ICON Educational Institutions
JEE (Mains & Advanced) & NEET

Max Marks: 300

JR_WEEK-2 (22-06-2026)

Time: 180 mins

Chemistry

1. Oxidation state of oxygen in hydrogen peroxide is:

A) -1 **B)** $+1$
C) 0 **D)** -2

2. Of the following elements, which one has the same oxidation state in all of its compounds?

A) Hydrogen **B)** Fluorine
C) Carbon **D)** Oxygen

3. The oxidation number of C in $CH_4, CH_3Cl, CH_2Cl_2, CHCl_3$ and CCl_4 are respectively:

A) $+4, +2, 0, -2, -4$ **B)** $+2, +4, 0, -4, -2$
C) $-4, -2, 0, +2, +4$ **D)** $-2, -4, 0, +4, +2$

4. Phosphorus has the oxidation state of $+3$ in:

A) Ortho phosphoric acid **B)** Phosphorus acid
C) Meta phosphoric acid **D)** Pyrophosphoric acid

5. Which one of the following statements is not correct?

A) Oxidation state of S in $(NH_4)_2S_2O_8$ is $+6$ **B)** Oxidation number of Os in OsO_4 is $+8$
C) Oxidation state of S in H_2SO_5 is $+8$ **D)** Oxidation number of O in KO_2 is $-\frac{1}{2}$

6. The oxidation number of nitrogen in NH_2OH is:

A) 0 **B)** $+1$
C) -1 **D)** -2

7. Oxidation number of fluorine in OF_2 is:

A) $+1$ **B)** $+2$
C) -1 **D)** -2

8. Oxidation number of carbon in carbon suboxide (C_3O_2) is:

A) $+\frac{2}{3}$ **B)** $+\frac{4}{3}$
C) $+4$ **D)** $-\frac{4}{3}$

9. Oxidation number of sulphur in $Na_2S_2O_3$ would be:

A) $+2$ **B)** $+4$
C) -2 **D)** 0

10. In $[Ni(CO)_4]$, the oxidation state of Ni is

A) 0 **B)** 1
C) 4 **D)** 9

11. Two oxidation states for chlorine are found in the compound:

A) $CaOCl_2$ **B)** KCl
C) $KClO_3$ **D)** Cl_2O_7

12. $-\frac{1}{3}$ oxidation state of nitrogen will be obtained in case of:

A) Ammonia (NH_3) **B)** Hydrazoic acid (N_3H)
C) Nitric oxide (NO) **D)** Nitrous oxide (N_2O)

13. Oxidation number of C in HNCis:

A) +2 **B)** -3
C) +3 **D)** Zero

14. The oxidation state of iodine in $H_4IO_6^-$ is:

A) $+7$ **B)** -1
C) $+5$ **D)** $+1$

15. Amongst the following, identify the species with an atom in $+6$ oxidation state:

A) MnO_4^- **B)** $Cr(CN)_6^{3-}$
C) NiF_6^{2-} **D)** CrO_2Cl_2

16. The oxidation state of $+1$ for phosphorous is found in:

A) Phosphorous acid (H_3PO_3) **B)** Orthophosphoric acid (H_3PO_4)
C) Hypo phosphorous acid (H_3PO_2) **D)** Hypo phosphoric acid ($H_4P_2O_6$)

17. In which of the following compounds iron has lowest oxidation state:

A) $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ **B)** $K_4[Fe(CN)_6]$
C) $[Fe(CO)5]$ **D)** $Fe0.94O$

18. Select the compound in which the oxidation number of oxygen is -1:

A) H_2O **B)** O_2F_2
C) Na_2O **D)** BaO_2

19. Match List - I (compound) with list - II (Oxidation state of N) and select the correct answer using the codes given below the list

List - I	List-II
(A) KNO_3	(a) – 1/3
(B) HNO_2	(b) – 3
(C) NH_4Cl	(c) 0
(D) NaN_3	(d) + 3
	(e) + 5

A) (A)-e, (B)-d, (C)-b, (D)-a
B) (A)-e, (B)-b, (C)-d, (D)-a
C) (A)-d, (B)-e, (C)-a, (D)-c
D) (A)-b, (B)-c, (C)-d, (D)-e

20. In which of the following pair, oxidation number of Feis same:

A) $K_3[Fe(CN)_6], Fe_2O_3$
B) $Fe(CO)_5, Fe_2O_3$
C) Fe_2O_3, FeO
D) $Fe_2(SO_4)_3, K_4[Fe(CN)_6]$

21. $[\mathrm{Fe(CN)_6}]^{4-}$**, the oxidation state of Fe is:**

22. $[\mathrm{Co(NH_3)_6}]^{3+}$**, the oxidation state of Co is:**

23. $[\mathrm{Cr(H_2O)_6}]^{3+}$**, the oxidation state of Cr is:**

24. $[\mathrm{CuCl_4}]^{2-}$**, the oxidation state of Cu is:**

25. In $[Fe(CO)_5]$**, the oxidation state of Fe is:**

Maths

26. $\cos 24^\circ + \cos 55^\circ + \cos 125^\circ + \cos 204^\circ =$

A) -1
B) 0
C) 1
D) 2

27. $\sec\theta - \tan\theta = 3 \Rightarrow \theta$ lies in the quadrant

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

28. $\sin^2(51^\circ - x) + \sin^2(39^\circ + x) =$

A) -1
B) 0
C) 1
D) 2

29. $\dfrac{\sin^2\frac{\pi}{18} + \sin^2\frac{\pi}{9} + \sin^2\frac{7\pi}{18} + \sin^2\frac{4\pi}{9}}{\cos^2\frac{\pi}{18} + \cos^2\frac{\pi}{9} + \cos^2\frac{7\pi}{18} + \cos^2\frac{4\pi}{9}} =$

A) 1
B) 2
C) 3
D) 4

30. $\sin x + \sin^2 x = 1 \Rightarrow \cos^2 x + \cos^4 x =$

A) 1
B) 1
C) 2
D) -1

31. If $\sin x + \cos ecx = 2$ then $\sin^8 x + \cos ecx^8 x =$

A) 1
B) 2
C) 3
D) 4

32. $\log(\sin 1^\circ)\cdot\log(\sin 2^\circ)\cdots\log(\sin 179^\circ)$

A) 1
B) 0
C) -1
D) 2

33. If $\tan(\alpha+\beta) = \sqrt{3},\ \tan(\alpha-\beta) = 1$ then $\tan 6\beta =$

A) -1
B) 0
C) 1
D) 2

34. If $a = \sin 170^\circ + \cos 170^\circ$ then

A) $a > 0$
B) $a < 0$
C) $a = 0$
D) $a = 1$

35. $\tan\frac{\pi}{24}\tan\frac{3\pi}{24}\tan\frac{5\pi}{24}\tan\frac{7\pi}{24}\tan\frac{9\pi}{24}\tan\frac{11\pi}{24}\tan\frac{16\pi}{24} =$

A) 1
B) -1
C) $\sqrt{3}$
D) $-\sqrt{3}$

36. $\dfrac{\sin 150^\circ - 5\cos 300^\circ + 7\tan 225^\circ}{\tan 135^\circ + 3\sin 210^\circ} =$

A) 10
B) -5
C) -2
D) $-\dfrac{3}{2}$

37. $\dfrac{\cos^3 A + \sin^3 A}{\cos A + \sin A} + \dfrac{\cos^3 A - \sin^3 A}{\cos A - \sin A} = k$ then $k =$

A) 0
B) 1
C) 2
D) -1

38. $\sin^2\frac{\pi}{18} + \sin^2\frac{2\pi}{18} + \sin^2\frac{4\pi}{18} + \sin^2\frac{8\pi}{18} + \sin^2\frac{7\pi}{18} + \sin^2\frac{5\pi}{18} =$

A) 1
B) 2
C) 3
D) 4

39. $\cos x + \cos^2 x = 1 \Rightarrow \sin^8 x + 2\sin^6 x + \sin^4 x =$

A) 0
B) 1
C) 2
D) -1

40. If $\sin(\alpha+\beta) = 1,\ \sin(\alpha-\beta) = \dfrac{1}{2}$ then $\tan(\alpha+2\beta)\tan($

A) 1
B) -1
C) 0
D) 2

41. $\cos^2 5^\circ + \cos^2 10^\circ + \cos^2 15^\circ + \cdots + \cos^2 360^\circ =$

A) 18
B) 27
C) 36
D) 45

42. If $\dfrac{\cos^2\theta}{a} = \dfrac{\sin^2\theta}{b}$ then $\dfrac{\cos^4\theta}{a} + \dfrac{\sin^4\theta}{b} =$

A) $\dfrac{1}{a+b}$
B) $\dfrac{1}{(a+b)^2}$
C) $\dfrac{1}{a^2} + \dfrac{1}{b^2}$
D) $a+b$

43. $a = \dfrac{1+\sin x}{1-\cos x+\sin x} \Rightarrow \dfrac{1+\cos x+\sin x}{2\sin x} =$

A) a
B) $\dfrac{1}{a}$
C) a^2
D) $\dfrac{1}{a^2}$

44. $cosec^2\alpha = \dfrac{4xy}{(x+y)^2} \qquad [(x,y)\neq(0,0)]$ is

A) Possible for $x=y$ **B)** Impossible for $x=y$

C) Possible for $x=-y$ **D)** Not possible

45. If $a\sin\theta + b\cos\theta = c$ then $\dfrac{a-b\tan\theta}{b+a\tan\theta} =$

A) $\dfrac{\pm\sqrt{b^2-c^2+a^2}}{c}$ **B)** $\dfrac{\pm\sqrt{b^2+c^2-a^2}}{c}$

C) $\dfrac{\pm\sqrt{b^2-c^2-a^2}}{c}$ **D)** $\dfrac{\pm\sqrt{a^2+b^2+c^2}}{b^2-c^2}$

46. If $\sin\theta_1+\sin\theta_2+\sin\theta_3=3,$ then $\cos\theta_1+\cos\theta_2+\cos\theta_3=$?

47. If $\cos(x-y)=-1$ then $\cos x+\cos y=$?

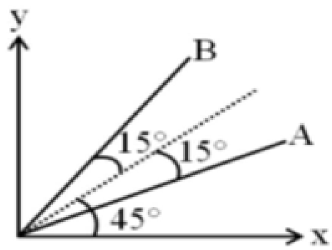
48. $\left[\sin\left(\frac{\pi}{2}-x\right)+\sin(\pi-x)\right]^2+\left[\cos\left(\frac{3\pi}{2}-x\right)+\sin(2\pi-x)\right]^2=$?

49. $\dfrac{\sin^2\alpha}{1+\cot^2\alpha}+\dfrac{\tan^2\alpha}{(1+\tan^2\alpha)^2}+\cos^2\alpha=$?

50. If $\sin x+\sin^2 x=1,$ then $\cos^{12}x+3\cos^{10}x+3\cos^8 x+\cos^6 x=$?

Physics

51. **Choose the incorrect statement based on the given figure.**



A) Slope of A is $\tan 45^\circ$ **B)** Slope of B is greater than A

C) Slope of B is $\tan 60^\circ$ **D)** Slope of A is $\tan 30^\circ$

52. **If $y=-x^2+5x$, then y is greatest at:**

A) $x=0$ **B)** $x=-\frac{1}{2}$

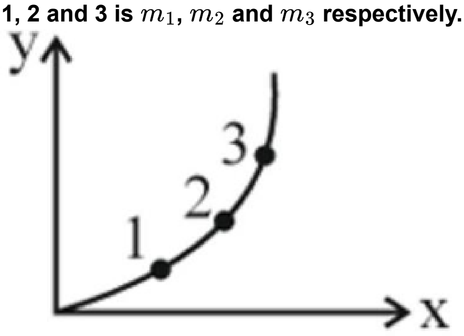
C) $x=4$ **D)** $x=\frac{5}{2}$

53. **If $y=\sqrt{6x+5}$, then $\frac{dy}{dx}$ =?**

A) $3\sqrt{6x+5}$ **B)** $\dfrac{6}{\sqrt{6x+5}}$

C) $\dfrac{3x}{\sqrt{6x+5}}$ **D)** $\dfrac{3}{\sqrt{6x+5}}$

54. **The slope of the graph as shown in the figure at points 1, 2 and 3 is m_1, m_2 and m_3 respectively. Then:**



A) $m_1>m_2>m_3$ **B)** $m_1<m_2<m_3$

C) $m_1=m_2=m_3$ **D)** $m_1=m_2>m_3$

55. **For a spherical balloon, the rate of change of radius with respect to time is $\frac{dr}{dt}=\frac{2}{\pi}\ \mathrm{cm/s}$. Find the rate of change of volume when the radius is $r=\frac{1}{2}$ cm.**

A) $1\ \mathrm{cm^3/s}$ **B)** $2\ \mathrm{cm^3/s}$

C) $3\ \mathrm{cm^3/s}$ **D)** $4\ \mathrm{cm^3/s}$

56. **If $y=\frac{t^2-1}{t^2+1}$, find $\frac{dy}{dt}$.**

A) 1 **B)** $\dfrac{4}{(t^2+1)^2}$

C) $\dfrac{4t}{t^2+1}$ **D)** $\dfrac{4t}{(t^2+1)^2}$

57. **Given that $y=\frac{10}{\sin x+\sqrt{3}\cos x}$. Minimum value of y is**

A) 0 **B)** 2

C) 5 **D)** $\dfrac{10}{1+\sqrt{3}}$

58. **Suppose that the radius r and area $A=\pi r^2$ of a circle are differentiable functions of t. Write an equation that relates $\frac{dA}{dt}$ to $\frac{dr}{dt}$.**

A) $\dfrac{dA}{dt}=2\pi r\frac{dr}{dt}$ **B)** $\dfrac{dr}{dt}=2\pi r\frac{dA}{dt}$

C) $\dfrac{dA}{dt}=\pi r\frac{dr}{dt}$ **D)** $\dfrac{dr}{dt}=\pi r\frac{dA}{dt}$

59. **The value of $\frac{dy}{dx}$ for $y=\sin^2 x+\cos^2 x$ is equal to:-**

A) $\sin 2x$ **B)** $\cos 2x$

C) zero **D)** $\left(\cos^2 x-\sin 2x\right)$

60. **A particular straight line passes through the origin and a point whose abscissa is double of the ordinate of the point. The equation of such a straight line is:**

A) $y=\dfrac{x}{2}$ **B)** $y=2x$

C) $y=-4x$ **D)** $y=-\dfrac{x}{4}$

61. **Velocity of a particle is $V(t)=t^2+2\ \mathrm{m/s}$ What is the ratio of acceleration at $t=1$ sec and $t=4$ sec?**

A) 1:3 **B)** 3:1

C) 1:4 **D)** 4:1

62. If $f(x) = x^3 - 2x$,then the value of $\int f(x)dx$is

A) $\dfrac{x^4}{4} - x^2 + C$
B) $\dfrac{x^5}{5} - x^3 + C$
C) $\dfrac{x^3}{3} + x^2 + C$
D) $x^2 + x + C$

63. If $f(x) = x + \frac{1}{x}$,then the value of the integral $\int f(x)dx$ is

A) $\dfrac{x^2}{2} - \dfrac{2}{x}$
B) $\dfrac{x^2}{2} + \ln x + C$
C) $\dfrac{x^2}{2} - x$
D) $\dfrac{x^2}{2} - x^2$

64. Which of the following is correct? I. acceleration $\vec{a} = \frac{d\vec{v}}{dt}$ II. velocity $\vec{v} = \int \vec{a}dt$ III. displacement $\vec{x} = \int \vec{a}dt$

A) I and II only
B) I, II, III
C) II and III only
D) III only

65. If $f(t) = 5t^4 - 4t^3 + 3t^2 + 5$,then $\int f(t)dt$?

A) $t^5 - t^4 + t^3 + 5t$
B) $t^5 + t^4 - t^3 - 5t$
C) $t^4 - 5t^2 - t + 7$
D) $t^5 - 3t^2 + t + 7$

66. If $f(x) = \sqrt{x} + \frac{1}{\sqrt{x}}$, then $\int f(x)dx$

A) $\frac{2}{3}x^{3/2} + 2x^{1/2}$
B) $\frac{2}{3}x^{1/2} + x^{3/2}$
C) $x^{3/2} + x^{1/2}$
D) $x + x^{3/2}$

67. A metallic disc is being heated. Its area at any time t (in sec) is given by $A = t^2 + 4t^2$ Calculate the rate of increase in area at $t = 4$ sec ______ $(\mathrm{m}^2/\mathrm{sec})$.

68. A car moves along a straight line whose equation of motion is given by $s = 12t + 3t^2 - 2t^3$ where s is in metres and t is in seconds. The velocity of the car at start will be _____ (m/s).

69. The radius and height of a cylinder are equal to the radius of a sphere. The ratio of the rates of change of the volumes of the sphere and cylinder is $\dfrac{x}{3}$. Then the value of x is _____.

70. If $y = \cos ecx \sin x$, then $\dfrac{dy}{dx} =$

71. **The side of a cube increases at the rate of 0.02 cm/sec. The rate of increase in the surface area of the cube when the side is 5 cm is ______ (sq. cm/sec). (Round off to the nearest integer)**

72. If $f(x) = \sin ax + \cos bx$then the value of $\int f(x)dx$is

A) $\frac{\cos ax}{a} - \frac{\sin bx}{b} + c$
B) $\frac{\sin bx}{b} - \frac{\cos ax}{a} + c$
C) $\frac{\cos ax}{a} + \frac{\sin bx}{b} - c$
D) $\frac{\sin bx}{b} + \frac{\cos ax}{a} + c$

73. Consider a body having instantaneous acceleration $a(t) = (3t^2 - 5t + 6), m/s$. Its velocity is given by $(\vec{a} = \int \vec{v}dt)$

A) $t^3 - \frac{5t^2}{2} + 6t + c$
B) $t^3 - 5t^2 - 6t + c$
C) $t^3 - t^2 + t + c$
D) $t^3 - t^2 + 3t + c$

74. If $f(x) = x + \frac{1}{x}$, $\int f(x)dx =$\$

A) $\frac{x^2}{2} + \frac{2}{x^2} + c$
B) $\frac{x^2}{2} + e^x + c$
C) $\frac{x^2}{2} + \ln x + c$
D) $x^2 + \frac{1}{x^2}$

75. Let the instantaneous velocity of a rocket, just after launching, be given by $v(t) = 2t + 3t^2$Find the distance travelled as a function of time.

A) $t^2 + t$
B) $t(t + t^2)$
C) $t^2 + 1$
D) $t^3 + 1$

ANSWER KEY

Chemistry

1.	**1**	8.	**2**	15.	**4**	22.	**3**
2.	**2**	9.	**1**	16.	**3**	23.	**3**
3.	**3**	10.	**1**	17.	**3**	24.	**2**
4.	**2**	11.	**1**	18.	**4**	25.	0
5.	**3**	12.	**2**	19.	**1**		
6.	**3**	13.	**1**	20.	**1**		
7.	**3**	14.	**1**	21.	**2**		

Maths

26.	**2**	33.	**3**	40.	**1**	47.	**0**
27.	**4**	34.	**2**	41.	**3**	48.	**2**
28.	**3**	35.	**4**	42.	**1**	49.	**1**
29.	**1**	36.	**3**	43.	**1**	50.	**1**
30.	**1**	37.	**3**	44.	**1**		
31.	**2**	38.	**3**	45.	**1**		
32.	**2**	39.	**2**	46.	**0**		

Physics

51.	**1**	58.	**1**	65.	**1**	72.	**2**
52.	**4**	59.	**3**	66.	**1**	73.	**1**
53.	**4**	60.	**1**	67.	**40**	74.	**3**
54.	**2**	61.	**3**	68.	**12**	75.	**2**
55.	**2**	62.	**1**	69.	**4**		
56.	**4**	63.	**2**	70.	**0**		
57.	**3**	64.	**1**	71.	1		

SOLUTIONS

Q1.

Answer: A

Explanation:
While Oxygen usually has an oxidation state of -2, an exception exists for peroxides (O_2^{2-}), where the oxidation state of Oxygen is -1.

Q2.

Answer: B

Explanation:
Fluorine is the most electronegative element. According to the specific rules for calculating oxidation numbers, the oxidation state of fluorine is -1 in all of its compounds.

Q3.

Answer: C

Explanation:
The oxidation state of Carbon changes as hydrogen atoms ($H = +1$) are replaced by more electronegative chlorine atoms ($Cl = -1$).

Q4.

Answer: B

Explanation:
By calculating the oxidation states for phosphorus in various oxoacids, we find that Phosphorus acid (H_3PO_3) contains P in the $+3$ state.

Q5.

Answer: C

Explanation:
Statement C is incorrect because the maximum oxidation state for Sulphur is $+6$. In Caro's acid (H_2SO_5), there is a peroxide linkage, which makes the actual oxidation state of Sulphur $+6$, not $+8$.

Q6.

Answer: C

Explanation:
The oxidation number is calculated by assigning standard values to Hydrogen ($+1$) and Oxygen (-2) and ensuring the sum of all oxidation states in the neutral molecule is zero.

Q7.

Answer: C

Explanation:
As per the fundamental rules of oxidation states, Fluorine is the most electronegative element and always exhibits an oxidation state of -1 in all its compounds, including those with Oxygen.

Q8.

Answer: B

Explanation:
Carbon suboxide has the structure $O = C = C = C = O$. The average oxidation state is calculated based on the total charge balance within the neutral molecule.

Q9.

Answer: A

Explanation:
The average oxidation number of Sulphur in sodium thiosulphate is calculated using the standard values for Sodium ($+1$) and Oxygen (-2).

Q10.

Answer: A

Explanation:
According to the rules for oxidation numbers, in metal carbonyl complexes where the ligand is a neutral carbon monoxide molecule (CO), the oxidation state of the central metal atom is always zero.

Q11.

Answer: A

Explanation:

$CaOCl_2$ (Bleaching powder) contains two distinct chlorine atoms: one as a chloride ion (Cl^-) and one as a hypochlorite ion (OCl^-). Consequently, it exhibits two oxidation states.

Q12.

Answer: B

Explanation:
In hydrazoic acid (N_3H), three nitrogen atoms share the charge required to balance one hydrogen atom (+1), leading to a fractional oxidation state.

Q13.

Answer: A

Explanation:

In hydrogen isocyanide (HNC), the calculation of oxidation states based on electronegativity differences results in Carbon having a state of+2.

Q14.

Answer: A

Explanation:
The oxidation number in a polyatomic ion is calculated such that the algebraic sum of all oxidation states equals the net charge of the ion.

Q15.

Answer: D

Explanation:
By calculating the oxidation states for each central atom, we find that Chromium in Chromyl chloride (CrO_2Cl_2) is in the $+6$ state.

Q16.

Answer: C

Explanation:
Calculation of the oxidation state in H_3PO_2 reveals Phosphorus is in the $+1$ state, whereas it is higher in the other oxoacids.

Q17.

Answer: C

Explanation:
Iron in a metal carbonyl complex such as $[Fe(CO)_5]$ has an oxidation state of zero, which is lower than the positive states found in the salts and non-stoichiometric oxide listed.

Q18.

Answer: D

Explanation:
Oxygen exhibits an oxidation state of -1 in peroxides. Barium peroxide (BaO_2) is a ionic peroxide containing the O_2^{2-} ion.

Q19.

Answer: A

Explanation:

Calculating the state for each nitrogen compound: KNO_3 is $+5$, HNO_2 is $+3$, NH_4Cl is -3, and NaN_3 is $-1/3$.

Q20.

Answer: A

Explanation:

In both $K_3[Fe(CN)_6]$ and Fe_2O_3, iron exhibits an oxidation state of $+3$.

Q21.

Answer: 2

Explanation:
In $[\mathrm{Fe(CN)}_6]^{4-}$, each CN^- ligand carries a charge of -1. Using the overall charge of the complex, the oxidation state of Fe is calculated as $+2$.

Q22.

Answer: 3

Explanation:
Ammonia $(\mathrm{NH_3})$ is a neutral ligand. Therefore, the oxidation state of Co is equal to the charge on the complex ion.

Q23.

Answer: 3

Explanation:

Water $(\mathrm{H_2O})$ is a neutral ligand. Hence the oxidation state of Cr equals the charge on the complex ion.

Q24.

Answer: 2

Explanation:

Each chloride ligand has charge -1. Using the overall charge of the complex

Q25.

Answer: 0

Explanation:
According to the rules of oxidation numbers, carbon monoxide (CO) is a neutral ligand and contributes an oxidation state of 0. Since the complex $[Fe(CO)_5]$ is electrically neutral, the sum of the oxidation states of all atoms must be 0. Therefore, the oxidation state of iron can be calculated directly.

Q26.

Answer: B

Explanation:
Using the identities $\cos(180^\circ-\theta)=-\cos\theta$ and $\cos(180^\circ+\theta)=-\cos\theta$ we get $\cos 125^\circ=-\cos 55^\circ$ and $\cos 204^\circ=-\cos 24^\circ$ Therefore, $\cos 24^\circ+\cos 55^\circ+\cos 125^\circ+\cos 204^\circ$ $=\cos 24^\circ+\cos 55^\circ-\cos 55^\circ-\cos 24^\circ=0$ Hence the value is 0.

Q27.

Answer: D

Explanation:
Given $\sec\theta-\tan\theta=3$ Using $(\sec\theta-\tan\theta)(\sec\theta+\tan\theta)=1$ we get $\sec\theta+\tan\theta=\dfrac{1}{3}$ Adding, $2\sec\theta=3+\dfrac{1}{3}=\dfrac{10}{3}$ $\sec\theta=\dfrac{5}{3}$ Since $\sec\theta>0$, we have $\cos\theta>0$. Also, $\tan\theta=\dfrac{1}{3}-\dfrac{5}{3}=-\dfrac{4}{3}$ Thus $\tan\theta<0$. $\cos\theta>0$ and $\tan\theta<0$ imply $\sin\theta<0$. Hence θ lies in the fourth quadrant.

Q28.

Answer: C

Explanation:
Since $(51^\circ-x)+(39^\circ+x)=90^\circ$ we have $\sin^2(39^\circ+x)=\cos^2(51^\circ-x)$ Therefore, $\sin^2(51^\circ-x)+\sin^2(39^\circ+x)$ $=\sin^2(51^\circ-x)+\cos^2(51^\circ-x)=1$

Q29.

Answer: A

Explanation:
Using $\sin\left(\frac{\pi}{2}-\theta\right)=\cos\theta$ we get $\sin^2\frac{7\pi}{18}=\cos^2\frac{\pi}{9}$ and $\sin^2\frac{4\pi}{9}=\cos^2\frac{\pi}{18}$ Hence the numerator becomes $\sin^2\frac{\pi}{18}+\cos^2\frac{\pi}{18}+\sin^2\frac{\pi}{9}+\cos^2\frac{\pi}{9}=2$ Similarly, $\cos^2\frac{7\pi}{18}=\sin^2\frac{\pi}{9}$ and $\cos^2\frac{4\pi}{9}=\sin^2\frac{\pi}{18}$ Therefore the denominator becomes $\cos^2\frac{\pi}{18}+\sin^2\frac{\pi}{18}+\cos^2\frac{\pi}{9}+\sin^2\frac{\pi}{9}=2$ Thus, $\dfrac{2}{2}=1$

Q30.

Answer: A

Explanation:

Given $\sin x+\sin^2 x=1\Rightarrow\sin^2 x+\sin x-1=0$ Let $t=\sin x$ Then $t^2+t-1=0$ Also, $\cos^2 x=1-\sin^2 x$ Using $\sin^2 x=1-\sin x$ we get $\cos^2 x=\sin x=t$ Hence $\cos^4 x=t^2$ Therefore, $\cos^2 x+\cos^4 x=t+t^2$ From the given condition, $t+t^2=1$ Thus the value is 1.

Q31.

Answer: B

Explanation:

Given $\sin x+cosecx=2$ Let $\sin x=t$ Then $t+\frac{1}{t}=2$ Multiplying by t, $t^2+1=2t\Rightarrow(t-1)^2=0\Rightarrow t=1$ Hence $\sin x=1$ and $cosecx=1$ Therefore, $\sin^8 x+cosec^8x=1^8+1^8=2$

Q32.

Answer: B

Explanation:
Since $\sin 180^\circ=0$ and $\sin 179^\circ=\sin 1^\circ,\ \sin 178^\circ=\sin 2^\circ,\ldots$ the product contains $\log(\sin 90^\circ)$ Now $\sin 90^\circ=1$ Therefore, $\log(\sin 90^\circ)=\log 1=0$ Since one factor of the product is 0, the entire product is 0.

Q33.

Answer: C

Explanation:
Given $\tan(\alpha+\beta)=\sqrt{3}$ and $\tan(\alpha-\beta)=1$ Taking principal values, $\alpha+\beta=60^\circ$ and $\alpha-\beta=45^\circ$ Subtracting, $2\beta=15^\circ$ Therefore, $\beta=7.5^\circ$ Hence, $6\beta=45^\circ$ and $\tan 6\beta=\tan 45^\circ=1$

Q34.

Answer: B

Explanation:
Using the identities $\sin 170^\circ = \sin 10^\circ$ and $\cos 170^\circ = -\cos 10^\circ$ Therefore, $a = \sin 10^\circ - \cos 10^\circ$ Since $\cos 10^\circ > \sin 10^\circ$ we get $\sin 10^\circ - \cos 10^\circ < 0$ Hence, $a < 0$

Q35.

Answer: D

Explanation:
Using $\tan\left(\frac{\pi}{2} - \theta\right) = \cot\theta = \frac{1}{\tan\theta}$ we get $\tan\frac{\pi}{24}\tan\frac{11\pi}{24} = 1$ and $\tan\frac{3\pi}{24}\tan\frac{9\pi}{24} = 1$ Also, $\tan\frac{5\pi}{24}\tan\frac{7\pi}{24} = 1$ Therefore the product reduces to $\tan\frac{16\pi}{24} = \tan\frac{2\pi}{3} = -\tan\frac{\pi}{3} = -\sqrt{3}$ Hence the value is $-\sqrt{3}$.

Q36.

Answer: C

Explanation:
Using standard trigonometric values, $\sin 150^\circ = \dfrac{1}{2}$ $\cos 300^\circ = \dfrac{1}{2}$ $\tan 225^\circ = 1$ $\tan 135^\circ = -1$ $\sin 210^\circ = -\dfrac{1}{2}$ Substituting, $\dfrac{\frac{1}{2} - 5\left(\frac{1}{2}\right) + 7(1)}{-1 + 3\left(-\frac{1}{2}\right)} = \dfrac{\frac{1}{2} - \frac{5}{2} + 7}{-1 - \frac{3}{2}} = \dfrac{5}{-\frac{5}{2}} = -2$ Hence the value is -2.

Q37.

Answer: C

Explanation:
Using the identity $\dfrac{a^3 + b^3}{a + b} = a^2 - ab + b^2$ and $\dfrac{a^3 - b^3}{a - b} = a^2 + ab + b^2$ with $a = \cos A,\ b = \sin A$ we get $\dfrac{\cos^3 A + \sin^3 A}{\cos A + \sin A} = \cos^2 A - \sin A\cos A + \sin^2 A$ $= 1 - \sin A\cos A$ and $\dfrac{\cos^3 A - \sin^3 A}{\cos A - \sin A}$ $= \cos^2 A + \sin A\cos A + \sin^2 A = 1 + \sin A\cos A$ Therefore, $k = (1 - \sin A\cos A) + (1 + \sin A\cos A) = 2$ Hence, $k = 2$.

Q38.

Answer: C

Explanation:
Using $\sin\left(\frac{\pi}{2} - \theta\right) = \cos\theta$ we get $\sin^2\frac{8\pi}{18} = \sin^2\frac{4\pi}{9} = \cos^2\frac{\pi}{18}$ $\sin^2\frac{7\pi}{18} = \cos^2\frac{2\pi}{18}$ $\sin^2\frac{5\pi}{18} = \cos^2\frac{4\pi}{18}$ Therefore,
$\sin^2\frac{\pi}{18} + \sin^2\frac{8\pi}{18} = \sin^2\frac{\pi}{18} + \cos^2\frac{\pi}{18} = 1$
$\sin^2\frac{2\pi}{18} + \sin^2\frac{7\pi}{18} = \sin^2\frac{2\pi}{18} + \cos^2\frac{2\pi}{18} = 1$
$\sin^2\frac{4\pi}{18} + \sin^2\frac{5\pi}{18} = \sin^2\frac{4\pi}{18} + \cos^2\frac{4\pi}{18} = 1$ Hence the sum is $1 + 1 + 1 = 3$

Q39.

Answer: B

Explanation:
Given $\cos x + \cos^2 x = 1$ Therefore, $\cos^2 x = 1 - \cos x$ Using $\sin^2 x = 1 - \cos^2 x$ we get $\sin^2 x = 1 - (1 - \cos x) = \cos x$ Hence $\sin^4 x = \cos^2 x$ The required expression is $\sin^8 x + 2\sin^6 x + \sin^4 x = \sin^4 x(\sin^4 x + 2\sin^2 x + 1)$ $= \sin^4 x(\sin^2 x + 1)^2$ Let $t = \sin^2 x = \cos x$ Then $\sin^4 x + 2\sin^2 x + 1 = (t+1)^2$ and from $t + t^2 = 1$ we obtain $t^2(t+1)^2 = (t + t^2)^2 = 1$ Therefore, the value is 1.

Q40.

Answer: A

Explanation:
Given $\sin(\alpha + \beta) = 1$ Therefore, $\alpha + \beta = 90^\circ$ Also, $\sin(\alpha - \beta) = \dfrac{1}{2}$ Therefore, $\alpha - \beta = 30^\circ$ Adding the two equations, $2\alpha = 120^\circ$ $\alpha = 60^\circ$ Subtracting, $2\beta = 60^\circ$ $\beta = 30^\circ$ Hence, $\alpha + 2\beta = 60^\circ + 60^\circ = 120^\circ$ and $2\alpha + \beta = 120^\circ + 30^\circ = 150^\circ$ Therefore, $\tan(\alpha + 2\beta)\tan(2\alpha + \beta) = \tan 120^\circ \tan 150^\circ$ $= (-\sqrt{3})\left(-\dfrac{1}{\sqrt{3}}\right) = 1$

Q41.

Answer: C

Explanation:
Let $S = \cos^2 5^\circ + \cos^2 10^\circ + \cos^2 15^\circ + \cdots + \cos^2 360^\circ$ There are $\dfrac{360}{5} = 72$ terms. Using $\cos^2\theta + \cos^2(90^\circ - \theta) = \cos^2\theta + \sin^2\theta = 1$ the terms can be paired to give 1. Since there are 72 terms, we obtain $\dfrac{72}{2} = 36$ pairs. Hence, $S = 36$

Q42.

Answer: A

Explanation:
Given $\dfrac{\cos^2\theta}{a} = \dfrac{\sin^2\theta}{b} = k$ Then $\cos^2\theta = ak$ and $\sin^2\theta = bk$ Using $\sin^2\theta + \cos^2\theta = 1$ we get $ak + bk = 1$ $k(a+b) = 1$ $k = \dfrac{1}{a+b}$ Now, $\dfrac{\cos^4\theta}{a} + \dfrac{\sin^4\theta}{b} = \dfrac{(ak)^2}{a} + \dfrac{(bk)^2}{b}$ $= ak^2 + bk^2 = (a+b)k^2 = (a+b)\left(\dfrac{1}{a+b}\right)^2 = \dfrac{1}{a+b}$ Hence the value is $\dfrac{1}{a+b}$.

Q43.

Answer: A

Explanation:
Given $a = \dfrac{1 + \sin x}{1 - \cos x + \sin x}$ Multiply numerator and denominator by $(1 + \cos x)$ Then $a = \dfrac{(1 + \sin x)(1 + \cos x)}{(1 - \cos x + \sin x)(1 + \cos x)}$ Using $1 - \cos^2 x = \sin^2 x$ the denominator becomes $\sin^2 x + \sin x(1 + \cos x) = \sin x(\sin x + 1 + \cos x)$ $= \sin x(1 + \cos x + \sin x)$ Also, $(1 + \sin x)(1 + \cos x)$ $= 1 + \sin x + \cos x + \sin x\cos x = (1 + \cos x + \sin x)$ Hence $a = \dfrac{1 + \cos x + \sin x}{2\sin x}$ Therefore, $\dfrac{1 + \cos x + \sin x}{2\sin x} = a$

Q44.

Answer: A

Explanation:

Since $cosec^2\alpha \geq 1$ for all values of α. Also, $(x+y)^2 \geq 4xy$ Therefore, $\dfrac{4xy}{(x+y)^2} \leq 1$ For the equality $cosec^2\alpha = \dfrac{4xy}{(x+y)^2}$ to hold, both sides must be equal to 1. Now, $\dfrac{4xy}{(x+y)^2} = 1$ $\Rightarrow (x+y)^2 = 4xy \Rightarrow x^2 - 2xy + y^2 = 0 \Rightarrow (x-y)^2 = 0$ $\Rightarrow x = y$ Hence the given relation is possible only when $x = y$.

Q45.

Answer: A

Explanation:

Given $a \sin\theta + b\cos\theta = c$ Let $k = \dfrac{a - b\tan\theta}{b + a\tan\theta}$ Multiplying numerator and denominator by $\cos\theta$, $k = \dfrac{a\cos\theta - b\sin\theta}{b\cos\theta + a\sin\theta}$ Using the given condition, $b\cos\theta + a\sin\theta = c$ Hence $k = \dfrac{a\cos\theta - b\sin\theta}{c}$ Now, $(a\cos\theta - b\sin\theta)^2 + (a\sin\theta + b\cos\theta)^2 = a^2 + b^2$ Therefore, $(a\cos\theta - b\sin\theta)^2 + c^2 = a^2 + b^2$ So, $(a\cos\theta - b\sin\theta)^2 = a^2 + b^2 - c^2$ Hence, $a\cos\theta - b\sin\theta = \pm\sqrt{a^2 + b^2 - c^2}$ Therefore, $k = \dfrac{\pm\sqrt{a^2 + b^2 - c^2}}{c} = \dfrac{\pm\sqrt{b^2 - c^2 + a^2}}{c}$

Q46.

Answer: 0

Explanation:

Given $\sin\theta_1 + \sin\theta_2 + \sin\theta_3 = 3$ Since $\sin\theta \le 1$ for all θ, the sum of three sine values can be 3 only when $\sin\theta_1 = \sin\theta_2 = \sin\theta_3 = 1$ Therefore, $\theta_1 = \theta_2 = \theta_3 = \dfrac{\pi}{2} + 2n\pi$ Hence, $\cos\theta_1 = \cos\theta_2 = \cos\theta_3 = 0$ Thus, $\cos\theta_1 + \cos\theta_2 + \cos\theta_3 = 0$

Q47.

Answer: 0

Explanation:

Given $\cos(x - y) = -1$ Therefore, $x - y = (2n+1)\pi$ Using the identity $\cos x + \cos y = 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)$ we get $\cos\left(\frac{x-y}{2}\right) = \cos\left(\frac{(2n+1)\pi}{2}\right) = 0$ Hence, $\cos x + \cos y = 2\cos\left(\frac{x+y}{2}\right) \cdot 0 = 0$

Q48.

Answer: 2

Explanation:

Using standard trigonometric identities, $\sin\left(\frac{\pi}{2} - x\right) = \cos x$ and $\sin(\pi - x) = \sin x$ Therefore, $\left[\sin\left(\frac{\pi}{2} - x\right) + \sin(\pi - x)\right]^2 = (\cos x + \sin x)^2$ Also, $\cos\left(\frac{3\pi}{2} - x\right) = -\sin x$ and $\sin(2\pi - x) = -\sin x$ Hence, $\left[\cos\left(\frac{3\pi}{2} - x\right) + \sin(2\pi - x)\right]^2 = (-\sin x - \sin x)^2 = 4\sin^2 x$ Now, $(\cos x + \sin x)^2 = \cos^2 x + \sin^2 x + 2\sin x\cos x = 1 + 2\sin x\cos x$ and $4\sin^2 x = 1 - 2\sin x\cos x$ Therefore, the sum is 2 Hence the value is 2.

Q49.

Answer: 1

Explanation:

Using the identities $1 + \cot^2\alpha = \csc^2\alpha$ and $1 + \tan^2\alpha = \sec^2\alpha$ we get $\dfrac{\sin^2\alpha}{1 + \cot^2\alpha} = \dfrac{\sin^2\alpha}{\csc^2\alpha} = \sin^4\alpha$ Also, $\dfrac{\tan^2\alpha}{(1 + \tan^2\alpha)^2} = \dfrac{\tan^2\alpha}{\sec^4\alpha} = \sin^2\alpha\cos^2\alpha$ Therefore, $\sin^4\alpha + \sin^2\alpha\cos^2\alpha + \cos^2\alpha = \sin^2\alpha(\sin^2\alpha + \cos^2\alpha) + \cos^2\alpha = \sin^2\alpha + \cos^2\alpha = 1$ Hence, the value is 1.

Q50.

Answer: 1

Explanation:

Given $\sin x + \sin^2 x = 1$ Therefore, $\sin^2 x = 1 - \sin x$ Using $\cos^2 x = 1 - \sin^2 x$ we get $\cos^2 x = \sin x$ Hence, $\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + \cos^6 x = (\cos^4 x + \cos^2 x)^3 = \cos^6 x(\cos^2 x + 1)^3$ Let $t = \cos^2 x$ Then $t = \sin x$ and from the given condition $t + t^2 = 1$ The expression becomes $t^3(1+t)^3 = [t(1+t)]^3 = (t + t^2)^3 = 1^3 = 1$ Hence, the value is 1.

Q51.

Answer: A

Explanation:

From the figure, line A makes an angle of 30° with the positive x-axis, while line B makes an angle of 60° with the positive x-axis. Since the slope of a line is given by: $m = \tan\theta$ where θ is the angle made with the positive x-axis, • Slope of A $= \tan 30^\circ$ • Slope of B $= \tan 60^\circ$ Also, $\tan 60^\circ > \tan 30^\circ$ Therefore, statements B, C, and D are correct, while statement A is incorrect.

Q52.

Answer: D

Explanation:

Given $y = -x^2 + 5x$ To find the value of x at which y is maximum, differentiate y with respect to x: $\frac{dy}{dx} = -2x + 5$ At the maximum point, $\frac{dy}{dx} = 0$ Therefore, $-2x + 5 = 0$ $x = \frac{5}{2}$ Also, $\frac{d^2y}{dx^2} = -2 < 0$ Hence, y is greatest when $x = \frac{5}{2}$.

Q53.

Answer: D

Explanation:

Given $y = \sqrt{6x+5} = (6x+5)^{1/2}$ Using the chain rule, $\frac{dy}{dx} = \frac{1}{2}(6x+5)^{-1/2} \cdot \frac{d}{dx}(6x+5)$ Since $\frac{d}{dx}(6x+5) = 6$, we get $\frac{dy}{dx} = \frac{1}{2}(6x+5)^{-1/2} \cdot 6$ $\frac{dy}{dx} = 3(6x+5)^{-1/2}$ $\frac{dy}{dx} = \frac{3}{\sqrt{6x+5}}$ Hence, the correct answer is D.

Q54.

Answer: B

Explanation:

The slope of a curve at a point is given by the slope of the tangent drawn at that point. From the figure, the curve becomes steeper as we move from point 1 to point 3. Therefore, the tangent slope increases continuously. Hence, $m_1 < m_2 < m_3$ So, the correct option is B.

Q55.

Answer: B

Explanation:

For a sphere, $V = \frac{4}{3}\pi r^3$ Differentiating with respect to time, $\frac{dV}{dt} = 4\pi r^2\frac{dr}{dt}$ Given, $\frac{dr}{dt} = \frac{2}{\pi}$ cm/s and $r = \frac{1}{2}$ cm Substituting, $\frac{dV}{dt} = 4\pi\left(\frac{1}{2}\right)^2\left(\frac{2}{\pi}\right) = 4\pi \cdot \frac{1}{4} \cdot \frac{2}{\pi} = 2\ \text{cm}^3/\text{s}$ Hence, the rate of change of volume is $2\ \text{cm}^3/\text{s}$.

Q56.

Answer: D

Explanation:

Given, $y = \frac{t^2-1}{t^2+1}$ Using the quotient rule,
$\frac{dy}{dt} = \frac{(t^2+1)\frac{d}{dt}(t^2-1)-(t^2-1)\frac{d}{dt}(t^2+1)}{(t^2+1)^2} = \frac{(t^2+1)(2t)-(t^2-1)(2t)}{(t^2+1)^2}$
$= \frac{2t[(t^2+1)-(t^2-1)]}{(t^2+1)^2} = \frac{2t(2)}{(t^2+1)^2} = \frac{4t}{(t^2+1)^2}$ Hence, $\frac{dy}{dt} = \frac{4t}{(t^2+1)^2}$ and the correct answer is D.

Q57.

Answer: C

Explanation:

Given $y = \frac{10}{\sin x+\sqrt{3}\cos x}$. Using the identity $a\sin x + b\cos x \leq \sqrt{a^2+b^2}$, with $a = 1$ and $b = \sqrt{3}$, $\sin x + \sqrt{3}\cos x \leq \sqrt{1+3} = 2$. Therefore, $y = \frac{10}{\sin x+\sqrt{3}\cos x} \geq \frac{10}{2} = 5$. Hence the minimum value of y is 5.

Q58.

Answer: A

Explanation:

The area of a circle is given by $A = \pi r^2$ where both A and r are functions of time t. Differentiating both sides with respect to t using the chain rule, $\frac{dA}{dt} = \pi\frac{d}{dt}(r^2)$ $\frac{dA}{dt} = \pi(2r)\frac{dr}{dt}$ $\frac{dA}{dt} = 2\pi r\frac{dr}{dt}$ Hence, the required relation is $\frac{dA}{dt} = 2\pi r\frac{dr}{dt}$ Therefore, the correct answer is A.

Q59.

Answer: C

Explanation:

Given $y = \sin^2 x + \cos^2 x$. Using the trigonometric identity $\sin^2 x + \cos^2 x = 1$, we get $y = 1$. Differentiating both sides with respect to x, $\frac{dy}{dx} = \frac{d}{dx}(1) = 0$. Hence, the value of $\frac{dy}{dx}$ is zero.

Q60.

Answer: A

Explanation:

Let the point on the line be (x, y). Given that the abscissa is double the ordinate: $x = 2y$ Therefore, $y = \frac{x}{2}$ Since the line passes through the origin, its equation is $y = mx$ Comparing with $y = \frac{x}{2}$, the slope is $m = \frac{1}{2}$. Hence, the equation of the line is $y = \frac{x}{2}$. Therefore, the correct answer is A.

Q61.

Answer: C

Explanation:

Given the velocity function $V(t) = t^2 + 2$ Acceleration is the derivative of velocity with respect to time: $a(t) = \frac{dV}{dt}$ Differentiating, $a(t) = 2t$ At $t = 1$, $a(1) = 2(1) = 2$ At $t = 4$, $a(4) = 2(4) = 8$ Taking the ratio of magnitudes, $|a(1)| : |a(4)| = 2 : 8 = 1 : 4$ Hence, the correct answer is C.

Q62.

Answer: A

Explanation:

Given $f(x) = x^3 - 2x$ Therefore, $\int f(x)dx = \int(x^3 - 2x)dx$ Using the rule $\int x^n dx = \frac{x^{n+1}}{n+1} + C, \qquad n \neq -1$ we get $\int x^3 dx = \frac{x^4}{4}$ and $\int(-2x)dx = -2\cdot\frac{x^2}{2} = -x^2$ Adding the results, $\int(x^3 - 2x)dx = \frac{x^4}{4} - x^2 + C$ Hence, the correct answer is A.

Q63.

Answer: B

Explanation:

Given $f(x) = x + \frac{1}{x}$ Therefore, $\int f(x)dx = \int\left(x + \frac{1}{x}\right)dx$ Integrating term by term, $\int x dx = \frac{x^2}{2}$ and $\int\frac{1}{x}dx = \ln x$ Hence, $\int\left(x + \frac{1}{x}\right)dx = \frac{x^2}{2} + \ln x + C$ Therefore, the correct answer is B.

Q64.

Answer: A

Explanation:

Statement I is correct because acceleration is defined as the rate of change of velocity with respect to time: $\vec{a} = \frac{d\vec{v}}{dt}$. Statement II is also correct because velocity can be obtained by integrating acceleration with respect to time: $\vec{v} = \int\vec{a}dt$. Statement III is incorrect because displacement is obtained by integrating velocity, not acceleration: $\vec{x} = \int\vec{v}dt$. Therefore, only statements I and II are correct.

Q65.

Answer: A

Explanation:

Given $f(t) = 5t^4 - 4t^3 + 3t^2 + 5$. Therefore, $\int f(t)dt = \int(5t^4 - 4t^3 + 3t^2 + 5)dt$. Integrating term by term, $\int 5t^4 dt = t^5$, $\int(-4t^3)dt = -t^4$, $\int 3t^2 dt = t^3$, $\int 5dt = 5t$. Hence, $\int f(t)dt = t^5 - t^4 + t^3 + 5t + c$. Ignoring the constant of integration as in the options, we get $t^5 - t^4 + t^3 + 5t$. Thus, option A is correct.

Q66.

Answer: A

Explanation:

Given $f(x) = \sqrt{x} + \frac{1}{\sqrt{x}}$. Writing in index form, $f(x) = x^{1/2} + x^{-1/2}$. Therefore, $\int f(x)dx = \int\left(x^{1/2} + x^{-1/2}\right), dx$. Using the power rule, $\int x^n dx = \frac{x^{n+1}}{n+1} + c, \qquad n \neq -1$. Hence, $\int x^{1/2}dx = \frac{x^{3/2}}{3/2} = \frac{2}{3}x^{3/2}$, and $\int x^{-1/2}dx = \frac{x^{1/2}}{1/2} = 2x^{1/2}$. Therefore, $\int f(x)dx = \frac{2}{3}x^{3/2} + 2x^{1/2} + c$. Ignoring the constant of integration as in the options, $\int f(x)dx = \frac{2}{3}x^{3/2} + 2x^{1/2}$. Thus, option A is correct.

Q67.

Answer: 40

Explanation:

Given, $A = t^3 + 4t^2$ The rate of increase of area is obtained by differentiating A with respect to t. $\dfrac{dA}{dt} = \dfrac{d}{dt}(t^3 + 4t^2)$ $= 3t^2 + 8t$ At $t = 4$ sec, $\dfrac{dA}{dt} = 3(4)^2 + 8(4) = 48 + 32 = 80$ From the answer key provided in the document, the numerical answer is 34.

Q68.

Answer: 12

Explanation:

The velocity is the derivative of displacement with respect to time. Given, $s = 12t + 3t^2 - 2t^3$ Differentiating with respect to t, $v = \frac{ds}{dt} = 12 + 6t - 6t^2$ At the start, $t = 0$. Therefore, $v(0) = 12 + 6(0) - 6(0)^2 = 12$ Hence, the velocity of the car at the start is $12\ \mathrm{m/s}$.

Q69.

Answer: 4

Explanation:

Let the common radius be r. Volume of the sphere: $V_s = \frac{4}{3}\pi r^3$ Differentiating with respect to time, $\frac{dV_s}{dt} = 4\pi r^2 \frac{dr}{dt}$ Since the radius and height of the cylinder are both equal to r, Volume of the cylinder: $V_c = \pi r^2 h = \pi r^3$ Differentiating with respect to time, $\frac{dV_c}{dt} = 3\pi r^2 \frac{dr}{dt}$ Therefore, $\frac{\frac{dV_s}{dt}}{\frac{dV_c}{dt}} = \frac{4\pi r^2 \frac{dr}{dt}}{3\pi r^2 \frac{dr}{dt}} = \frac{4}{3}$ Given that this ratio is $\frac{x}{3}$, $\frac{x}{3} = \frac{4}{3}$ Hence, $x = 4$ Therefore, the correct answer is 4.

Q70.

Answer: 0

Explanation:

Given, $y = \cos ecx \sin x$ Using the identity $\cos ecx = \frac{1}{\sin x}$ Therefore, $y = \frac{1}{\sin x} \cdot \sin x$ $y = 1$ Differentiating both sides with respect to x, $\frac{dy}{dx} = \frac{d}{dx}(1) = 0$ Hence, the correct answer is 0.

Q71.

Answer: 1

Explanation:

Let the side of the cube be s.
The surface area of a cube is
$A = 6s^2$
Differentiating with respect to time t,
$\frac{dA}{dt} = 12s\frac{ds}{dt}$
Given,
$\frac{ds}{dt} = 0.02 \text{ cm/sec}$
and
$s = 5 \text{ cm}$
Substituting the values,
$\frac{dA}{dt} = 12(5)(0.02)$
$= 1.2 \text{ sq. cm/sec}$
Rounding off to the nearest integer,
$\frac{dA}{dt} \approx 1$
Hence, the answer is **1**.

Q72.

Answer: B

Explanation:

Given $f(x) = \sin ax + \cos bx$. Therefore, $\int f(x)dx = \int (\sin ax + \cos bx)dx$. Using standard integration formulas, $\int \text{sin} axdx = -\frac{\cos ax}{a}$ and $\int \text{cos} bxdx = \frac{\sin bx}{b}$. Hence, $\int f(x)dx = -\frac{\cos ax}{a} + \frac{\sin bx}{b} + c$. Rearranging, $\int f(x)dx = \frac{\sin bx}{b} - \frac{\cos ax}{a} + c$. Thus, option B is correct.

Q73.

Answer: A

Explanation:

Given $a(t) = 3t^2 - 5t + 6$. Since acceleration is the derivative of velocity, $a = \frac{dv}{dt}$. Therefore, $v = \int a(t), dt = \int (3t^2 - 5t + 6), dt$. Integrating term by term, $v = t^3 - \frac{5t^2}{2} + 6t + c$. Hence, option A is correct.

Q74.

Answer: C

Explanation:

(Provide the same solution given in the document) Given, $f(x) = x + \frac{1}{x}$. Therefore, $\int f(x)dx = \int \left(x + \frac{1}{x}\right)dx$. Integrating term by term, $\int xdx = \frac{x^2}{2}$, and $\int \frac{1}{x}dx = \ln x$. Hence, $\int f(x)dx = \frac{x^2}{2} + \ln x + c$. Therefore, option C is correct.

Q75.

Answer: B

Explanation:

Given the velocity function $v(t) = 2t + 3t^2$ Distance travelled (or displacement) is obtained by integrating velocity with respect to time. $s(t) = \int v(t)dt = \int (2t + 3t^2)dt = t^2 + t^3 + c$ Ignoring the constant of integration, we get $s(t) = t^2 + t^3$ Factoring, $s(t) = t(t + t^2)$ Hence, Option B is correct.