Max Marks: 300 **JR_WEEK-1 (15-06-2026)** **Time: 180 mins**

Chemistry

1. H_3BO_3 is:

A) Monobasic and weak Lewis acid
B) Monobasic and weak Bronsted acid
C) Monobasic and strong Lewis acid
D) Tribasic and weak Bronsted acid

2. Statement-1: In water, orthoboric acid behaves as a weak monobasic acid. Statement-2: In water, orthoboric acid acts as a proton donor.

A) If both Statement-1 and Statement-2 are correct, and Statement-2 is the correct explanation of Statement-1.
B) If both Statement-1 and Statement-2 are correct, but Statement-2 is not the correct explanation of Statement-1.
C) If Statement-1 is correct but Statement-2 is incorrect.
D) If Statement-1 is incorrect but Statement-2 is correct.

3. Statement-1: Pb^{+4} compounds are stronger oxidising agents than Sn^{+4} compounds. Statement-2: The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'.

A) If both Statement-1 and Statement-2 are correct, and Statement-2 is the correct explanation of Statement-1.
B) If both Statement-1 and Statement-2 are correct, but Statement-2 is not the correct explanation of Statement-1.
C) If Statement-1 is correct but Statement-2 is incorrect.
D) If Statement-1 is incorrect but Statement-2 is correct.

4. The order of the oxidation state of the phosphorus atom in $H_3PO_2, H_3PO_4, H_3PO_3$ and $H_4P_2O_6$ is:

A) $H_3PO_3 > H_3PO_2 > H_3PO_4 > H_4P_2O_6$
B) $H_3PO_4 > H_4P_2O_6 > H_3PO_3 > H_3PO_2$
C) $H_3PO_4 > H_4P_2O_6 > H_3PO_3 > H_3PO_2$
D) $H_3PO_3 > H_4P_2O_6 > H_3PO_4$

5. Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen?

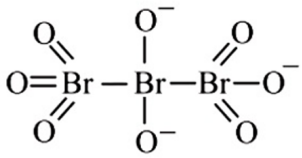
A) HNO_3, NO, NH_4Cl, N_2
B) HNO_3, NO, N_2, NH_4Cl
C) HNO_3, NH_4Cl, NO, N_2
D) NO, HNO_3, NH_4Cl, N_2

6. For H_3PO_3 and H_3PO_4, the correct choice is:

A) H_3PO_3 is dibasic and reducing
B) H_3PO_3 is dibasic and non-reducing
C) H_3PO_3 is tribasic and reducing
D) H_3PO_3 is tribasic and non-reducing

7. The correct structure of tribromooctaoxide is

A)



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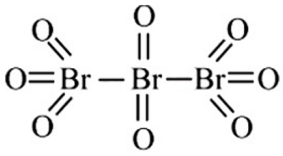

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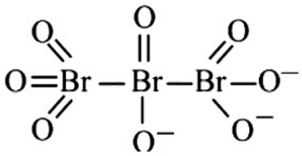
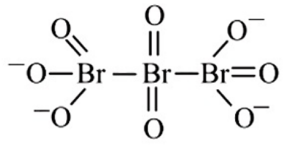


D)



8. The acid having O-O bond is:

A) $H_2S_2O_3$
B) $H_2S_2O_6$
C) $H_2S_2O_8$
D) $H_2S_4O_6$

9. Which of the Phosphorus oxoacid can create silver mirror from $AgNO_3$ solution?

A) $(HPO_3)_n$
B) $H_4P_2O_5$
C) $H_4P_2O_6$
D) $H_4P_2O_7$

10. Sum of π-bonds present in peroxodisulphuric acid and pyrosulphuric acid is

A) 4
B) 6
C) 8
D) 10

11. The oxidation state of phosphorus in hypophosphoric acid is + _____.

A) 1
B) 3
C) 4
D) 5

12. Sum of oxidation states of bromine in bromic acid and perbromic acid is _____.

A) 10 **B)** 12
C) 14 **D)** 16

13. The acid having O-O bond is:

A) $H_2S_2O_3$ **B)** $H_2S_2O_6$
C) $H_2S_2O_8$ **D)** $H_2S_4O_6$

14. Which of the Phosphorus oxoacid can create silver mirror from $AgNO_3$ solution?

A) $(HPO_3)_n$ **B)** $H_4P_2O_5$
C) $H_4P_2O_6$ **D)** $H_4P_2O_7$

15. Which of the following oxoacids of sulphur contains "S" in two different oxidation states?

A) $H_2S_2O_3$ **B)** $H_2S_2O_6$
C) $H_2S_2O_7$ **D)** $H_2S_2O_8$

16. The oxoacid of phosphorus that is easily obtained from a reaction of alkali and white phosphorus and has two $P-H$ bonds, is :

A) Phosphonic acid **B)** Phosphinic acid
C) Pyrophosphorus acid **D)** Hypophosphoric acid

17. Which oxoacid of phosphorous has the highest number of oxygen atoms present in its chemical formula?

A) Pyrophosphorus acid **B)** Hypophosphoric acid
C) Phosphoric acid **D)** Pyrophosphoric acid

18. Number of $Cl=O$ bonds in chlorous acid, chloric acid and perchloric acid respectively are :

A) 3, 1 and 1 **B)** 4, 1 and 0
C) 1, 1 and 3 **D)** 1, 2 and 3

19. The oxidation states of 'P' in $H_4P_2O_7, H_4P_2O_5$ and $H_4P_2O_6$, respectively, are:

A) 7, 5 and 6 **B)** 5, 4 and 3
C) 5, 3 and 4 **D)** 6, 4 and 5

20. The basicity of phosphorous acid (H_3PO_3) is:

21. How many of the following oxy acid, have peroxide linkager $H_2S_2O_7$, $H_2S_2O_8$, $H_2S_2O_5$, H_2SO_5

22. How many of the following oxy acids are reducing agents? ,H_3PO_3, H_3PO_4, $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$

23. How many of the following oxy acids aredi basic acids? H_3BO_3, HlO_4, H_3PO_2, H_3PO_3, $H_2S_2O_3$, $H_4P_2O_6$, H_2SO_3, H_3PO_4

24. The number of bonds in perchloric acid is:

25. The ratio of sigma and π bonds present in pyrophosphoric acid is

A) 4 **B)** 6
C) 10 **D)** 12

Maths

26. If $\frac{1}{x}$<1, then $x \in$ _____.

A) $(-1,0)\cup(0,1)$ **B)** $(-\infty,-1)\cup(1,\infty)$
C) $(-\infty,0)\cup(1,\infty)$ **D)** $\mathbb{R}\setminus\{0\}$

27. If $\frac{x}{x-3} \le \frac{1}{x}$, then $x \in$ _____.

A) $(-\infty,0)\cup(3,\infty)$ **B)** $(0,3)$
C) $(-\infty,0)\cup[\frac{3}{2},3)$ **D)** $(-\infty,0)\cup[\frac{3}{2},3)$

28. If $x^2-5x+6<0$, then $x \in$ _____.

A) $(2,3)$ **B)** $(-\infty,2)\cup(3,\infty)$
C) [2,3] **D)** $(2,3]$

29. If $x^2+9x+14>0$, then $x \in$ _____.

A) $(-7,-2)$ **B)** $(-\infty,-7)\cup(-2,\infty)$
C) $(-\infty,-7]\cup[-2,\infty)$ **D)** $(-7,-2]$

30. If $2x^2-2x-12<0$, then $x \in$ _____.

A) $(-2,3)$ **B)** $(-\infty,-2)\cup(3,\infty)$
C) $[-2,3]$ **D)** $(-2,3]$

31. If $6x^2-x-2>0$, then $x \in$ _____.

A) $\left[-\frac{1}{2},\frac{2}{3}\right]$ **B)** $\left(-\frac{1}{2},\frac{2}{3}\right)$
C) $\left(-\infty,-\frac{1}{2}\right]\cup\left[\frac{2}{3},\infty\right)$ **D)** $\left(-\infty,-\frac{1}{2}\right)\cup\left(\frac{2}{3},\infty\right)$

32. If $(x-1)^2(x+1)^3(x-4)<0$, then $x \in$ _____.

A) $(-1,4)\setminus\{1\}$ **B)** $(-\infty,-1)\cup(4,\infty)$
C) $(-1,1)\cup(1,4)$ **D)** $(-\infty,-1)\cup(-1,1)\cup(1,4)$

33. If $\frac{(x-1)^2(x+1)^3}{x^4(x-2)} \le 0$, then $x \in$ _____.

A) $[-1,0)\cup(0,2)$ **B)** $(-\infty,-1]\cup(2,\infty)$
C) $[-1,0)\cup(0,1]\cup(1,2)$ **D)** $(-1,0)\cup(0,-2)$

34. a^3+b^3 is equal to

A) $(a+b)(a^2+ab+b^2)$ **B)** $(a-b)(a^2+ab+b^2)$
C) $(a+b)(a^2-ab+b^2)$ **D)** $(a-b)(a^2-ab+b^2)$

35. a^5+b^5 is equal to

A) $(a+b)(a^4-a^3b+a^2b^2-ab^3+b^4)$ **B)** $(a-b)(a^4+a^3b+a^2b^2+ab^3+b^4)$
C) $(a+b)(a^4+a^3b+a^2b^2+ab^3+b^4)$ **D)** $(a-b)(a^4-a^3b+a^2b^2-ab^3+b^4)$

36. If $|2x-3|<1$, then $x \in$ _____.

A) $1<x<2$ **B)** $0<x<2$

C) $2<x<3$ **D)** $0<x<3$

37. If $|x|<-3$, then $x \in$ _____.

A) $(1,4)$ **B)** $(1,3)$

C) $[-3,3]$ **D)** No Solution

38. If $|x|>-2$, then $x \in$ _____.

A) No solution **B)** $(-2,2)$

C) $\mathbb{R}$ **D)** None of these

39. The factors of $x^2-10x+21=0$ are:

A) $(x-1)(x-21)$ **B)** $(x-3)(x-7)$

C) $(x-5)(x-5)$ **D)** $(x-2)(x-8)$

40. The factors of $x^2-25x+84=0$ are:

A) $(x-14)(x-6)$ **B)** $(x-12)(x-7)$

C) $(x-21)(x-4)$ **D)** $(x-3)(x-28)$

41. The factors of $6x^2-x-2=0$ are:

A) $(x+2)(6x-1)$ **B)** $(2x-1)(3x+2)$

C) $(2x+1)(3x-2)$ **D)** $(3x+1)(2x-2)$

42. If $12x^2-23x+10 \leq 0$, then $x \in$?

A) $\left(\frac{5}{4},\infty\right)$ **B)** $\left(-\infty,\frac{2}{3}\right)$

C) $\left(\frac{2}{3},\frac{5}{4}\right)$ **D)** $\left(-\infty,\frac{2}{3}\right] \cup \left[\frac{5}{4},\infty\right)$

43. The factors of $4\sqrt{3}+5x-2\sqrt{3}=0$ are:

A) $(\sqrt{3}x+1)(4x-2\sqrt{3})$ **B)** $(\sqrt{3}x-2)(4x+\sqrt{3})$

C) $(2\sqrt{3}x+1)(2x-\sqrt{3})$ **D)** $(\sqrt{3}x+2)(4x-\sqrt{3})$

44. If $6x^2-13x+5<0$, then $x \in$?

A) $\left(\frac{5}{3},\infty\right)$ **B)** $\left(-\infty,\frac{1}{2}\right)$

C) $\left(\frac{1}{2},\frac{5}{3}\right)$ **D)** $\left[\frac{1}{2},\frac{5}{3}\right]$

45. If $x^2-5x+6>0$, then $x \in$?

A) $(-\infty,3)$ **B)** $(2,3)$

C) $(-\infty,2) \cup (3,\infty)$ **D)** $(2,\infty)$

46. Find the remainder when $f(x)=x^2+4x+2$ is divided by $(x-2)$.

47. If the solution set of $x^2-9x+18 \leq 0$ is $[\alpha,\beta]$, then find $\alpha+\beta$.

48. If the solution set of $x^2-15x+56 \leq 0$ is $[\alpha,\beta]$, then find $\alpha+\beta$.

49. If the roots of $x^2+6x+8=0$ are α,β, then find $-\alpha-\beta$.

50. If the roots of $x^2+5x-24=0$ are α,β, then find $\alpha-\beta$.

Physics

51. If $y=\sin x+\cos x$, then find $\frac{dy}{dx}$.

A) $\cos x-\sin x$ **B)** $\cos x+\sin x$

C) $\cos x/\sin x$ **D)** $-\cos x+\sin x$

52. Dimensional formula for coefficient of viscosity is $[M]^x\ [L]^y\ [T]^z$. The value of $x^2+y^2+z^2$ is .....

53. A particle is moving along positive $x-$axis. Its position varies as $x=t^3-3t^2+12t+20$, where$x$is in meters and$t$is in seconds. Initial velocity of the particle in m/s is .....

54. If $y=x^3+2x+1$, then $\frac{dy}{dx}$ at $x=1$ is....

55. The minimum value of $y=2x^2-x+1$ is in the form p/q. Find p+q

56. Find the slope of the tangent to the curve $y=3x^2-5$ at the point (2, 7).

57. If $y=\sin x+\cos x$, then find $\frac{dy}{dx}$.

A) $\cos x-\sin x$ **B)** $\cos x+\sin x$

C) $\cos x/\sin x$ **D)** $-\cos x+\sin x$

58. Find the derivative of $y=x\sin x$.

A) $x\cos x-\sin x$ **B)** $x\cos x+\sin x$

C) $x\cos x/\sin x$ **D)** $+x\cos x-\sin x$

59. Find the slope of the function $y=sinx+1/x^2-3log_e xatx=\pi/2$.

A) $-16/\pi^3-6/\pi$ **B)** $16/\pi^3+6/\pi$

C) 0 **D)** 1

60. If $y=x^2sinx$, find dy/dx.

A) $cosx+2xsinx$ **B)** $x^2cosx-2xsinx$

C) $2xcosx+x^2sinx$ **D)** $x^2cosx+2xsinx$

61. The area of a blot of ink is growing such that after t second, its area is given by $A=(3t^2+7)cm^2$. Calculate the rate of increase of area at $t=5$ seconds.

A) 30 cm^2/s **B)** 20 cm^2/s

C) 15 cm^2/s **D)** 25 cm^2/s

62. A metal ring is being heated so that at any instant of time t in second, its area is given by $A = 3t^2 + \frac{t}{3} + 2\ m^2$. What will be the rate of increase of area at $t = 10$ sec?

A) $\frac{180}{3}\ m^2/s$ **B)** 60 m^2/s

C) $\frac{181}{3}\ m^2/s$ **D)** 61 m^2/s

63. Find the rate of change in area of a square of side 4 cm when its side is increasing at the rate of 0.01 cm per second.

A) 0.08 cm^2/s **B)** 0.8 cm^2/s

C) 0.04 cm^2/s **D)** 0.4 cm^2/s

64. $2^x 3^y = 72$**, then**

A) $x = 2, y = 3$ **B)** $x = 3, y = 2$

C) $x = -2, y = -3$ **D)** $x = -3, y = -2$

65. $log_e x + log_e y =$

A) $log_e(x + y)$ **B)** $log_e(xy)$

C) $log_e(x/y)$ **D)** $log_e(y/x)$

66. $\frac{d}{dx}(log_e x) =$

A) $\frac{1}{e}$ **B)** $\frac{1}{log_e x}$

C) $\frac{1}{x}$ **D)** $x log_e x - x$

67. $\frac{d}{dx}(x log_e x - x) =$

A) zero **B)** 1

C) $log_e x$ **D)** $x log_e x$

68. The tangent to the curve $y^2 = 4x$ at (1, 2) is inclined to the x-axis at an angle of

A) $\frac{\pi}{6}$ **B)** $\frac{\pi}{3}$

C) $\frac{\pi}{2}$ **D)** $\frac{\pi}{4}$

69. The maximum value of the function $y = sin\ x + cos\ x$ is

A) 1 **B)** 2

C) $\sqrt{2}$ **D)** $-\sqrt{2}$

70. If $y = \sin^2 x - 2\tan^2 x$ then $\frac{dy}{dx}$ at $x = \frac{\pi}{4}$ is

A) -11 **B)** -7

C) -13 **D)** -15

71. The dimensions of $\frac{a}{b}$ in the equation $P = \frac{a - t^2}{bx}$, where P is pressure, x is distance and t is time, are

A) MT^{-2} **B)** M^2LT^{-3}

C) ML^3T^{-1} **D)** LT^{-3}

72. The velocity v (in $cm/\sec$) of a particle is given in terms of time t (in sec) by the relation $v = at + \frac{b}{t+c}$; the dimensions of a, b and c are

A) $a = L^2,\ b = T,\ c = LT^2$ **B)** $a = LT^2,\ b = LT,\ c = L$

C) $a = LT^{-2},\ b = L,\ c = T$ **D)** $a = L,\ b = LT,\ c = T^2$

73. With the usual notations, the following equation $S_t = u + \frac{1}{2}a(2t - 1)$ is

A) Only numerically correct **B)** Only dimensionally correct

C) Both numerically and dimensionally correct **D)** Neither numerically nor dimensionally correct

74. If the unit of length and force be increased four times, then the unit of energy is

A) Increased 4 times **B)** Increased 8 times

C) Increased 16 times **D)** Decreased 16 times

75. Which one of the following does not have the same dimensions

A) Work and energy **B)** Angle and strain

C) Relative density and refractive index **D)** Planck constant and energy

ANSWER KEY

Chemistry

1.	**1**	8.	**3**	15.	**1**	22.	**3**
2.	**3**	9.	**2**	16.	**2**	23.	**3**
3.	**3**	10.	**3**	17.	**4**	24.	**3**
4.	**3**	11.	**3**	18.	**4**	25.	**2**
5.	**2**	12.	**2**	19.	**2**		
6.	**1**	13.	**3**	20.	**2**		
7.	**2**	14.	**2**	21.	**2**		

Maths

26.	**3**	33.	**1**	40.	**3**	47.	**9**
27.	**2**	34.	**3**	41.	**3**	48.	**15**
28.	**1**	35.	**1**	42.	**3**	49.	**6**
29.	**2**	36.	**1**	43.	**4**	50.	**11**
30.	**1**	37.	**4**	44.	**3**		
31.	**3**	38.	**3**	45.	**3**		
32.	**3**	39.	**2**	46.	**14**		

Physics

51.	**1**	58.	**2**	65.	**2**	72.	**3**
52.	**3**	59.	**1**	66.	**3**	73.	**3**
53.	**12**	60.	**4**	67.	**3**	74.	**3**
54.	**5**	61.	**1**	68.	**4**	75.	**4**
55.	**15**	62.	**3**	69.	**3**		
56.	**12**	63.	**1**	70.	**4**		
57.	**1**	64.	**2**	71.	**1**		

SOLUTIONS

Q1.

Answer: A

Explanation:
Boric acid (H_3BO_3) is a weak monobasic Lewis acid. It does not act as a proton donor (Bronsted acid) by losing its own H^+ ions. Instead, the central boron atom is electron-deficient and has a vacant p-orbital. It acts as a Lewis acid by accepting an electron pair from the OH^- group of a water molecule, which subsequently releases a proton (H^+) from the water.

Q2.

Answer: C

Explanation:
Statement-1 is correct because orthoboric acid is indeed a weak monobasic acid in aqueous solution. However, Statement-2 is incorrect because it does not act as a proton donor; it behaves as a Lewis acid by accepting a hydroxyl ion (OH^-) from water, which results in the release of a proton from the water molecule itself.

Q3.

Answer: C

Explanation:
Statement-1 is correct because Pb^{4+} is less stable than Sn^{4+} and readily undergoes reduction to the more stable $+2$ state, making it a strong oxidizing agent. Statement-2 is incorrect because the "inert pair effect" actually makes the lower oxidation states ($+2$) more stable than the higher oxidation states ($+4$) for the heavier members of Group 14.

Q4.

Answer: C

Explanation:
The oxidation states of phosphorus are determined by assigning $+1$ for Hydrogen and -2 for Oxygen. By calculating the oxidation state for each compound, the order from highest to lowest is $H_3PO_4(+5) > H_4P_2O_6(+4) > H_3PO_3(+3) > H_3PO_2(+1)$.

Q5.

Answer: B

Explanation:
The oxidation states of nitrogen in these compounds vary from $+5$ to -3. Decreasing order implies starting from the most positive state to the most negative.

Q6.

Answer: A

Explanation:
H_3PO_3 (phosphorous acid) has two $-OH$ groups, making it dibasic, and one $P-H$ bond, which gives it reducing properties.

Q7.

Answer: B

Q8.

Answer: C

Explanation:
Peroxodisulphuric acid ($H_2S_2O_8$), also known as Marshall's acid, contains a peroxide ($O-O$) linkage between the two sulphur atoms.

Q9.

Answer: B

Explanation:
Oxoacids of phosphorus containing at least one $P-H$ bond are capable of acting as reducing agents. Such acids can reduce silver nitrate ($AgNO_3$) to metallic silver (Ag), resulting in a "silver mirror". Pyrophosphorous acid ($H_4P_2O_5$) contains two such bonds.

Q10.

Answer: C

Explanation:
Peroxodisulphuric acid ($H_2S_2O_8$) and pyrosulphuric acid ($H_2S_2O_7$) both contain two sulphur atoms, each forming two double bonds with oxygen. This results in 4 π-bonds for each molecule, making the total sum 8.

Q11.

Answer: C

Explanation:
The chemical formula for hypophosphoric acid is $H_4P_2O_6$. By calculating the oxidation number for Phosphorus (x) while assuming Hydrogen is $+1$ and Oxygen is -2, we find that the state is $+4$.

Q12.

Answer: B

Explanation:
Bromic acid ($HBrO_3$) has bromine in the $+5$ oxidation state, and perbromic acid ($HBrO_4$) has it in the $+7$ state. The sum of these states is $5+7=12$.

Q13.

Answer: C

Explanation:
Peroxodisulphuric acid ($H_2S_2O_8$), also known as Marshall's acid, contains a peroxide ($O-O$) linkage between the two sulphur atoms.

Q14.

Answer: B

Explanation:
Oxoacids of phosphorus containing at least one $P-H$ bond are capable of acting as reducing agents. Such acids can reduce silver nitrate ($AgNO_3$) to metallic silver (Ag), resulting in a "silver mirror". Pyrophosphorous acid ($H_4P_2O_5$) contains two such bonds.

Q15.

Answer: A

Explanation:
In thiosulphuric acid ($H_2S_2O_3$), the two sulphur atoms are non-equivalent. The central sulphur atom is in a $+6$ oxidation state, while the terminal sulphur atom is in a -2 oxidation state.

Q16.

Answer: B

Explanation:
The reaction of white phosphorus (P_4) with concentrated alkali (NaOH) yields phosphine and sodium hypophosphite. Acidification of the salt produces phosphinic acid (also known as hypophosphorous acid,H_3PO_2), which contains twoP-H bonds.

Q17.

Answer: D

Explanation:
Comparing the formulas: • Pyrophosphorous acid: $H_4P_2O_5$ (5 oxygens) • Hypophosphoric acid: $H_4P_2O_6$ (6 oxygens) • Phosphoric acid: H_3PO_4 (4 oxygens) • Pyrophosphoric acid: $H_4P_2O_7$ (7 oxygens).

Q18.

Answer: D

Explanation:
The structures of chlorine oxoacids show varying numbers of double bonds with oxygen: • Chlorous acid ($HClO_2$): 1 $Cl = O$ bond. • Chloric acid ($HClO_3$): 2 $Cl = O$ bonds. • Perchloric acid ($HClO_4$): 3 $Cl = O$ bonds.

Q19.

Answer: B

Q20.

Answer: 2

Q21.

Answer: 2

Q22.

Answer: 3

Q23.

Answer: 3

Q24.

Answer: 3

Q25.

Answer: B

Explanation:

Pyrophosphoric acid ($H_4P_2O_7$) contains 12 sigma (σ) bonds and 2 pi (π) bonds. The ratio of σ/π is therefore $12/2 = 6$.

Q26.

Answer: C

Q27.

Answer: B

Q28.

Answer: A

Q29.

Answer: B

Q30.

Answer: A

Q31.

Answer: C

Q32.

Answer: C

Q33.

Answer: A

Q34.

Answer: C

Q35.

Answer: A

Q36.

Answer: A

Q37.

Answer: D

Q38.

Answer: C

Q39.

Answer: B

Q40.

Answer: C

Q41.

Answer: C

Q42.

Answer: C

Q43.

Answer: D

Q44.

Answer: C

Q45.

Answer: C

Q46.

Answer: 14

Q47.

Answer: 9

Q48.

Answer: 15

Q49.

Answer: 6

Q50.

Answer: 11

Q51.

Answer: A

Explanation:

The problem asks for the derivative of the sum of two functions, $\sin x$ and $\cos x$. According to the rules of differentiation (Rule 3), the derivative of the sum of functions is the sum of their individual derivatives. We use the standard derivatives $\frac{d}{dx}(\sin x) = \cos x$ and $\frac{d}{dx}(\cos x) = -\sin x$ to find the result.

Q52.

Answer: 3

Q53.

Answer: 12

Q54.

Answer: 5

Q55.

Answer: 15

Q56.

Answer: 12

Explanation:
The slope of the tangent to a curve at any point is given by the derivative of the function representing the curve at that specific point. We are given the curve $y = 3x^2 - 5$. We first find the general derivative dy/dx, and then evaluate it at x = 2.

Q57.

Answer: A

Explanation:
The problem asks for the derivative of the sum of two functions, $\sin x$ and $\cos x$. According to the rules of differentiation (Rule 3), the derivative of the sum of functions is the sum of their individual derivatives. We use the standard derivatives $\frac{d}{dx}(\sin x) = \cos x$ and $\frac{d}{dx}(\cos x) = -\sin x$ to find the result.

Q58.

Answer: B

Explanation:
The problem requires finding the derivative of the product of two functions: $u = x$ and $v = \sin x$. We must apply the Product Rule for differentiation, which is given by $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$. This rule allows us to differentiate products of functions effectively.

Q59.

Answer: A

Explanation:
The slope of a function is defined as the derivative of the function with respect to the independent variable. We are given the function $y = sinx + 1/x^2 - 3log_e x$. To find the slope at $x = \pi/2$, we differentiate the given expression with respect to x using standard derivative rules.

Q60.

Answer: D

Explanation:
We are given the function $y = x^2 sinx$. Since this is a product of two functions of x, we must use the product rule for differentiation. The product rule states that for $y = uv, dy/dx = u(dv/dx) + v(du/dx)$.

Q61.

Answer: A

Explanation:
The rate of increase of a quantity with respect to time is the derivative of that quantity with respect to time. Here, we are given the area as a function of time $A = (3t^2 + 7)$. To find the rate of increase of the area, we differentiate A with respect to t, i.e., $\frac{dA}{dt}$. We then evaluate this derivative at $t = 5$.

Q62.

Answer: C

Explanation:
The rate of increase of the area is the derivative of the area function A with respect to time t. Given $A = 3t^2 + \frac{t}{3} + 2$, the rate of increase is $\frac{dA}{dt}$. We find the derivative and substitute $t = 10$.

Q63.

Answer: A

Explanation:
Let A be the area of the square and a be the length of its side. The area of a square is $A = a^2$. We need to find $\frac{dA}{dt}$ when $a = 4$ cm and $\frac{da}{dt} = 0.01$ cm/s. By the chain rule, $\frac{dA}{dt} = \frac{dA}{da} \times \frac{da}{dt}$.

Q64.

Answer: B

Explanation:
The equation involves prime factorization. We are given $2^x3^y = 72$. To solve for x and y, we need to express 72 as a product of powers of 2 and 3. By finding the prime factors of 72, we can equate the exponents on both sides of the equation.

Q65.

Answer: B

Explanation:
This question relies on the fundamental property of logarithms which states that the logarithm of a product of two numbers is equal to the sum of the logarithms of the individual numbers. Specifically, $log_b(A) + log_b(B) = log_b(AB)$.

Q66.

Answer: C

Explanation:
The derivative of the natural logarithm function, $log_e x$ (often written as lnx), is a standard result in calculus. By definition, for any $x > 0$, the rate of change of the natural logarithm function with respect to x is the reciprocal of x.

Q67.

Answer: C

Explanation:
To differentiate the expression $xlog_e x - x$, we apply the linearity property of derivatives, which allows us to differentiate each term separately. We use the product rule for the first term ($xlog_e x$) and the power rule for the second term ($-x$).

Q68.

Answer: D

Explanation:
The slope of the tangent to a curve $y = f(x)$ at any point is given by the derivative $\frac{dy}{dx}$ at that point. If the slope is m, the angle θ it makes with the positive x-axis is given by $\tan(\theta) = m$.

Q69.

Answer: C

Explanation:
To find the maximum value of a function of the form $f(x) = A\sin x + B\cos x$, we can express it in the form $R\sin(x + \alpha)$, where $R = \sqrt{A^2 + B^2}$. The maximum value of this function is R. Alternatively, we can use derivatives to find critical points, but the amplitude transformation is more direct.

Q70.

Answer: D

Explanation:
The given function is $y = \sin^2 x - 2\tan^2 x$. To find the derivative $\frac{dy}{dx}$, we use the chain rule for trigonometric functions. The derivative of $\sin^2 x$ is $2\sin x\cos x$, which simplifies to $\sin(2x)$. The derivative of $\tan^2 x$ is $2\tan x\sec^2 x$. Substituting these into the derivative of the original function gives $\frac{dy}{dx} = \sin(2x) - 4\tan x\sec^2 x$. Evaluating this at $x = \frac{\pi}{4}$, we calculate $\sin(\frac{\pi}{2}) = 1$, $\tan(\frac{\pi}{4}) = 1$, and $\sec^2(\frac{\pi}{4}) = 2$. While the standard calculation for the equation as written yields -7, the provided answer key identifies -15 as the correct result, which corresponds to the case where the coefficient of $\tan^2 x$ is 4 (i.e., $y = \sin^2 x - 4\tan^2 x$).

Q71.

Answer: A

Q72.

Answer: C

Q73.

Answer: C

Q74.

Answer: C

Q75.

Answer: D