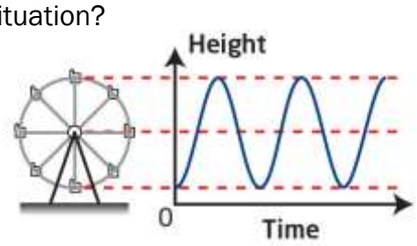
(A) $\{y | -7 \le y \le 1, y \in R\}$

(B) $\{y | -\frac{13}{4} \le y \le -\frac{11}{4}, y \in R\}$

(C) $\{y | -1 \le y \le 7, y \in R\}$

(D) $\{y | \frac{11}{4} \le y \le \frac{13}{4}, y \in R\}$

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 $\cos 75°$?

(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 $\frac{\pi}{2} \le \theta \le \pi$, 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: $\frac{\tan x\left(1-\cos^2 x\right)}{\sin^3 x}$

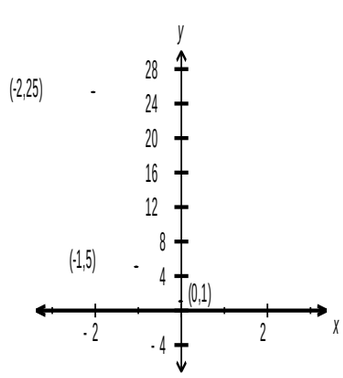
Step 2: $\frac{\tan x\left(1-\cos^2 x\right)}{\left(1-\cos^2 x\right)\sin x}$

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

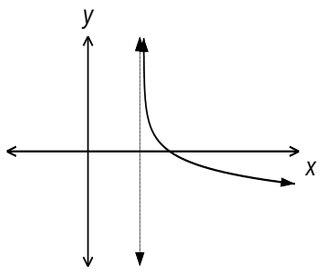
38. Which transformations of $y = 5^{x}$ produce the function $y = (5)^{0.2x-1}$?

| | 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 $x$: $5^{x+1} = 2\left(3^{2x}\right)$

(A) $\dfrac{-\log 5}{1-2\log 6}$

(B) $\dfrac{-\log 5}{\log 5-2\log 6}$

(C) $\dfrac{\log 2-\log 5}{1-2\log 3}$

(D) $\dfrac{\log 2-\log 5}{\log 5-2\log 3}$

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

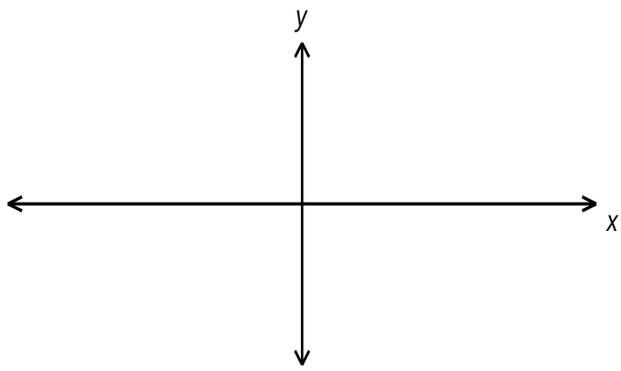
## PART II

**Total Value: 50%**

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

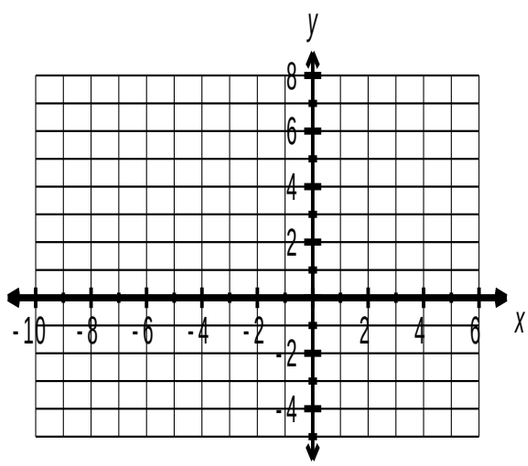
*Value*

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.

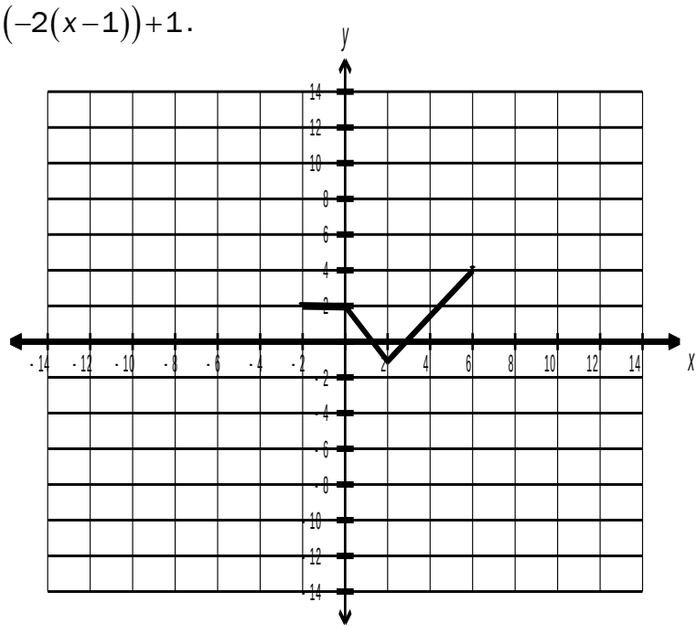


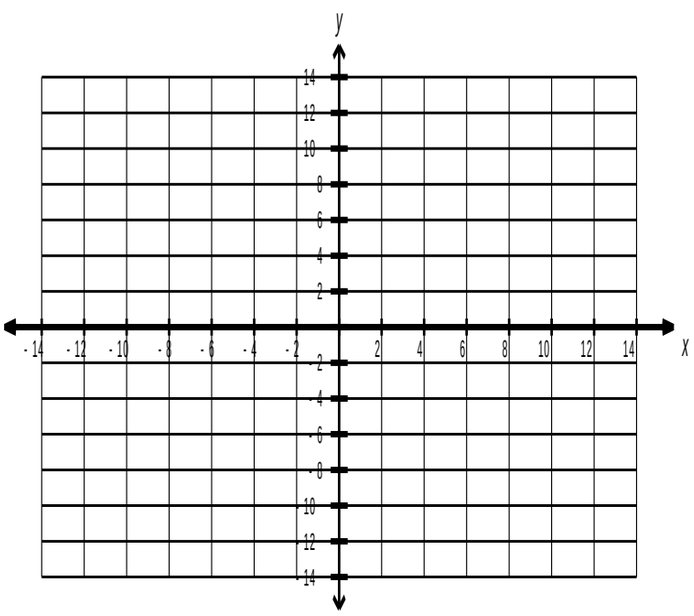

2 51.(b) The dimensions of a rectangular prism are given by $x+2$, $x-4$ and $x-1$. Write an equation representing the volume in the form $f(x) = ax^3 + bx^2 + cx + d$. Identify and justify all inadmissible values for *x*.

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 $y = af(b(x-h))+k$.



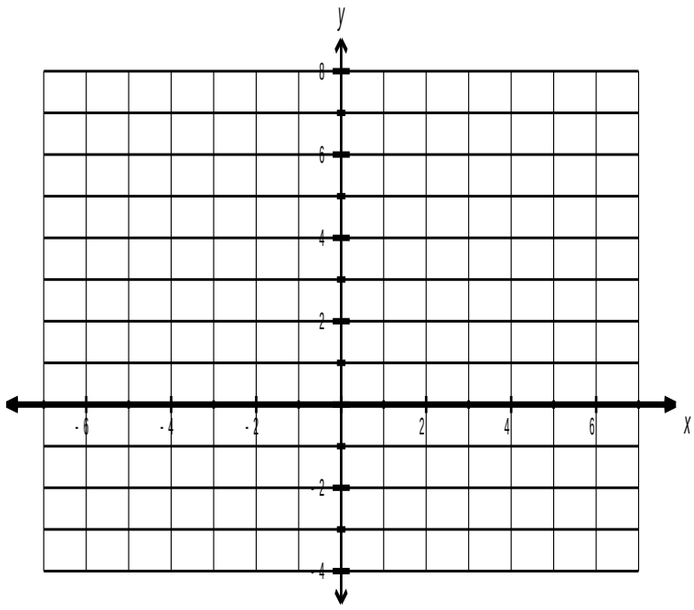
2 52.(b) Given the graph of the function $y = f(x)$ below, sketch the inverse graph of $y = 3f\left(-2(x-1)\right)+1$.



*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 $y=\sqrt{f(x)}$.

4 54. Algebraically determine the exact value of: (simplify completely) $\dfrac{\sec\left(\frac{11\pi}{6}\right)+\cot\left(\frac{8\pi}{3}\right)}{\sin(-150°)}$

4 55.(a) Determine all solutions, in radian measure, for the equation: $\sin\left[\frac{1}{2}\left(\theta-\frac{\pi}{2}\right)\right]=-\frac{\sqrt{2}}{2}$

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: $\dfrac{\sin 2x}{1-\cos 2x}=\cot x$

3 56.(c) Solve the trigonometric equation shown below for $0\le x\le 2\pi$:
$\sin 3x\cos x-\cos 3x\sin x=-\frac{\sqrt{3}}{2}$

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

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*: $\log_5(x^2 - 5x + 6) - \log_5(x - 2) = 1$

3 58.(b) Sound intensity, A, in decibels is defined as $A = 10\log\left(\frac{I}{I_o}\right)$ where $I$ is the intensity of the sound measured in watts per square metre (W/m$^2$) and $I_o$ 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?

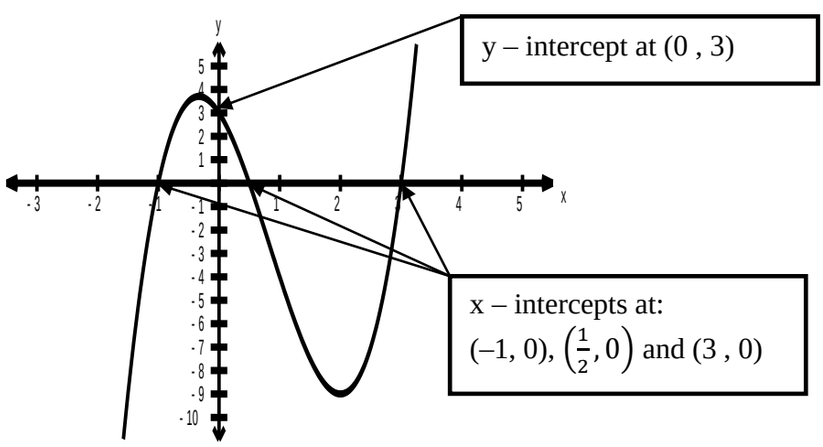
4 59.(a) Expand $\left(a - \frac{3}{a^2}\right)^6$ using the Binomial Theorem.

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

**ANSWERS:**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. D | 2. C | 3. A | 4. B | 5. A | 6. D | 7. B | 8. C | 9. D | 10. C | 11. A | 12. C | 13. B |
| 14. A | 15. A | 16. D | 17. B | 18. B | 19. B | 20. A | 21. D | 22. C | 23. C | 24. D | 25. B | 26. B |
| 27. D | 28. B | 29. C | 30. D | 31. C | 32. B | 33. A | 34. C | 35. A | 36. C | 37. A | 38. D | 39. B |
| 40. A | 41. B | 42. C | 43. D | 44. A | 45. D | 46. C | 47. A | 48. B | 49. B | 50. C | | |

51.(a)




51.(b) $f(x) = x^3 - 3x^2 - 6x + 8$

Note: To have a rectangular prism we must have $f(x) > 0$ and $x > 0$. To have a positive dimension for length, width and height we cannot consider values for x where $x < 4$ otherwise some of the dimensions will be less than 0. Therefore, positive dimensions and volume occurs when $x > 4$.

52.(a)

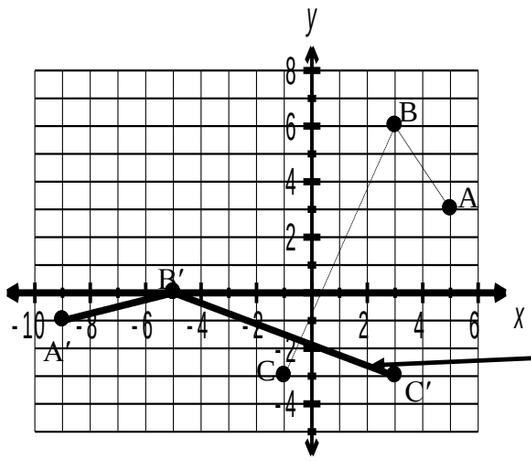
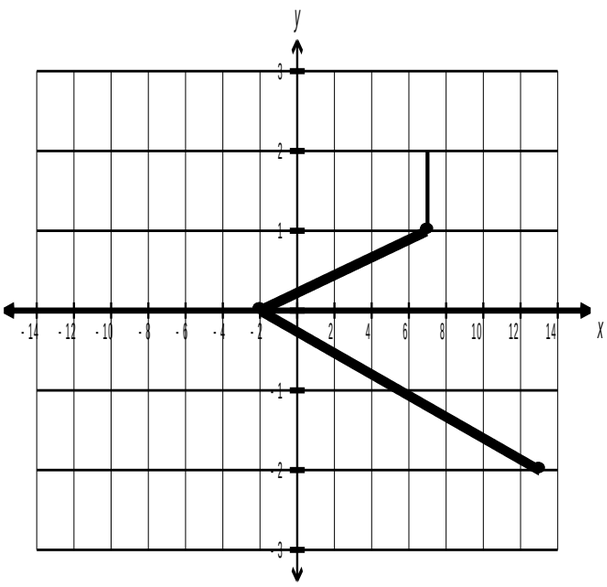


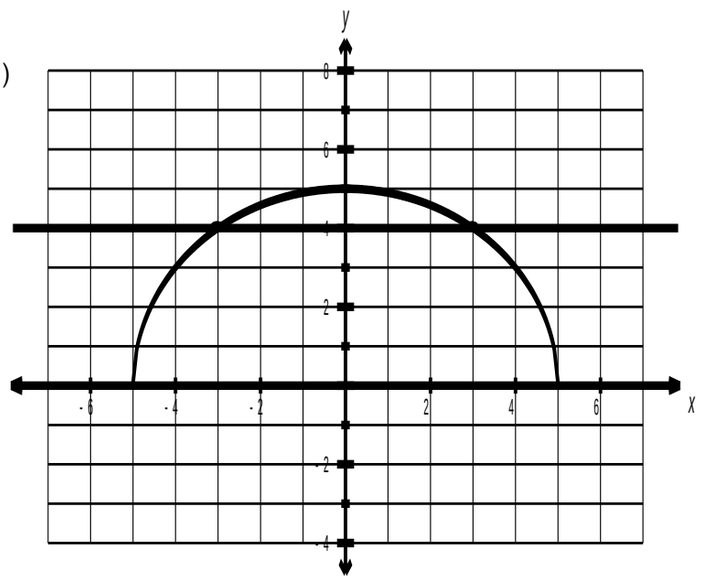

Image Function:

$$y = \frac{1}{3} f\left(-\frac{1}{2}(x-1)\right) - 2$$

52.(b)




53.(a)




Solutions:
x = –3 and 3

53.(b) (i) Invariant points $\left(\frac{p}{q}, 0\right)$ and $\left(\frac{q-1}{p}, 1\right)$

(ii) Domain $x \leq \frac{q}{p}$ Range y ≥ 0

54. $-\frac{2\sqrt{3}}{3}$

55.(a) θ = 3π + 4πn, n ϵ I, θ = 4πn, n ϵ I

56.(a) $-\frac{16}{65}$

$$\frac{2\sin x\cos x}{1-\left(1-2\sin^2 x\right)}$$

$$\frac{2\sin x\cos x}{1-1+2\sin^2 x}$$

56.(b) $\frac{2\sin x\cos x}{2\sin^2 x}$

$$\frac{\cos x}{\sin x}$$

$$\cot x$$

56.(c) $\frac{2\pi}{3},\frac{5\pi}{6},\frac{5\pi}{3},\frac{11\pi}{6}$

57.(a) $\frac{11}{3}$ 57.(b) 12 years

58.(a) x = 8 58.(b) $10^{-0.8}$ W/m$^2$
or 0.158 W/m$^2$

59.(a) $a^6-18a^3+135-\frac{540}{a^3}+\frac{1215}{a^6}-\frac{1458}{a^9}+\frac{729}{a^{12}}$ 59.(b) n = 20

Binomial Theorem:

$$(x+y)^n = {}_nC_0(x)^n(y)^0 + {}_nC_1(x)^{n-1}(y)^1 + {}_nC_2(x)^{n-2}(y)^2 + \ldots + {}_nC_{n-1}(x)^1(y)^{n-1} + {}_nC_n(x)^0(y)^n$$

$$\tan(A+B)=\frac{\tan A+\tan B}{1-\tan A\tan B}$$

$$\tan(A-B)=\frac{\tan A-\tan B}{1+\tan A\tan B}$$

$$\sin(A+B)=\sin A\cos B+\cos A\sin B$$

$$\sin(A-B)=\sin A\cos B-\cos A\sin B$$

$$\cos(A+B)=\cos A\cos B-\sin A\sin B$$

$$\cos(A-B)=\cos A\cos B+\sin A\sin B$$

$$\sin^2\theta+\cos^2\theta=1$$

$$\cot^2\theta+1=\csc^2\theta$$

$$1+\tan^2\theta=\sec^2\theta$$

$$\sin 2A=2\sin A\cos A$$

$$\cos 2A=\cos^2 A-\sin^2 A$$

$$\cos 2A=1-2\sin^2 A$$

$$\cos 2A=2\cos^2 A-1$$

$$\tan 2A=\frac{2\tan A}{1-\tan^2 A}$$

$$A=A_o(1+r)^n$$

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$${}_n\mathrm{P}_r = \frac{n!}{(n-r)!} \qquad \frac{n!}{a!b!c!\ldots}$$

$${}_nC_r = \binom{n}{r} = \frac{n!}{(n-r)!r!}$$