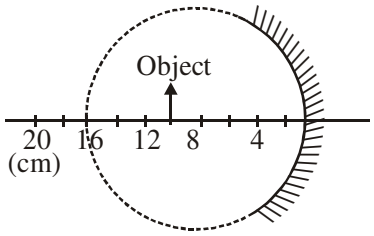
FINAL JEE–MAIN EXAMINATION – SEPTEMBER, 2020

(Held On Wednesday 02nd SEPTEMBER, 2020) TIME : 9 AM to 12 PM

PHYSICS

TEST PAPER WITH ANSWER & SOLUTION

1. 

A spherical mirror is obtained as shown in the figure from a hollow glass sphere. If an object is positioned in front of the mirror, what will be the nature and magnification of the image of the object ? (Figure drawn as schematic and not to scale)

(1) Inverted, real and magnified

(2) Erect, virtual and magnified

(3) Erect, virtual and unmagnified

(4) Inverted, real and unmagnified

2. A particle of mass m with an initial velocity $u\hat{i}$ collides perfectly elastically with a mass 3m at rest. It moves with a velocity $v\hat{j}$ after collision, then, v is given by :

(1) $v = \sqrt{\frac{2}{3}}u$ (2) $v = \frac{1}{\sqrt{6}}u$

(3) $v = \frac{u}{\sqrt{3}}$ (4) $v = \frac{u}{\sqrt{2}}$

Before collision After collision

3. A beam of protons with speed 4×10^5 ms^{-1} enters a uniform magnetic field of 0.3 T at an angle of 60° to the magnetic field. The pitch of the resulting helical path of protons is close to: (Mass of the proton = 1.67×10^{-27} kg, charge of the proton = 1.69×10^{-19} C

(1) 12 cm (2) 4 cm

(3) 5 cm (4) 2 cm

4. Consider four conducting materials copper, tungsten, mercury and aluminium with resistivity $\rho_C > \rho_T > \rho_M$ and ρ_A respectively. Then:

(1) $\rho_A > \rho_T > \rho_C$ (2) $\rho_C > \rho_A > \rho_T$

(3) $\rho_A > \rho_M > \rho_C$ (4) $\rho_M > \rho_A > \rho_C$

5. Magnetic materials used for making permanent magnets (P) and magnets in a transformer (T) have different properties of the following, which property best matches for the type of magnet required ?

(1) T : Large retentivity, small coercivity

(2) P : Small retentivity, large coercivity

(3) T : Large retentivity, large coercivity

(4) P : Large retentivity, large coercivity

6. The least count of the main scale of a vernier callipers is 1 mm. Its vernier scale is divided into 10 divisions and coincide with 9 divisions of the main scale. When jaws are touching each other, the 7th division of vernier scale coincides with a division of main scale and the zero of vernier scale is lying right side of the zero of main scale. When this vernier is used to measure length of a cylinder the zero of the vernier scale between 3.1 cm and 3.2 cm and 4th VSD coincides with a main scale division. The length of the cylinder is : (VSD is vernier scale division)

(1) 3.21 cm (2) 2.99 cm

(3) 3.2 cm (4) 3.07 cm

7. The mass density of a spherical galaxy varies as $\frac{K}{r}$ over a large distance 'r' from its centre. In that region, a small star is in a circular orbit of radius R. Then the period of revolution, T depends on R as :

(1) $T \propto R$ (2) $T^2 \propto \frac{1}{R^3}$

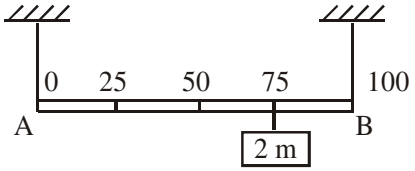
(3) $T^2 \propto R$ (4) $T^2 \propto R^3$

8. Interference fringes are observed on a screen by illuminating two thin slits 1 mm apart with a light source (λ = 632.8 nm). The distance between the screen and the slits is 100 cm. If a bright fringe is observed on a screen at a distance of 1.27 mm from the central bright fringe, then the path difference between the waves, which are reaching this point from the slits is close to :

(1) 1.27 μm (2) 2 nm

(3) 2.87 nm (4) 2.05 μm

9.

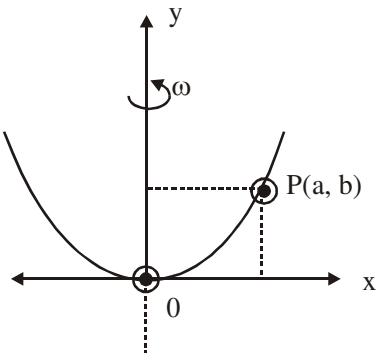


Shown in the figure is rigid and uniform one meter long rod AB held in horizontal position by two strings tied to its ends and attached to the ceiling. The rod is of mass 'm' and has another weight of mass 2 m hung at a distance of 75 cm from A. The tension in the string at A is :

(1) 2 mg (2) 0.5 mg

(3) 0.75 mg (4) 1 mg

10. A bead of mass m stays at point P(a, b) on a wire bent in the shape of a parabola $y = 4Cx^2$ and rotating with angular speed ω (see figure). The value of ω is (neglect friction) :



(1) $\sqrt{\frac{2gC}{ab}}$ (2) $2\sqrt{2gC}$ (3) $\sqrt{\frac{2g}{C}}$ (4) $2\sqrt{gC}$

11. A plane electromagnetic wave, has frequency of 2.0×10^{10} Hz and its energy density is 1.02×10^{-8} J/ m^3 in vacuum. The amplitude of the magnetic field of the wave is close to

$(\frac{1}{4\pi\varepsilon_0} = 9\times10^9 \frac{Nm^2}{C^2}$ and speed of light $= 3 \times 10^8$ ms^{-1}) :

(1) 180 nT (2) 160 nT

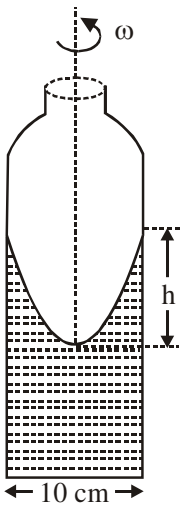
(3) 150 nT (4) 190 nT

12. In a reactor, 2 kg of $_{92}U^{235}$ fuel is fully used up in 30 days. The energy released per fission is 200 MeV. Given that the Avogadro number, N = 6.023×10^{26} per kilo mole and 1 eV = 1.6×10^{-19} J. The power output of the reactor is close to :

(1) 125 MW (2) 60 MW

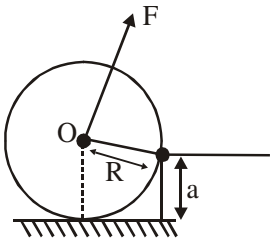
(3) 35 MW (4) 54 MW

13. A cylindrical vessel containing a liquid is rotated about its axis so that the liquid rises at its sides as shown in the figure. The radius of vessel is 5 cm and the angular speed of rotation is ω rad s^{-1}. The difference in the height, h(in cm) of liquid at the centre of vessel and at the side will be:



(1) $\frac{25\omega^2}{2g}$ (2) $\frac{2\omega^2}{5g}$ (3) $\frac{5\omega^2}{2g}$ (4) $\frac{2\omega^2}{25g}$

14. A uniform cylinder of mass M and radius R is to be pulled over a step of height a (a < R) by applying a force F at its centre 'O' perpendicular to the plane through the axes of the cylinder on the edge of the step (see figure). The minimum value of F required is :



(1) $Mg\sqrt{1-\frac{a^2}{R^2}}$

(2) $Mg\sqrt{\left(\frac{R}{R-a}\right)^2-1}$

(3) $Mg\frac{a}{R}$

(4) $Mg\sqrt{1-\left(\frac{R-a}{R}\right)^2}$

15. A gas mixture consists of 3 moles of oxygen and 5 moles of argon at temperature T. Assuming the gases to be ideal and the oxygen bond to be rigid, the total internal energy (in units of RT) of the mixture is :

(1) 11

(2) 15

(3) 20

(4) 13

16. If speed V, area A and force F are chosen as fundamental units, then the dimension of Young's modulus will be :

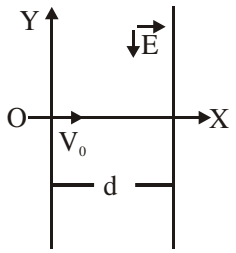
(1) $FA^{-1}V^0$

(2) FA^2V^{-1}

(3) FA^2V^{-3}

(4) FA^2V^{-2}

17. A charged particle (mass m and charge q) moves along X axis with velocity V_0. When it passes through the origin it enters a region having uniform electric field $\vec{E} = -E\hat{j}$ which extends upto x = d. Equation of path of electron in the region x > d is :



(1) $y = \frac{qEd}{mV_0^2}\left(\frac{d}{2} - x\right)$

(2) $y = \frac{qEd}{mV_0^2}(x - d)$

(3) $y = \frac{qEd}{mV_0^2}x$

(4) $y = \frac{qEd^2}{mV_0^2}x$

18. An amplitude modulated wave is represented by the expression $v_m = 5(1+ 0.6 \cos 6280t) \sin(211 \times 10^4 t)$ volts. The minimum and maximum amplitudes of the amplitude modulated wave are, respectively :

(1) 5V, 8V

(2) $\frac{3}{2}$V, 5V

(3) $\frac{5}{2}$V, 8V

(4) 3V, 5V

19. Train A and train B are running on parallel tracks in the opposite directions with speeds of 36 km/hour and 72 km/hour, respectively. A person is walking in train A in the direction opposite to its motion with a speed of 1.8 km/hr. Speed (in ms^{-1}) of this person as observed from train B will be close to : (take the distance between the tracks as negligible)

(1) 30.5 ms^{-1}

(2) 29.5 ms^{-1}

(3) 31.5 ms^{-1}

(4) 28.5 ms^{-1}

20. Two identical strings X and Z made of same material have tension T_X and T_Z in them. It their fundamental frequencies are 450 Hz and 300 Hz, respectively, then the ratio T_X/T_Z is :

(1) 0.44

(2) 1.5

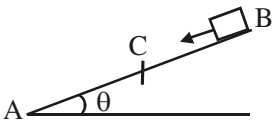
(3) 2.25

(4) 1.25

21. A 5 μF capacitor is charged fully by a 220 V supply. It is then disconnected from the supply and is connected in series to another uncharged 2.5 μF capacitor. If the energy change during the charge redistribution is $\frac{X}{100}$J then value of X to the nearest integer is_____.

22. An engine takes in 5 moles of air at 20°C and 1 atm, and compresses it adiabaticaly to l/l0th of the original volume. Assuming air to be a diatomic ideal gas made up of rigid molecules, the change in its internal energy during this process comes out to be X kJ. The value of X to the nearest integer is _____.

23.



A small block starts slipping down from a point B on an inclined plane AB, which is making an angle θ with the horizontal section BC is smooth and the remaining section CA is rough with a coefficient of friction μ. It is found that the block comes to rest as it reaches the bottom (point A) of the inclined plane. If BC = 2AC, the coefficient of friction is given by $\mu = k \tan\theta$). The value of k is _____.

24. A circular coil of radius 10 cm is placed in a uniform magnetic field of 3.0×10^{-5} T with its plane perpendicular to the field initially. It is rotated at constant angular speed about an axis along the diameter of coil and perpendicular to magnetic field so that it undergoes half of rotation in 0.2s. The maximum value of EMF induced (in μV) in the coil will be close to the integer _____.

25. When radiation of wavelength λ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength 3λ, the stopping potential is $\frac{V}{4}$. If the threshold wavelength for the metallic surface is nλ then value of n will be _____.

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CHEMISTRY

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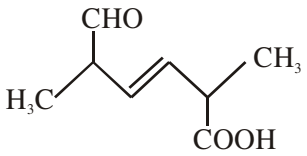
1. The IUPAC name for the following compound is:



(1) 2, 5-dimethyl-6-carboxy-hex-3-enal

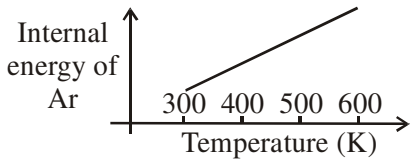
(2) 6-formyl-2-methyl-hex-3-enoic acid

(3) 2, 5-dimethyl-5-carboxy-hex-3-enal

(4) 2, 5-dimethyl-6-oxo-hex-3-enoic acid

2. The figure that is not a direct manifestation of the quantum nature of atoms is :

(1)



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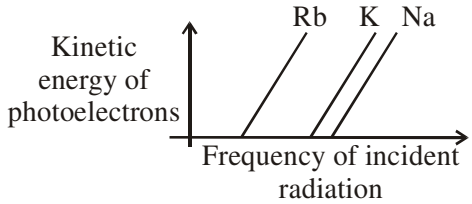
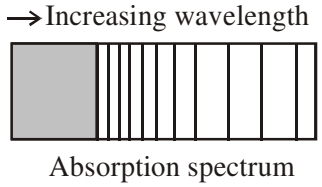
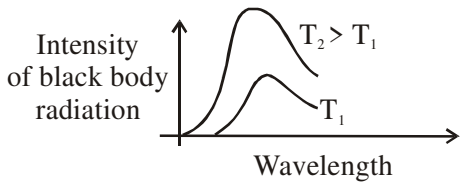


(3)



(4)



3. For the following Assertion and Reason, the correct option is

Assertion (A) : When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

Reason (R) : The equilibrium constant of $Cu^{2+}(aq) + S^{2-}(aq) \rightleftharpoons CuS(s)$ is high because the solubility product is low.

(1) Both (A) and (R) are true and (R) is the explanation for (A)

(2) Both (A) and (R) are false

(3) (A) is false and (R) is true

(4) Both (A) and (R) are true but (R) is not the explanation for (A)

4. If AB_4 molecule is a polar molecule, a possible geometry of AB_4 is :

(1) Square pyramidal

(2) Tetrahedral

(3) Square planar

(4) Rectangular planar

5. On heating compound (A) gives a gas (B) which is constituent of air. This gas when treated with H_2 in the presence of a catalyst gives another gas (C) which is basic in nature. (A) should not be:

(1) $(NH_4)_2Cr_2O_7$

(2) $Pb(NO_3)_2$

(3) NaN_3

(4) NH_4NO_2

6. In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is

(1) Electronegativity

(2) Electron gain enthalpy

(3) Ionization enthalpy

(4) Atomic radius

7. The statement that is not true about ozone is :

(1) in the stratosphere, it forms a protective shield against UV radiation.

(2) it is a toxic gas and its reaction with NO gives NO_2.

(3) in the atmosphere, it is depleted by CFCs.

(4) in the stratophere, CFCs release chlorine free radicals ($\dot{Cl}$) which reacts with O_3 to give chlorine dioxide radicals.

8. The metal mainly used in devising photoelectric cells is:

(1) Na (2) Rb

(3) Li (4) Cs

9. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements :

(I) both the complexes can be high spin

(II) Ni(II) complex can very rarely be low spin.

(III) with strong field ligands, Mn(II) complexes can be low spin.

(IV) aqueous solution of Mn(II) ions is yellow in color.

The **correct** statements are :

(1) (I), (III) and (IV) only

(2) (II), (III) and (IV) only

(3) (I), (II) and (III) only

(4) (I) and (II) only

10. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :

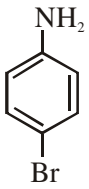
(1) tetrahedral and $-1.6\ \Delta_t + 1P$

(2) tetrahedral and $-0.6\ \Delta_t$

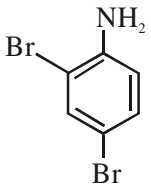
(3) octahedral and $-1.6\ \Delta_0$

(4) octahedral and $-2.4\ \Delta_0 + 2P$

11. In Carius method of estimation of halogen, 0.172g of an organic compound showed presence of 0.08g of bromine. Which of these is the **correct** structure of the compound :

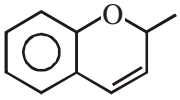
(1) 

(2) $H_3C–CH_2–Br$

(3) 

(4) $H_3C–Br$

12. The major aromatic product C in the following reaction sequence will be :



$\xrightarrow[\Delta]{\text{HBr (excess),}}$ (A) $\xrightarrow[\text{(ii)}H^+]{\text{(i) KOH(Alc.)}}$ B

$\xrightarrow[Zn/H_3O^+]{O_3}$ C

13. An open beaker of water in equilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules :

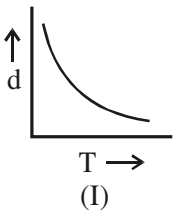
(1) leaves the vapour increases

(2) leaves the solution increases

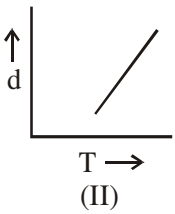
(3) leaves the solution decreases

(4) leaves the vapour decreases

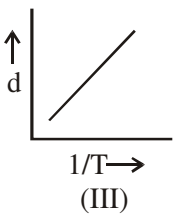
14. Which one of the following graphs is **not correct** for ideal gas ?



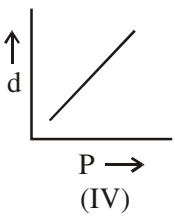
(I)



(II)



(III)



(IV)

d = Density, P = Pressure, T = Temperature

(1) II (2) III

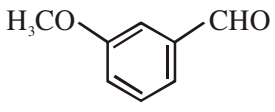
(3) I (4) IV

15. Which of the following compounds will show retention in configuration on nucleophic substitution by OH^- ion ?

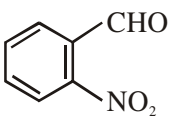
(1) $CH_3-\underset{\underset{C_2H_5}{|}}{CH}-CH_2Br$ (2) $CH_3-\underset{\underset{C_6H_5}{|}}{CH}-Br$

(3) $CH_3-\underset{\underset{CH_3}{|}}{CH}-Br$ (4) $CH_3-\overset{\overset{Br}{|}}{\underset{\underset{C_6H_{13}}{|}}{C}}-H$

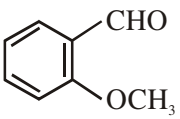
16. The increasing order of the following compounds towards HCN addition is :



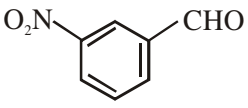
(i)



(ii)



(iii)



(iv)

(1) (iii) < (iv) < (ii) < (i)

(2) (iii) < (iv) < (i) < (ii)

(3) (iii) < (i) < (iv) < (ii)

(4) (i) < (iii) < (iv) < (ii)

17. While titrating dilute HCl solution with aqueous NaOH, which of the following will **not** be required?

(1) Clamp and phenolphthalein

(2) Pipette and distilled water

(3) Burette and porcelain tile

(4) Bunsen burner and measuring cylinder

18. Consider the following reactions :

(i) Glucose + ROH $\xrightarrow{\text{dry HCl}}$ Acetal

$\xrightarrow[(CH_3CO)_2O]{\text{x eq. of}}$ acetyl derivative

(ii) Glucose $\xrightarrow{Ni/H_2}$ A $\xrightarrow[(CH_3CO)_2O]{y\ eq.of}$ acetyl derivative

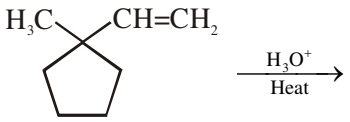
(iii) Glucose $\xrightarrow[(CH_3CO)_2O]{z\ eq.of}$ acetyl derivative

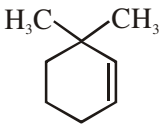
'x', 'y' and 'z' in these reactions are respectively.

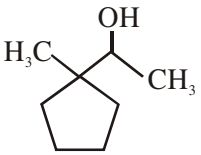
(1) 5, 6, & 5 (2) 4, 5 & 5

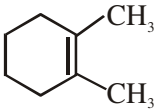
(3) 5, 4 & 5 (4) 4, 6 & 5

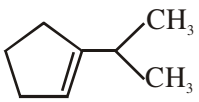
19. The major product in the following reaction is :



(1) 

(2) 

(3) 

(4) 

20. Which of the following is used for the preparation of colloids ?

(1) Ostwald Process (2) Van Arkel Method
(3) Bredig's Arc Method (4) Mond Process

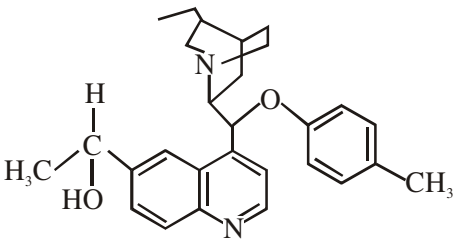
21. The Gibbs energy change (in J) for the given reaction at $[Cu^{2+}] = [Sn^{2+}] = 1$ M and 298K is:
$Cu(s) + Sn^{2+}(aq.) \rightarrow Cu^{2+}(aq.) + Sn(s)$;

($E^0_{Sn^{2+}|Sn} = -0.16V$, $E^0_{Cu^{2+}|Cu} = 0.34V$,

Take F = 96500 C mol^{-1})

22. The mass of gas adsorbed, x, per unit mass of adsorbate, m, was measured at various pressures, p. A graph between $\log \frac{x}{m}$ and log p gives a straight line with slope equal to 2 and the intercept equal to 0.4771. The value of $\frac{x}{m}$ at a pressure of 4 atm is : (Given log 3 = 0.4771)

23. The number of chiral carbons present in the molecule given below is _____ .



24. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x,y and z is ____.

$Na_4[Fe(CN)_5NOS)]$ (A) $Na_4[FeO_4]$ (B) $[Fe_2(CO)_9]$ (C)

25. The internal energy change (in J) when 90g of water undergoes complete evaporation at 100°C is ____ .

(Given : ΔH_{vap} for water at 373 K = 41 kJ/mol, R = 8.314 JK^{-1} mol^{-1})

FINAL JEE–MAIN EXAMINATION – SEPTEMBER, 2020

(Held On Wednesday 02nd SEPTEMBER, 2020) TIME : 9 AM to 12 PM

MATHEMATICS — TEST PAPER WITH SOLUTION

1. If $|x| < 1$, $|y| < 1$ and $x \neq y$, then the sum to infinity of the following series

$(x+y) + (x^2+xy+y^2) + (x^3+x^2y + xy^2+y^3)+.....$

(1) $\frac{x+y-xy}{(1-x)(1-y)}$ (2) $\frac{x+y-xy}{(1+x)(1+y)}$

(3) $\frac{x+y+xy}{(1+x)(1+y)}$ (4) $\frac{x+y+xy}{(1-x)(1-y)}$

2. Let $\alpha > 0$, $\beta > 0$ be such that $\alpha^3 + \beta^2 = 4$. If the maximum value of the term independent of x in the binomial expansion of $\left(\alpha x^{\frac{1}{9}} + \beta x^{-\frac{1}{6}}\right)^{10}$ is 10k, then k is equal to :

(1) 176 (2) 336

(3) 352 (4) 84

3. If a function f(x) defined by

$$f(x) = \begin{cases} ae^x + be^{-x}, & -1 \le x < 1 \\ cx^2 \quad\quad , & 1 \le x \le 3 \\ ax^2 + 2cx \ , & 3 < x \le 4 \end{cases}$$

be continuous for some a, b, c $\in$ R and $f'(0) + f'(2) = e$, then the value of of a is :

(1) $\frac{e}{e^2-3e-13}$ (2) $\frac{e}{e^2+3e+13}$

(3) $\frac{1}{e^2-3e+13}$ (4) $\frac{e}{e^2-3e+13}$

4. Box I contains 30 cards numbered 1 to 30 and Box II contains 20 cards numbered 31 to 50. A box is selected at random and a card is drawn from it. The number on the card is found to be a non-prime number. The probability that the card was drawn from Box I is :

(1) $\frac{8}{17}$ (2) $\frac{2}{3}$

(3) $\frac{4}{17}$ (4) $\frac{2}{5}$

5. Area (in sq. units) of the region outside $\frac{|x|}{2}+\frac{|y|}{3}=1$ and inside the ellipse $\frac{x^2}{4}+\frac{y^2}{9}=1$ is :

(1) $3(4-\pi)$ (2) $6(\pi-2)$

(3) $3(\pi-2)$ (4) $6(4-\pi)$

6. Let S be the set of all $\lambda \in R$ for which the system of linear equations

$2x - y + 2z = 2$

$x - 2y + \lambda z = -4$

$x + \lambda y + z = 4$

has no solution. Then the set S

(1) contains more than two elements.

(2) is a singleton.

(3) contains exactly two elements.

(4) is an empty set.

7. Let A be a 2×2 real matrix with entries from $\{0, 1\}$ and $|A| \neq 0$. Consider the following two statements :

(P) If $A \neq I_2$, then $|A| = -1$

(Q) If $|A| = 1$, then $tr(A) = 2$,

where I_2 denotes 2×2 identity matrix and tr(A) denotes the sum of the diagonal entries of A. Then:

(1) (P) is true and (Q) is false

(2) Both (P) and (Q) are false

(3) Both (P) and (Q) are true

(4) (P) is false and (Q) is true

8. The contrapositive of the statement "If I reach the station in time, then I will catch the train" is :

(1) If I will catch the train, then I reach the station in time.

(2) If I do not reach the station in time, then I will not catch the train.

(3) If I will not catch the train, then I do not reach the station in time.

(4) If I do not reach the station in time, then I will catch the train.

9. Let y = y(x) be the solution of the differential equation,

$\frac{2+\sin x}{y+1}\cdot\frac{dy}{dx}=-\cos x, y>0, y(0)=1$. If $y(\pi)=a$ and $\frac{dy}{dx}$ at $x=\pi$ is b, then the ordered pair (a, b) is equal to :

(1) (2, 1)

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

(3) (1, –1)

(4) (1, 1)

10. Let $X = \{x \in N : 1 \le x \le 17\}$ and $Y = \{ax + b: x \in X \text{ and } a, b \in R, a > 0\}$. If mean and variance of elements of Y are 17 and 216 respectively then a + b is equal to :

(1) –7

(2) 7

(3) 9

(4) –27

11. If the tangent to the curve $y = x + \sin y$ at a point (a, b) is parallel to the line joining $\left(0,\frac{3}{2}\right)$ and $\left(\frac{1}{2},2\right)$, then :

(1) $b = a$ (2) $b = \frac{\pi}{2} + a$

(3) $|b - a| = 1$ (4) $|a+b| = 1$

12. Let P(h, k) be a point on the curve $y = x^2 + 7x + 2$, nearest to the line, $y = 3x - 3$. Then the equation of the normal to the curve at P is :

(1) $x + 3y - 62 = 0$ (2) $x - 3y - 11 = 0$

(3) $x - 3y + 22 = 0$ (4) $x + 3y + 26 = 0$

13. The plane passing through the points (1, 2, 1), (2, 1, 2) and parallel to the line, $2x = 3y$, $z = 1$ also passes through the point :

(1) (0, 6, –2) (2) (–2, 0, 1)

(3) (0, –6, 2) (4) (2, 0, –1)

14. Let α and β be the roots of the equation $5x^2 + 6x - 2 = 0$. If $S_n = \alpha^n + \beta^n$, n = 1,2,3...., then :

(1) $5S_6 + 6S_5 = 2S_4$

(2) $5S_6 + 6S_5 + 2S_4 = 0$

(3) $6S_6 + 5S_5 + 2S_4 = 0$

(4) $6S_6 + 5S_5 = 2S_4$

15. If $R = \{(x,y) : x,y \in Z, x^2 + 3y^2 \le 8\}$ is a relation on the set of integers Z, then the domain of R^{-1} is :

(1) {–2, –1, 1,2} (2) {–1, 0, 1}

(3) {–2, –1, 0, 1, 2} (4) {0, 1}

16. The sum of the first three terms of a G.P. is S and their product is 27. Then all such S lie in :

(1) $[-3, \infty)$ (2) $(-\infty, 9]$

(3) $(-\infty, -9] \cup [3, \infty)$ (4) $(-\infty, -3] \cup [9, \infty)$

17. A line parallel to the straight line $2x - y = 0$ is tangent to the hyperbola $\frac{x^2}{4} - \frac{y^2}{2} = 1$ at the point (x_1, y_1). Then $x_1^2 + 5y_1^2$ is equal to :

(1) 5 (2) 6

(3) 8 (4) 10

18. The domain of the function $f(x)=\sin^{-1}\left(\frac{|x|+5}{x^2+1}\right)$ is $(-\infty, -a]\cup[a, \infty)$. Then a is equal to :

(1) $\frac{1+\sqrt{17}}{2}$ (2) $\frac{\sqrt{17}-1}{2}$

(3) $\frac{\sqrt{17}}{2}+1$ (4) $\frac{\sqrt{17}}{2}$

19. The value of $\left(\frac{1+\sin\frac{2\pi}{9}+i\cos\frac{2\pi}{9}}{1+\sin\frac{2\pi}{9}-i\cos\frac{2\pi}{9}}\right)^3$ is :

(1) $\frac{1}{2}\left(\sqrt{3}-i\right)$ (2) $-\frac{1}{2}\left(\sqrt{3}-i\right)$

(3) $-\frac{1}{2}\left(1-i\sqrt{3}\right)$ (4) $\frac{1}{2}\left(1-i\sqrt{3}\right)$

20. If p(x) be a polynomial of degree three that has a local maximum value 8 at x = 1 and a local minimum value 4 at x = 2; then p(0) is equal to:

(1) 12 (2) –24

(3) 6 (4) –12

21. The integral $\int_0^2 |\,|x-1|-x\,|\,dx$ is equal to_____.

22. Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $|\vec{a}-\vec{b}|^2+|\vec{a}-\vec{c}|^2=8$.

Then $|\vec{a}+2\vec{b}|^2+|\vec{a}+2\vec{c}|^2$ is equal to _____.

23. If $\lim\limits_{x\to 1}\dfrac{x+x^2+x^3+\ldots+x^n-n}{x-1}=820, (n\in N)$ then the value of n is equal to_____.

24. If the letters of the word 'MOTHER' be permuted and all the words so formed (with or without meaning) be listed as in a dictionary, then the position of the word 'MOTHER' is _____.

25. The number of integral values of k for which the line, $3x + 4y = k$ intersects the circle, $x^2 + y^2 - 2x - 4y + 4 = 0$ at two distinct points is _____.