

CHEMISTRY**Q.1**

Nitrogen and halogens in a given organic compound can be estimated respectively by

- (a) Kjeldahl's, carius methods,
- (b) Carius, duma's methods
- (c) Liebig's Kjeldahl's methods
- (d) Liebig's Carius methods

Q.2

Halides of alkali metals possess NaCl type structure with 6:6 coordination. What will happen if these are subjected to high pressure?

- (a) Will transform to 8 : 8 coordination
- (b) Will transform to 4 : 4 coordination
- (c) Coordination will not change
- (d) Crystal will become good conductor of electricity

Q.3

Diamagnetic and paramagnetic species among $\text{Ni}(\text{CO})_4$, $[\text{Ni}(\text{CN})_4]^{2-}$ and $[\text{NiCl}_4]^{2-}$ are:

- (a) $\text{Ni}(\text{CO})_4$ and $[\text{NiCl}_4]^{2-}$ are diamagnetic and $[\text{Ni}(\text{CN})_4]^{2-}$ is paramagnetic.
- (b) $[\text{NiCl}_4]^{2-}$, $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic and $\text{Ni}(\text{CO})_4$ is paramagnetic.
- (c) $\text{Ni}(\text{CO})_4$ and $[\text{Ni}(\text{CN})_4]^{2-}$ are diamagnetic and $[\text{NiCl}_4]^{2-}$ is paramagnetic
- (d) All the three are diamagnetic

Q.4

100 cm^3 of a gas at 127°C and pressure "p", is compressed to 50 cm^3 at the same temperature. In order to occupy 75 cm^3 volume, the compressed gas should be heated to

- (a) 600°C
- (b) 273°C
- (c) 327°C
- (d) 273°C

Q.5

Al cannot be extracted by electrolysis of fused aluminium chloride because

- (a) Pure aluminium chloride exists as dimer and is broken with difficulty.
- (b) It is a covalent compound and is a poor conductor of electricity
- (c) Fusion temperature of AlCl_3 is too high to conduct the electrolysis.
- (d) It has extremely negative reduction potential

Q.6

Increasing carbon contents in steel

- (a) Increases ductility as well as tensile strength.
- (b) Decreases ductility as well as tensile strength.
- (c) Increases ductility but decreases tensile strength.
- (d) Decreases ductility but increases tensile strength.

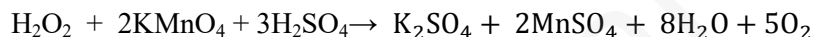
Q.7

Ammonium phosphate on heating gives :

- (a) Phosphorous acid & NH₃
- (b) Ammonium phosphide & NH₃
- (c) Metaphosphoric acid & NH₃
- (d) None of these.

Q.8

What mass of O₂ would be formed from the reaction of 34.0 g H₂S₂, 180.0 g KMnO₄ and excess of H₂SO₄ according to following equation. (mol wt. of H₂O₂ = 34 amu, KMnO₄ = 158 amu) ?



- (a) 32 g
- (b) 64 g
- (c) 8.9 g
- (d) 160 g

Q.9

Which of the following is incorrect ?

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{KOH}(\text{alc}) \rightarrow \text{CH}_3\text{CH} = \text{CH}_2$
- (b) $2\text{C}_2\text{H}_5\text{I} + \text{AgO} \rightarrow \text{C}_2\text{H}_5\text{OC}_2\text{H}_3 + 2\text{AgI}$
- (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Cu}^{573\text{K}}} \text{CH}_3\text{CH}_2\text{CHO}$
- (d) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Al}_2\text{O}_3, \text{heat}} \text{CH}_3\text{CH}_2\text{CHO}$

Q.10

$\text{C}_2\text{H}_5\text{Br} + \text{AgCN} \xrightarrow{-\text{AgBr}} \text{A} \xrightarrow{\text{H}^+, 2\text{H}_2\text{O}} \text{B}$, The product B is

- (a) A mixture of acetic acid and methyl amine
- (b) A mixture of propanoic acid and ammonia
- (c) Propanamide
- (d) A mixture of ethyl amine and formic acid

Q.11

Tin in its +4 oxidation state is quite stable but lead (IV) is strongly oxidising in nature. This is due to:

- (a) Inert pair effect
- (b) Presence of low lying vacant d-orbitals
- (c) Its strong covalent nature
- (d) Its strongly ionic character

Q.12

A mixture of calcium formate and acetate is dry distilled and the organic product obtained is heated with chlorine in the presence of NaOH. The final product in this sequence should be:

- (a) Acetic acid
- (b) Trichloroacetic acid
- (c) Chloroform
- (d) Trichloroethanol

Q.13

Which of the following give reaction with nitrous acid ?

- (a) Aniline
- (b) N,N-dimethylaniline
- (c) N-Methylaniline
- (d) All of these

Q.14

For the gaseous reaction : $A_2(g) \leftrightarrow 2 A(g)$, the equilibrium constant at 250 K is 10^4 the approximate value of ΔG° is

- (a) 19.14 kJ
- (b) 189 kJ
- (c) 20.15 kJ
- (d) 210 kJ

Q.15

In the reaction : $2Fe^{3+} + H_2O_2 + 2OH^- \rightarrow 2Fe^{2+} + 2H_2O + O_2$, Hydrogen peroxide acts as : }

- (a) Acid
- (b) Oxidising agent
- (c) Reducing agent
- (d) Base

Q.16

Chlorobenzene reacts with sodium in the presence of ether to give biphenyl, the reaction is called:

- (a) Fitting reaction
- (b) Wurtz – fitting reaction
- (c) Ullmann reaction
- (d) Wurtz reaction

Q.17

Sodium acetate when treated with 2- bromopropane would yield:

- (a) $\text{CH}_3\text{COOCH}_3$
- (b) $\text{CH}_3\text{COCH}(\text{CH}_3)_2$
- (c) $\text{CH}_3\text{COOCH}(\text{CH}_3)_2$
- (d) $(\text{CH}_3)_2\text{CHCOOCH}_3$

Q.18

The rate of reaction, $2\text{A} + \text{B}_2 \rightarrow 2\text{AB}$, becomes double when the conc. Of B_2 is doubled. However, when the conc. Of both the reactants are tripled simultaneously, the rate becomes nine times. What is order of reaction

- (a) First
- (b) Second
- (c) Third
- (d) Zero

Q.19

Thering structures of glucose and fructose in invert sugar are :

- (a) same as in sucrose
- (b) both pyranose form
- (c) both in furanose form
- (d) glucose in pyranose from and fructose in furanose form

Q.20

Treatment of ethane with alkaline KMnO_4 produces

- (a) Glycol
- (b) Oxalic acid
- (c) Formic acid
- (d) Formaldehyde

Q.21

An example of pyrosilicate is:

- (a) $Zn_4(OH)_2(Si_2O_7)H_2O$
- (b) $Si_2O_7^{4-}$
- (c) Be_2SiO_4
- (d) $Ca_3Si_3O_9$

Q.22

What is osmotic pressure of 0.1 N $ZnSO_4$ solution at $0^\circ C$, if $ZnSO_4$ is 40% ionized ?

- (a) 2.24
- (b) 3.13
- (c) 4.48
- (d) 3.20

Q.23

What is not true about amino acids ?

- (a) All the α -amino acids except glycine are optically active
- (b) A-amino acids exist as zwitteriondueto
- (c) All α -amino acids have D-configuration
- (d) A-amino acids are generally solublein water but sparingly soluble inorganic solvents

Q.24

Which of the dollowing cannot produce H_2 gas ?

- (a) $Zn + H_2SO_4$
- (b) $Al + HCl$
- (c) $Cu + HNO_3$
- (d) Red hot $Fe + steam$

Q.25

One of the chemical methods of softening water is sequestration. In this process :

- (a) Ca and Mg are precipitated from hard water as carbonates and phosphates
- (b) Hard water is treated with sodium poly meta phosphate to form soluble non-interfering Ca & Mg complexes
- (c) Coagulation of calcium and magnesium salts takes place.
- (d) Ion-exchanger is used for purification of hard water

Q.26

The first I.E. of 5d row elements is higher than 3d & 4d elements due to

- (a) Poor shielding of 6s electrons
- (b) Poor shielding of 4s electrons
- (c) Greater shielding of 6s electrons
- (d) Greater shielding of 4s electrons

Q.27

The ligand dimethyl glyoxime (DMG) is :

- (a) Bidentate
- (b) Tridentate
- (c) Tetradentate
- (d) Hexadentate

Q.28

What is emulsification?

- (a) Process of making an emulsion
- (b) Breaking up of an emulsion
- (c) Separation of emulsion
- (d) Destabilisation of emulsion

Q.29

The strongest reducing agent out of following is :

- (a) SnCl_2
- (b) PbCl_2
- (c) PbCl_4
- (d) SnCl_4

Q.30

The solution of alkali metals in ammonia are blue in colour due to :

- (a) Formation of ammoniated electrons
- (b) D-d transition
- (c) Formation of an excited Na^+ complex
- (d) None of these

Q.1

A screw gauge has 250 equal divisions marked along the periphery of circular scale. If one full rotation gives advancement of 0.625 cm, the least count of the arrangement is

- (a) 2.5×10^{-4} cm
- (b) 2.5×10^{-2} cm
- (c) 2.5×10^{-3} cm
- (d) None of these

Q.2

A boatman can row with a speed of 10 km/h in still water. if a river of width 2 km flows at 5 km/h in the direction in which the boat man should row to reach a point on the other bank directly opposite to the point from where he started

- (a) Along the flow
- (b) 60° in North West
- (c) 90° to direction of flow
- (d) 120° to flow

Q.3

A body moving with a velocity v breaks up into two equal parts. One of the parts retraces back with velocity v . The velocity of the other part is

- (a) V in forward direction
- (b) $3v$ in forward direction
- (c) V in backward direction
- (d) $3v$ backward direction

Q.4

If the heart pulse 1cc of blood in one second under a pressure of 20000 Nm^2 , the power of heart is

- (a) 0.02 W
- (b) 400 W
- (c) 5×10^{-10} W
- (d) 0.2 W

Q.5

A metre scale is standing up right on one of its ends. It then falls without slipping. The velocity with which the free end of scale strikes the earth is

- (a) 9.8 m/s
- (b) 5.4 m/s
- (c) 4.5 m/s
- (d) 1 m/s

Q.6

Satellites P and Q orbit a planet in circular orbits with radii $4r$ and r respectively. If speed of satellite P is $3v$, the speed of satellite Q is

- (a) $6v$ (b) $4v/3$
(c) $3v/2$ (d) $12v$

Q.7

The compressibility of water is 4×10^{-5} per unit atmospheric pressure. The decrease in volume of 100 cm^3 of water under pressure of 100 atmosphere is

- (a) 0.1 cm^3
(b) 0.2 cm^3
(c) 0.3 cm^3
(d) 0.4 cm^3

Q.8

Starting with same initial conditions an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_2 if purely isobaric and W_3 if purely isothermal, W_1 if purely adiabatic, then

- (a) $W_2 > W_1 > W_3$
(b) $W_2 > W_3 > W_1$
(c) $W_1 > W_2 > W_3$
(d) $W_1 > W_3 > W_2$

Q.9

At which of the following temperature would the molecules of a gas have twice the average kinetic energy they have at 20°C ?

- (a) 313°C
(b) 373°C
(c) 393°C
(d) 586°C

Following questions consist of two statements printed as Statement 1 and Statement 2. While answering these questions you are required to select any one of the responses indicated as

1. If both Statement 1 and Statement 2 are true and Statement 2 is a correct explanation of Statement 1.
2. If both Statement 1 and Statement 2 are true but the statement 2 is not a correct explanation of statement 1.
3. If statement 1 is true but the statement 2 is false.
4. If statement 1 is false but statement 2 is true.

Q.10

Statement 1: Two strings of the same material and length under same tension will vibrate with same fundamental frequency. Statement 2: $v\rho = \text{constant}$ where v is frequency and ρ is density of material.

- (a) 1 (b) 2
(c) 3 (d) 4

Q.11

A spring constant K is halved then the new constant of the halved spring is

- (a) $2K$
(b) $K/2$
(c) $4K$
(d) $K/4$

Q.12

A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at $x=0$ and positive plate is at $x=3d$. The slab is equidistant from the plates. The capacitor is given some charge. As x goes from 0 to $3d$

- (a) The magnitude of the electric field remains the same
(b) The direction of the electric field remains the same
(c) The electric potential remains constant
(d) The electric potential increases at first, then decreases and again increases

Q.13

In a meter bridge with standard resistor of 5Ω in left gap, the ratio of balancing lengths bridge wire is 2 : 3. The unknown resistance is

- (a) 15Ω
(b) 10Ω
(c) 3.3Ω
(d) 7.5Ω

Q.14

A small rod of bismuth is suspended freely between the poles of a strong electromagnet. It is found to arrange itself at right angles to the magnetic field. It is concluded that bismuth is

- (a) Diamagnetic
(b) Paramagnetic
(c) Ferromagnetic
(d) Antiferromagnetic

Q.15

A galvanometer of resistance 20Ω is to be converted into an ammeter of range 1A. If a current of 1 mA produces full scale deflection, the shunt required for the purpose is

- (a) 0.01Ω
- (b) 0.05Ω
- (c) 0.02Ω
- (d) 0.04Ω

Q.16

Alternating current is transmitted to distant places

- (a) At high voltage and low current
- (b) At high voltage and high current
- (c) At low voltage and low current
- (d) At low voltage and high current

Q.17

Two coils of self inductance L_1 and L_2 are placed so close together that effective flux in one coil is completely linked with other. If M is mutual inductance between them, M is equal to

- (a) L_1L_2
- (b) L_1/L_2
- (c) $(L_1L_2)^2$
- (d) $\sqrt{L_1L_2}$

Q.18

The speed of electromagnetic wave in a medium of dielectric constant 2.25 and relative permeability 4 is

- (a) 1×10^8 m/s
- (b) 2.5×10^8 m/s
- (c) 2×10^8 m/s
- (d) 3×10^8 m/s

Q.19

The depth of a tank is $2d$. The refractive index of air is μ and that of liquid is 1.5μ . The apparent depth is 60% of that of real depth. The refractive index of the medium with respect to air is given by

- (a) 0.66
- (b) 1.66
- (c) 1.55
- (d) 2

Q.20

A beam of light consisting of red and blue light is made to pass through one of the faces of a right angled prism. Then both the light rays emerged out of the other end

- (a) In different directions
- (b) In same directions
- (c) Red is absorbed, blue comes out
- (d) Blue is absorbed, red comes out

Q.21

In a young's double slit experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600 nm is used. If the wavelength of light is changed to 400 nm, number of fringes observed in same segment of the screen is

- (a) 12
- (b) 18
- (c) 24
- (d) 30

Q.22

Electrons with energy 80 keV are incident on tungsten target of an X ray tube. K shell electrons of tungsten have -72.5 KeV energy. X-rays emitted by tube contain only

- (a) Continuous X ray spectrum (Bremstrahlung) with a minimum wavelength of 0.155\AA
- (b) In continuous X ray spectrum (Bremstrahlung) with all wavelengths
- (c) The characteristic X ray spectrum of tungsten
- (d) A continuous X ray spectrum (Bremstrahlung) with a minimum wavelength of 0.155\AA and characteristic X ray spectrum of tungsten

Q.23

The ratio of radii of nuclei ${}_{13}^{27}\text{Al}$ and ${}_{52}^{125}\text{Te}$ is approximately

- (a) 6 : 10
- (b) 13 : 52
- (c) 60 : 177
- (d) 14 : 7

Q.24

Which of the following is not correct ? In bohr model of hydrogen atom

- (a) The radius of nth orbit is proportional to n^2
- (b) The total energy of electron in nth orbit is proportional n
- (c) The angular momentum of an electron in an orbit is an integral multiple of $h/2\pi$
- (d) The magnitude of the potential energy of an electron in any orbit is greater than its kinetic energy

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Q.25

Statement 1 : In an npn transistor, the collector current is 10 mA and 90% of the electrons emitted reach the collector. Statement 2 : For the same data the base current will be 0.2 mA

- (a) 1
- (b) 2
- (c) 3
- (d) 4

Q.26

Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 and X_2 will be $1/e$ after a time

- (a) $1/10\lambda$
- (b) $1/11\lambda$
- (c) $11/10\lambda$
- (d) $1/9\lambda$

Q.27

The ratio of the speed of sound in nitrogen gas to that in helium gas at 300 K is

- (a) $(2/7)^{1/2}$
- (b) $(1/7)^{1/2}$
- (c) $(\sqrt{3})/5$
- (d) $(\sqrt{6})/5$

Q.28

A concave lens of glass with refractive index 1.5 has both surfaces of same radius of curvature R . On immersion in a medium of refractive index 1.75, it will behave as a

- (a) Convergent lens of focal length $3.5 R$
- (b) Convergent lens of focal length $3.0 R$
- (c) Divergent lens of focal length $3.5 R$
- (d) Divergent lens of focal length $3.0 R$

Q.29

A parallel combination of $0.1 \text{ M}\Omega$ resistor and a $10\mu\text{F}$ capacitor is connected across a 1.5V source of negligible resistance. The time required for the capacitor to get charged up to 0.75 V is approximately (in second)

- (a) Infinite
- (b) $\log_e 2$
- (c) $\log_{10} 2$
- (d) Zero

Q.30

Masses of two isobars ${}_{29}\text{Cu}^{64}$ and ${}_{30}\text{Zn}^{64}$ are 63.9298 u and 63.9292 u respectively. It can be concluded from these data that

- (a) Both the isobars are stable
- (b) Zn^{64} is radioactive, decaying to Cu^{64} through beta decay
- (c) Cu^{64} is radioactive, decaying to Zn^{64} through gamma decay
- (d) Cu^{64} is decaying to Zn^{64} through beta decay

MATHEMATICS

Q.1

In a class of 25 students, 12 have taken mathematics, 8 have taken mathematics but not biology. The number of students who have taken both mathematics and biology are

- (a) 2
- (b) 4
- (c) 8
- (d) 25

Q.2

The domain of the function $f(x) = \sin\left(\log\left(\frac{\sqrt{4-x^2}}{1-x}\right)\right)$ is

- (a) $(-2, 1)$
- (b) $(0, \infty)$
- (c) $(-\infty, \infty)$
- (d) $(1, \infty)$

Q.3

In a triangle of the ABC, $\frac{2 \cos A}{a} + \frac{\cos B}{b} + \frac{2 \cos C}{c} = \frac{a}{bc} + \frac{b}{ca}$, then A is

- (a) 0°
- (b) 30°
- (c) 45°
- (d) 90°

Q.4

$\sin^4 \frac{\pi}{8} + \sin^4 \frac{3\pi}{8} + \sin^4 \frac{5\pi}{8} + \sin^4 \frac{7\pi}{8}$ is equal to

- (a) $\frac{1}{2}$
- (b) 1
- (c) $\frac{3}{2}$
- (d) 2

Q.5

$\left(\frac{1+\sqrt{3}}{-1+\sqrt{3}}\right)^{200} + \left(\frac{1-\sqrt{3}}{1+\sqrt{3}}\right)^{200}$ is equal to

- (a) -1
- (b) 0
- (c) 1
- (d) 2

Q.6

Solution set of $\frac{1}{x+1} - \frac{4}{(2+x)^2} > 0$ is

- (a) $(-\infty, 0)$
- (c) $(-\infty, \infty)$

Q.7

The number of words of 3 vowels and 2 consonants, that can be formed from the letters of the word „INVOLUTE“ are

- (a) 1580
- (b) 2070
- (c) 2880
- (d) 3260

Q.8

The sum of the rational terms in the expansion of $(\sqrt{2} + 3^{\frac{1}{5}})^{10}$

- (a) 20
- (b) 41
- (c) 48
- (d) 57

Q.9

Sum of n terms of the series $1 + 3 + 7 + 15 + 31 + \dots$ is

- (a) $2^{n+1} - n - 2$
- (b) $2^n - 2$
- (c) $2^{n+1} + n$
- (d) $2^{n-1} + n - 2$

Q.10

A line cuts the x-axis at $A(7, 0)$ and y-axis at $B(0, -5)$. A variable line PQ is drawn perpendicular to AB cutting the x-axis at P and y-axis at Q . If AQ and BP intersect at R , then the locus of R is

- (a) $x^2 + y^2 - 7x + 5y = 0$
- (b) $x^2 + y^2 + 5x + 3y + 1 = 0$
- (c) $x^2 + y^2 + 7x - 3y + 2 = 0$
- (d) $x^2 + y^2 - 5x + 3y = 0$

Q.11

The equation of the circle of radius 5 whose centre lies on x-axis and passes through the point $(2, 3)$ is

- a. $x^2 + y^2 - 12x - 10 = 0$
- b. $x^2 + y^2 - 12x + 11 = 0$
- c. $x^2 + y^2 + 3x + 7 = 0$
- d. $x^2 + y^2 + 2y + 4 = 0$

Q.12

An ellipse has major axis along x-axis and passes through the points (4,3) and (-1,4) The equation of the ellipse is

- (a) $x^2 + 2y^2 = 48$
- (b) $2x^2 + y^2 = 96$
- (c) $7x^2 + 15y^2 = 247$
- (d) $15x^2 + 7y^2 = 247$

Q.13

$\lim_{x \rightarrow 0} \frac{(1+x)^{\frac{1}{x}} - e + \frac{ex}{2}}{x^2}$ is equal to

- (a) $\frac{5e}{12}$
- (b) $\frac{7e}{12}$
- (c) $\frac{11e}{24}$
- (d) $\frac{12e}{25}$

Q.14

If $f(x) = \begin{cases} x^3, & x \leq 2 \\ ax^2 + bx, & x > 2 \end{cases}$ is differentiable on whole line, then a, b is equal to

- (a) 1, -1
- (b) 2, -2
- (c) 3, -3
- (d) 4, -4

Q.15

Three numbers are chosen at random without replacement from $\{1, 2, 3, \dots, 10\}$. The probability that the minimum of the chosen number is 3 or the maximum is 7 is

- (a) $\frac{11}{40}$
- (b) $\frac{13}{40}$
- (c) $\frac{17}{44}$
- (d) $\frac{19}{49}$

Q.16

The sum of the series

$$1 + \frac{1+a}{2!} + \frac{1+a+a^2}{3!} + \frac{1+a+a^2+a^3}{4!} + \dots \text{is}$$

- (a) e^a
- (b) $e^a - e$
- (c) $\frac{e^a - e}{a}$
- (d) $\frac{e^a - e}{a-1}$

Q.17

$$\begin{vmatrix} -2a & a+b & a+c \\ b+a & -2b & b+c \\ c+a & c+b & -2c \end{vmatrix} \text{ is equal to}$$

- (a) $4abc$
- (b) $4(a+b)(b+c)(c+a)$
- (c) $-8abc$
- (d) $8(a+b)(b+c)(c+a)$

Q.18

Let f be a greatest integer function and g be an absolute value function. Then the value of $(f \circ g)\left(-\frac{3}{2}\right) + (g \circ f)\left(\frac{4}{2}\right)$ is

- (a) 0
- (b) 1
- (c) 2
- (d) 3

Q.19

$$\tan^{-1} \left[\frac{\sqrt{1+x^2} + \sqrt{1-x^2}}{\sqrt{1+x^2} - \sqrt{1-x^2}} \right] \text{ is equal to}$$

- (a) $\frac{1}{2} \sin^{-1} x^2$
- (b) $\frac{1}{2} \cos^{-1} x^2$
- (c) $\frac{\pi}{4} + \frac{1}{2} \sin^{-1} x^2$
- (d) $\frac{\pi}{4} + \frac{1}{2} \cos^{-1} x^2$

If $f(x) = \begin{cases} \frac{x-5}{|x-5|} + a & \text{if } x < 5 \\ a + b & \text{if } x = 5, \text{ is continuous function. Then } a \text{ and } b \text{ is equal to} \\ \frac{x-5}{|x-5|} + b & \text{if } x > 5 \end{cases}$

- (a) 1, -1
- (b) 2, -2
- (c) -1, 1
- (d) -2, 2

Q.21

If $y = \cos^{-1} \left(\frac{3 \cos x - 4 \sin x}{5} \right)$ then $\frac{dy}{dx}$ is equal to

- (a) 0
- (b) 1
- (c) $\frac{\pi}{4}$
- (d) $\frac{\pi}{2}$

Q.22

The interval in which $f(x) = x^3 + \frac{1}{x^3}, x \neq 0$ is strictly decreasing is

- (a) (-1, 1)
- (b) (-1, 0)
- (c) (1, ∞)
- (d) (0, ∞)

Q.23

$\int \frac{dx}{(x^2-1)\sqrt{x-1}}$ is equal to

- (a) $-\frac{1}{\sqrt{x-1}} - \frac{1}{\sqrt{2}} \cot^{-1} \left(\frac{\sqrt{x-1}}{\sqrt{2}} \right) + c$
- (b) $\frac{1}{\sqrt{x-1}} + \frac{1}{\sqrt{2}} \cot^{-1} \left(\frac{\sqrt{x-1}}{\sqrt{2}} \right) + c$
- (c) $\frac{1}{\sqrt{x-1}} + \frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{\sqrt{x-1}}{\sqrt{2}} \right) + c$
- (d) $-\frac{1}{\sqrt{x-1}} - \frac{1}{\sqrt{2}} \tan^{-1} \left(\frac{\sqrt{x-1}}{\sqrt{2}} \right) + c$

Q.24

$\int_0^{\pi/2} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x} dx$ is equal to

- (a) π^2
- (b) $\frac{\pi^2}{2}$
- (c) $\frac{\pi^2}{4}$
- (d) $\frac{\pi^2}{16}$

Q.25

The area of the smaller part of the circle $x^2 + y^2 = a^2$ cut off by the line $x = \frac{a}{\sqrt{2}}$ is

- (a) $\frac{a^2}{4}(\pi - 1)$ sq. units
- (b) $\frac{a^2}{2}(\pi - 2)$ sq. units
- (c) $\frac{a^2}{4}(\pi - 2)$ sq. units
- (d) $\frac{a^2}{2}(\pi - 1)$ sq. units

Q.26

The solution of the differential equation $(1 + e^{\frac{x}{y}}) dx + ey^{\frac{x}{y}}(1 - \frac{x}{y}) dy = 0$ is

- (a) $x + ye^{\frac{x}{y}} = c$
- (b) $y + xe^{\frac{y}{x}} = c$
- (c) $x + ey^{\frac{x}{y}} = c$
- (d) $x + e^{\frac{y}{x}} = c$

Q.27

If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j} - \hat{k}$, then the unit vector perpendicular to both vectors is

- (a) $\frac{1}{\sqrt{145}}(3\hat{i} + 4\hat{j} + 7\hat{k})$
- (b) $\frac{1}{\sqrt{155}}(3\hat{i} + 5\hat{j} + 11\hat{k})$
- (c) $\frac{1}{\sqrt{155}}(3\hat{i} - 4\hat{j} - 11\hat{k})$
- (d) $\frac{1}{\sqrt{145}}(3\hat{i} - 5\hat{j} + 11\hat{k})$

Q.28

The coordinates of the point where the line through $A(3, 4, 1)$ and $B(5, 1, 6)$ across the xy plane is

- (a) $\left(\frac{13}{5}, \frac{23}{5}, 0\right)$
- (b) $\left(\frac{23}{5}, \frac{13}{5}, 0\right)$
- (c) $\left(-\frac{13}{5}, \frac{23}{5}, 0\right)$
- (d) $\left(\frac{12}{5}, \frac{22}{5}, 0\right)$

Q.29

If A and B are independent events such that $P(A) = 0.38$ and $P(A \cup B) = 0.69$ then $P(B)$ is equal to

- (a) 0
- (b) 0.5
- (c) 0.6
- (d) 0.75

Q.30

The probability of shooter hitting a target is $\frac{3}{4}$. If the probability of hitting the target at least once is more than 0.99, then the minimum number of times he must fire is

- (a) 1
- (b) 2
- (c) 3
- (d) 4