

FINAL JEE–MAIN EXAMINATION – SEPTEMBER, 2020

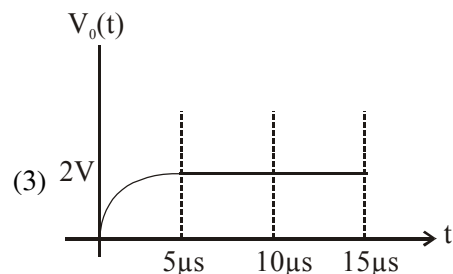
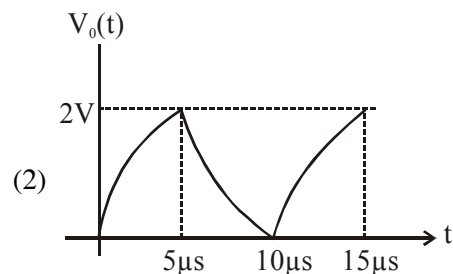
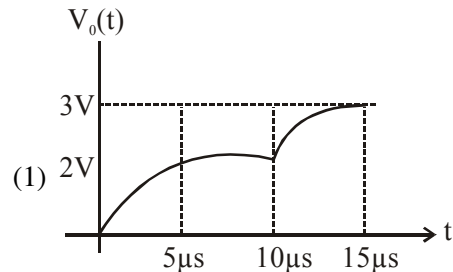
(Held On Sunday 06th SEPTEMBER, 2020) TIME : 9 AM to 12 PM

PHYSICS

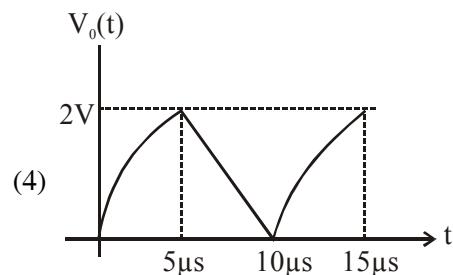
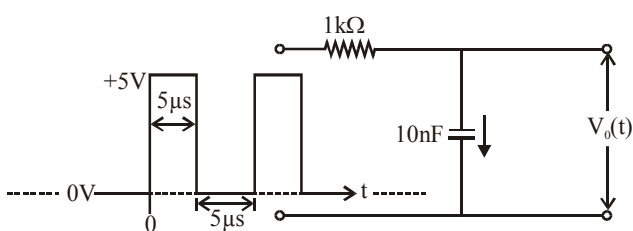
TEST PAPER WITH ANSWER & SOLUTION

1. A satellite is in an elliptical orbit around a planet P. It is observed that the velocity of the satellite when it is farthest from the planet is 6 times less than that when it is closest to the planet. The ratio of distances between the satellite and the planet at closest and farthest points is :

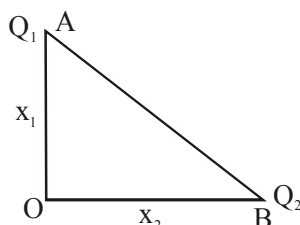
- (1) 1 : 6 (2) 3 : 4
(3) 1 : 3 (4) 1 : 2



2. For the given input voltage waveform $V_{in}(t)$, the output voltage waveform $V_D(t)$, across the capacitor is correctly depicted by:



3. Charges Q_1 and Q_2 are at points A and B of a right angle triangle OAB (see figure). The resultant electric field at point O is perpendicular to the hypotenuse, then Q_1/Q_2 is proportional to :



- (1) $\frac{x_2^2}{x_1^2}$ (2) $\frac{x_1^3}{x_2^3}$ (3) $\frac{x_1}{x_2}$ (4) $\frac{x_2}{x_1}$

4. A screw gauge has 50 divisions on its circular scale. The circular scale is 4 units ahead of the pitch scale marking, prior to use. Upon one complete rotation of the circular scale, a displacement of 0.5 mm is noticed on the pitch scale. The nature of zero error involved, and the least count of the screw gauge, are respectively :
- (1) Negative, $2 \mu\text{m}$
 (2) Positive, $10 \mu\text{m}$
 (3) Positive, $0.1 \mu\text{m}$
 (4) Positive, 0.1 mm

5. An object of mass m is suspended at the end of a massless wire of length L and area of cross-section, A . Young modulus of the material of the wire is Y . If the mass is pulled down slightly its frequency of oscillation along the vertical direction is:

$$(1) f = \frac{1}{2\pi} \sqrt{\frac{YA}{mL}} \quad (2) f = \frac{1}{2\pi} \sqrt{\frac{YL}{mA}}$$

$$(3) f = \frac{1}{2\pi} \sqrt{\frac{mA}{YL}} \quad (4) f = \frac{1}{2\pi} \sqrt{\frac{mL}{YA}}$$

6. A particle of charge q and mass m is moving with a velocity $-v\hat{i}$ ($v \neq 0$) towards a large screen placed in the Y - Z plane at a distance d . If there is a magnetic field $\vec{B} = B_0\hat{k}$, the minimum value of v for which the particle will not hit the screen is:

$$(1) \frac{qdB_0}{2m} \quad (2) \frac{qdB_0}{m}$$

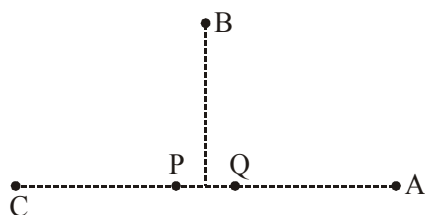
$$(3) \frac{2qdB_0}{m} \quad (4) \frac{qdB_0}{3m}$$

7. An insect is at the bottom of a hemispherical ditch of radius 1 m. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefficient of friction between the ground and the insect is 0.75, then h is :
($g = 10\text{ms}^{-2}$)
- (1) 0.80 m (2) 0.60 m
(3) 0.45 m (4) 0.20 m

8. A clock has a continuously moving second's hand of 0.1 m length. The average acceleration of the tip of the hand (in units of ms^{-2}) is of the order of:

(1) 10^{-3} (2) 10^{-2}
 (3) 10^{-4} (4) 10^{-1}

9. In the figure below, P and Q are two equally intense coherent sources emitting radiation of wavelength 20 m. The separation between P and Q is 5 m and the phase of P is ahead of that of Q by 90° . A, B and C are three distinct points of observation, each equidistant from the midpoint of PQ. The intensities of radiation at A, B, C will be in the ratio:



(1) 0 : 1 : 2 (2) 4 : 1 : 0
 (3) 0 : 1 : 4 (4) 2 : 1 : 0

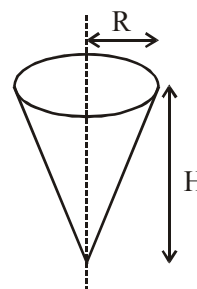
10. An electron, a doubly ionized helium ion (He^{++}) and a proton are having the same kinetic energy. The relation between their respective de-Broglie wavelengths λ_e , $\lambda_{\text{He}^{++}}$ and λ_p is:

- (1) $\lambda_e < \lambda_p < \lambda_{\text{He}^{++}}$ (2) $\lambda_e < \lambda_{\text{He}^{++}} = \lambda_p$
 (3) $\lambda_e > \lambda_{\text{He}^{++}} > \lambda_p$ (4) $\lambda_e > \lambda_p > \lambda_{\text{He}^{++}}$

11. An electron is moving along + x direction with a velocity of $6 \times 10^6 \text{ ms}^{-1}$. It enters a region of uniform electric field of 300 V/cm pointing along + y direction. The magnitude and direction of the magnetic field set up in this region such that the electron keeps moving along the x direction will be:

- (1) $5 \times 10^{-3} \text{ T}$, along +z direction
 (2) $3 \times 10^{-4} \text{ T}$, along -z direction
 (3) $3 \times 10^{-4} \text{ T}$, along +z direction
 (4) $5 \times 10^{-3} \text{ T}$, along -z direction

12. Shown in the figure is a hollow icecream cone (it is open at the top). If its mass is M, radius of its top, R and height, H, then its moment of inertia about its axis is:



- (1) $\frac{MR^2}{2}$ (2) $\frac{MH^2}{3}$
 (3) $\frac{MR^2}{3}$ (4) $\frac{M(R^2 + H^2)}{4}$

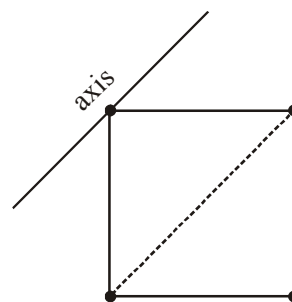
13. An AC circuit has $R = 100 \, \Omega$, $C = 2 \, \mu\text{F}$ and $L = 80 \, \text{mH}$, connected in series. The quality factor of the circuit is :

(1) 0.5 (2) 2
(3) 20 (4) 400

14. If the potential energy between two molecules is given by $U = \frac{A}{r^6} + \frac{B}{r^{12}}$, then at equilibrium, separation between molecules, and the potential energy are :

(1) $\left(\frac{B}{A}\right)^{1/6}, 0$ (2) $\left(\frac{B}{2A}\right)^{1/6}, -\frac{A^2}{2B}$
(3) $\left(\frac{2B}{A}\right)^{1/6}, -\frac{A^2}{4B}$ (4) $\left(\frac{2B}{A}\right)^{1/6}, -\frac{A^2}{2B}$

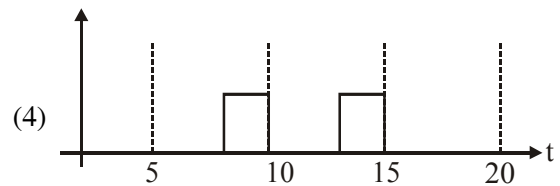
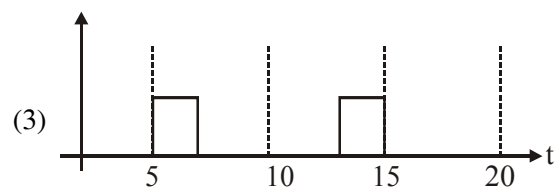
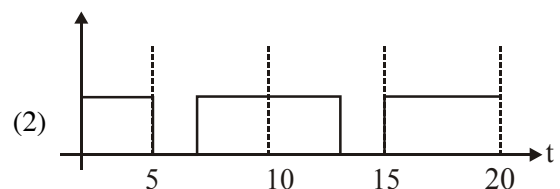
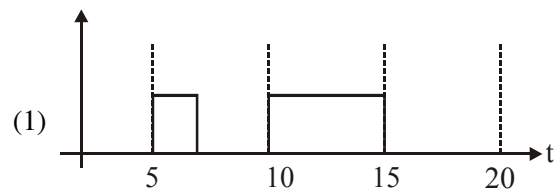
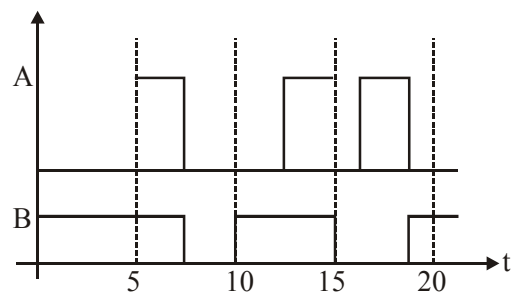
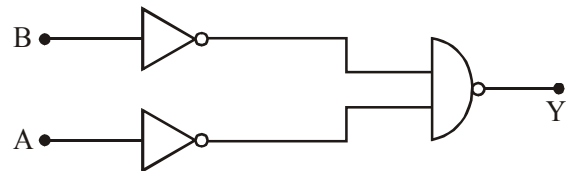
15. Four point masses, each of mass m , are fixed at the corners of a square of side ℓ . The square is rotating with angular frequency ω , about an axis passing through one of the corners of the square and parallel to its diagonal, as shown in the figure. The angular momentum of the square about this axis is:



(1) $2m\ell^2\omega$ (2) $3m\ell^2\omega$
(3) $m\ell^2\omega$ (4) $4m\ell^2\omega$

16. You are given that Mass of ${}^7_3\text{Li} = 7.0160 \text{ u}$,
 Mass of ${}^4_2\text{He} = 4.0026 \text{ u}$
 and Mass of ${}^1_1\text{H} = 1.0079 \text{ u}$.
 When 20 g of ${}^7_3\text{Li}$ is converted into ${}^4_2\text{He}$ by
 proton capture, the energy liberated, (in kWh),
 is: [Mass of nucleon = $1 \text{ GeV}/c^2$]
 (1) 8×10^6 (2) 1.33×10^6
 (3) 6.82×10^5 (4) 4.5×10^5

17. Identify the correct output signal Y in the given combination of gates (as shown) for the given inputs A and B.



18. Molecules of an ideal gas are known to have three translational degrees of freedom and two rotational degrees of freedom. The gas is maintained at a temperature of T . The total internal energy, U of a mole of this gas, and

the value of $\gamma \left(= \frac{C_p}{C_v} \right)$ given, respectively, by:

(1) $U = \frac{5}{2}RT$ and $\gamma = \frac{6}{5}$

(2) $U = 5RT$ and $\gamma = \frac{7}{5}$

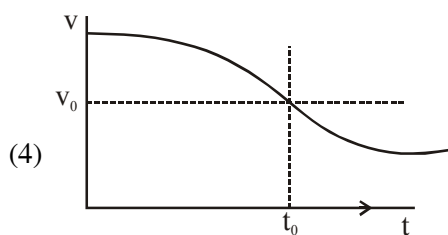
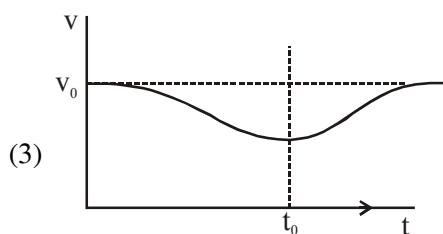
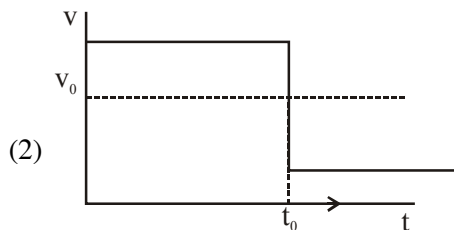
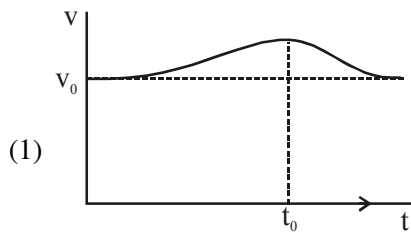
(3) $U = 5RT$ and $\gamma = \frac{6}{5}$

(4) $U = \frac{5}{2}RT$ and $\gamma = \frac{7}{5}$

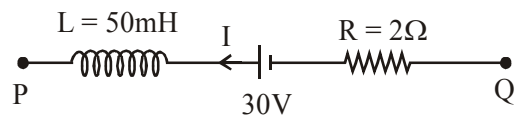
19. A point like object is placed at a distance of 1m in front of a convex lens of focal length 0.5 m. A plane mirror is placed at a distance of 2 m behind the lens. The position and nature of the final image formed by the system is :

- (1) 1 m from the mirror, virtual
- (2) 1 m from the mirror, real
- (3) 2.6 m from the mirror, real
- (4) 2.6 m from the mirror, virtual

20. A sound source S is moving along a straight track with speed v , and is emitting sound of frequency ν_0 (see figure). An observer is standing at a finite distance, at the point O, from the track. The time variation of frequency heard by the observer is best represented by : (t_0 represents the instant when the distance between the source and observer is minimum)



21. A part of a complete circuit is shown in the figure. At some instant, the value of current I is 1 A and it is decreasing at a rate of 10^2 A s^{-1} . The value of the potential difference $V_P - V_Q$, (in volts) at that instant, is.



22. Two bodies of the same mass are moving with the same speed, but in different directions in a plane. They have a completely inelastic collision and move together thereafter with a final speed which is half of their initial speed. The angle between the initial velocities of the two bodies (in degree) is.

23. Suppose that intensity of a laser is

$\left(\frac{315}{\pi}\right) \text{ W/m}^2$. The rms electric field, in units

of V/m associated with this source is close to the nearest integer is

$(\epsilon_0 = 8.86 \times 10^{-12} \text{ C}^2 \text{ Nm}^{-2}; c = 3 \times 10^8 \text{ ms}^{-1})$

24. The density of a solid metal sphere is determined by measuring its mass and its diameter. The maximum error in the density

of the sphere is $\left(\frac{x}{100}\right)\%$. If the relative errors

in measuring the mass and the diameter are 6.0% and 1.5% respectively, the value of x is .

25. Initially a gas of diatomic molecules is contained in a cylinder of volume V_1 at a pressure P_1 and temperature 250 K. Assuming that 25% of the molecules get dissociated causing a change in number of moles. The pressure of the resulting gas at temperature 2000 K, when contained in a volume $2V_1$ is given by P_2 . The ratio P_2/P_1 is.

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CHEMISTRY	TEST PAPER WITH ANSWER & SOLUTION
<p>1. The set that contains atomic number of only transition element is -</p> <p>(1) 21, 32, 53, 64</p> <p>(2) 21, 25, 42, 72</p> <p>(3) 9, 17, 34, 38</p> <p>(4) 37, 42, 50, 64</p>	<p>5. A solution of two components containing n_1 moles of the 1st component and n_2 moles of the 2nd component is prepared. M_1 and M_2 are the molecular weights of component 1 and 2 respectively. If d is the density of the solution in g mL^{-1}, C_2 is the molarity and x_2 is the mole fraction of the 2nd component, then C_2 can be expressed as :</p> <p>(1) $C_2 = \frac{1000x_2}{M_1 + x_2(M_2 - M_1)}$</p> <p>(2) $C_2 = \frac{dx_2}{M_2 + x_2(M_2 - M_1)}$</p> <p>(3) $C_2 = \frac{dx_1}{M_2 + x_2(M_2 - M_1)}$</p> <p>(4) $C_2 = \frac{1000dx_2}{M_1 + x_2(M_2 - M_1)}$</p>
<p>2. The lanthanoid that does NOT show +4 oxidation state is</p> <p>(1) Dy</p> <p>(2) Eu</p> <p>(3) Ce</p> <p>(4) Tb</p>	
<p>3. The INCORRECT statement is :</p> <p>(1) bronze is an alloy of copper and tin.</p> <p>(2) brass is an alloy of copper and nickel</p> <p>(3) cast iron is used to manufacture wrought iron.</p> <p>(4) german silver is an alloy of zinc, copper and nickel</p>	<p>6. The major products of the following reaction are :</p> $\text{CH}_3-\overset{\text{CH}_3}{\underset{\text{OSO}_2\text{CH}_3}{\text{CH}}}-\text{CH}-\text{CH}_3 \xrightarrow[\text{(ii) O}_3/\text{H}_2\text{O}_2]{\text{(i) KO}^t\text{Bu}/\Delta}$ <p>(1) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\text{CH}}-\text{COOH} + \text{HCOOH}$</p> <p>(2) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\text{CH}}-\text{CHO} + \text{HCHO}$</p> <p>(3) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\text{C}}=\text{O} + \text{CH}_3\text{CHO}$</p> <p>(4) $\text{H}_3\text{C}-\overset{\text{CH}_3}{\text{C}}=\text{O} + \text{CH}_3\text{COOH}$</p>
<p>4. The correct statement with respect to dinitrogen is :</p> <p>(1) liquid dinitrogen is not used in cryosurgery.</p> <p>(2) it can be used as an inert diluent for reactive chemicals.</p> <p>(3) it can combine with dioxygen at 25°C</p> <p>(4) N_2 is paramagnetic in nature.</p>	

7. Kraft temperature is the temperature
- below which the formation of micelles takes place.
 - below which the aqueous solution of detergents starts freezing.
 - above which the formation of micelles takes place.
 - above which the aqueous solution of detergents starts boiling.

8. Consider the Assertion and Reason given below.

Assertion (A) : Ethene polymerized in the presence of Ziegler Natta Catalyst at high temperature and pressure is used to make buckets and dustbins.

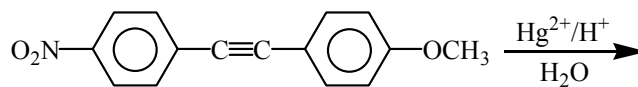
Reason (R): High density polymers are closely packed and are chemically inert. Choose the correct answer from the following :

- (A) is correct but (R) is wrong.
- (A) and (R) both are wrong.
- Both (A) and (R) are correct and (R) is the correct explanation of (A).
- Both (A) and (R) are correct but (R) is not the correct explanation of (A).

9. The species that has a spin only magnetic moment of 5.9 BM, is -

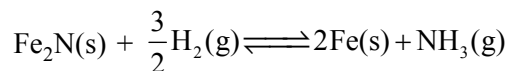
- $\text{Ni}(\text{CO})_4(\text{T}_d)$
- $[\text{MnBr}_4]^{2-}(\text{T}_d)$
- $[\text{NiCl}_4]^{2-}(\text{T}_d)$
- $[\text{Ni}(\text{CN})_4]^{2-}$ (square planar)

10. The major product obtained from the following reaction is -



-
-
-
-

11. For the reaction :



- $K_C = K_P(RT)$
- $K_C = K_P(RT)^{-1/2}$
- $K_C = K_P(RT)^{-3/2}$
- $K_C = K_P(RT)^{1/2}$

12. Arrange the following solutions in the decreasing order of pOH :

- 0.01 M HCl
- 0.01 M NaOH
- 0.01 M CH_3COONa
- 0.01 M NaCl

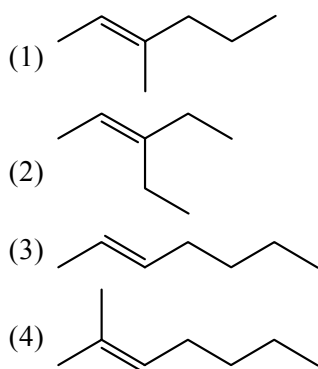
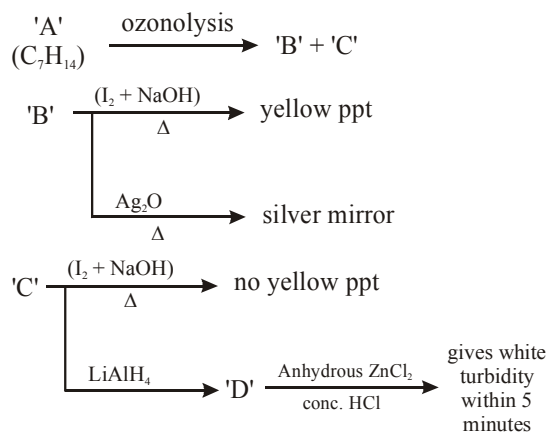
- (B) > (C) > (D) > (A)
- (A) > (C) > (D) > (B)
- (B) > (D) > (C) > (A)
- (A) > (D) > (C) > (B)

13. The presence of soluble fluoride ion upto 1 ppm concentration in drinking water, is :

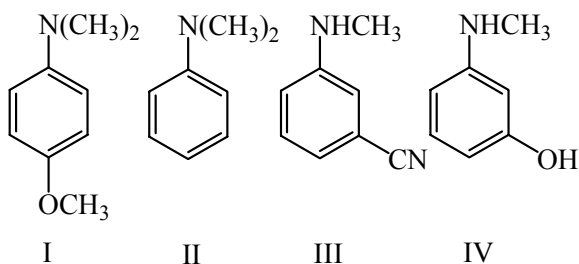
(1) harmful to bones
(2) harmful for teeth
(3) safe for teeth
(4) harmful to skin

14. Consider the following reactions :

'A' is -



15. The increasing order of pK_b values of the following compounds is -



(1) $I < II < IV < III$
(2) $II < IV < III < I$

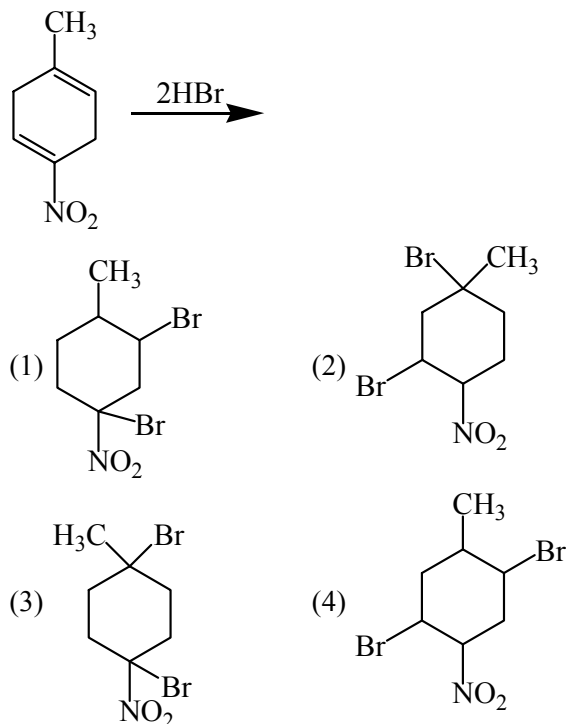
(3) $II < I < III < IV$

(4) $I < II < III < IV$

16. Among the sulphates of alkaline earth metals, the solubilities of $BeSO_4$ and $MgSO_4$ in water, respectively, are:

(1) high and high (2) poor and poor
(3) high and poor (4) poor and high

17. The major product of the following reaction is



18. The variation of equilibrium constant with temperature is given below :

Temperature **Equilibrium constant**

$T_1 = 25^\circ C$ $K_1 = 100$

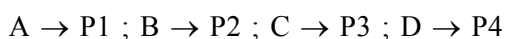
$T_2 = 100^\circ C$ $K_2 = 100$

The values of ΔH° , ΔG° at T_1 and ΔG° at T_2 (in kJ mol^{-1}) respectively, are close to

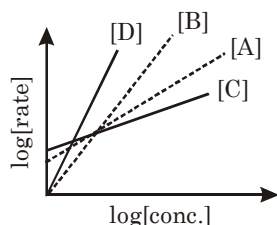
[Use $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$]

(1) 0.64, -5.71 and -14.29
(2) 28.4, -7.14 and -5.71
(3) 28.4, -5.71 and -14.29
(4) 0.64, -7.14 and -5.71

19. Consider the following reactions :



The order of the above reactions are a, b, c, and d, respectively. The following graph is obtained when $\log [\text{rate}]$ vs. $\log [\text{conc}]$ are plotted:



Among the following , the correct sequence for the order of the reactions is:

- (1) $a > b > c > d$
 - (2) $c > a > b > d$
 - (3) $d > b > a > c$
 - (4) $d > a > b > c$
20. Which of the following compound shows geometrical isomerism
- (1) 2-methylpent-2-ene
 - (2) 4-methylpent-1-ene
 - (3) 4-methylpent-2-ene
 - (4) 2-methylpent-1-ene
21. In an estimation of bromine by Carius method, 1.6 g of an organic compound gave 1.88 g of AgBr. The mass percentage of bromine in the compound is _____
- (Atomic mass, Ag=108, Br = 80 g mol⁻¹)

22. The elevation of boiling point of 0.10 m aqueous $\text{CrCl}_3 \cdot x\text{NH}_3$ solution is two times that of 0.05m aqueous CaCl_2 solution. The value of x is ____.
- [Assume 100% ionisation of the complex and CaCl_2 , coordination number of Cr as 6, and that all NH_3 molecules are present inside the coordination sphere]

23. A spherical balloon of radius 3 cm containing helium gas has a pressure of 48×10^{-3} bar. At the same temperature, the pressure, of a spherical balloon of radius 12 cm containing the same amount of gas will be $\text{_____} \times 10^{-6}$ bar.

24. The number of $\text{Cl}=\text{O}$ bonds in perchloric acid is, " _____ "

25. Potassium chlorate is prepared by the electrolysis of KCl in basic solution



If only 60% of the current is utilized in the reaction, the time (rounded to the nearest hour) required to produce 10 g of KClO_3 using a current of 2 A is _____.

(Given : $F = 96,500 \text{ C mol}^{-1}$ molar mass of $\text{KClO}_3 = 122 \text{ g mol}^{-1}$)

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MATHEMATICS

TEST PAPER WITH SOLUTION

1. Which of the following points lies on the locus of the foot of perpendicular drawn upon any tangent to the ellipse, $\frac{x^2}{4} + \frac{y^2}{2} = 1$ from any of its foci ?

- (1) $(-1, \sqrt{3})$ (2) $(-1, \sqrt{2})$
(3) $(-2, \sqrt{3})$ (4) $(1, 2)$

2. Two families with three members each and one family with four members are to be seated in a row. In how many ways can they be seated so that the same family members are not separated ?

- (1) $2!3!4!$ (2) $(3!)^3 \cdot (4!)$
(3) $(3!)^2 \cdot (4!)$ (4) $3!(4!)^3$

3.
$$\lim_{x \rightarrow 1} \left(\frac{\int_0^{(x-1)^2} t \cos(t^2) dt}{(x-1) \sin(x-1)} \right)$$

- (1) does not exist (2) is equal to $\frac{1}{2}$
(3) is equal to 1 (4) is equal to $-\frac{1}{2}$

4. If $\{p\}$ denotes the fractional part of the number p , then $\left\{\frac{3^{200}}{8}\right\}$, is equal to
- (1) $\frac{1}{8}$ (2) $\frac{5}{8}$ (3) $\frac{3}{8}$ (4) $\frac{7}{8}$

5. The values of λ and μ for which the system of linear equations
- $$x + y + z = 2$$
- $$x + 2y + 3z = 5$$
- $$x + 3y + \lambda z = \mu$$
- has infinitely many solutions are, respectively
- (1) 5 and 7 (2) 6 and 8
(3) 4 and 9 (4) 5 and 8

6. The area (in sq. units) of the region $A = \{(x,y) : |x| + |y| \leq 1, 2y^2 \geq |x|\}$ is :
- (1) $\frac{1}{6}$ (2) $\frac{1}{3}$ (3) $\frac{7}{6}$ (4) $\frac{5}{6}$

8. If $\sum_{i=1}^n (x_i - a) = n$ and $\sum_{i=1}^n (x_i - a)^2 = na$, ($n, a > 1$) then the standard deviation of n observations x_1, x_2, \dots, x_n is
- (1) $n\sqrt{a-1}$ (2) $\sqrt{a-1}$
(3) $a - 1$ (4) $\sqrt{n(a-1)}$
7. Out of 11 consecutive natural numbers if three numbers are selected at random (without repetition), then the probability that they are in A.P. with positive common difference, is :
- (1) $\frac{15}{101}$ (2) $\frac{5}{101}$ (3) $\frac{5}{33}$ (4) $\frac{10}{99}$
9. Let L_1 be a tangent to the parabola $y^2 = 4(x + 1)$ and L_2 be a tangent to the parabola $y^2 = 8(x + 2)$ such that L_1 and L_2 intersect at right angles. Then L_1 and L_2 meet on the straight line :
- (1) $x + 3 = 0$ (2) $x + 2y = 0$
(3) $2x + 1 = 0$ (4) $x + 2 = 0$

10. The negation of the Boolean expression

$p \vee (\sim p \wedge q)$ is equivalent to :

- (1) $\sim p \vee \sim q$ (2) $\sim p \vee q$
 (3) $\sim p \wedge \sim q$ (4) $p \wedge \sim q$

11. If $f(x+y) = f(x)f(y)$ and $\sum_{x=1}^{\infty} f(x) = 2, x, y \in \mathbb{N}$,

where \mathbb{N} is the set of all natural numbers, then

the value of $\frac{f(4)}{f(2)}$ is

- (1) $\frac{1}{9}$ (2) $\frac{4}{9}$ (3) $\frac{1}{3}$ (4) $\frac{2}{3}$

12. The general solution of the differential equation

$$\sqrt{1+x^2+y^2+x^2y^2} + xy \frac{dy}{dx} = 0 \text{ is :}$$

(where C is a constant of integration)

(1) $\sqrt{1+y^2} + \sqrt{1+x^2} = \frac{1}{2} \log_e \left(\frac{\sqrt{1+x^2}+1}{\sqrt{1+x^2}-1} \right) + C$

(2) $\sqrt{1+y^2} - \sqrt{1+x^2} = \frac{1}{2} \log_e \left(\frac{\sqrt{1+x^2}+1}{\sqrt{1+x^2}-1} \right) + C$

(3) $\sqrt{1+y^2} + \sqrt{1+x^2} = \frac{1}{2} \log_e \left(\frac{\sqrt{1+x^2}-1}{\sqrt{1+x^2}+1} \right) + C$

(4) $\sqrt{1+y^2} - \sqrt{1+x^2} = \frac{1}{2} \log_e \left(\frac{\sqrt{1+x^2}-1}{\sqrt{1+x^2}+1} \right) + C$

13. A ray of light coming from the point $(2, 2\sqrt{3})$ is incident at an angle 30° on the line $x=1$ at the point A. The ray gets reflected on the line $x=1$ and meets x-axis at the point B. Then, the line AB passes through the point:

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

14. Let a, b, c, d and p be any non zero distinct real numbers such that $(a^2 + b^2 + c^2)p^2 - 2(ab + bc + cd)p + (b^2 + c^2 + d^2) = 0$. Then :
 (1) a, c, p are in G.P. (2) a, c, p are in A.P.
 (3) a, b, c, d are in G.P. (4) a, b, c, d are in A.P.

15. If $I_1 = \int_0^1 (1-x^{50})^{100} dx$ and $I_2 = \int_0^1 (1-x^{50})^{101} dx$

such that $I_2 = \alpha I_1$ then α equals to

- (1) $\frac{5050}{5051}$ (2) $\frac{5050}{5049}$
 (3) $\frac{5049}{5050}$ (4) $\frac{5051}{5050}$

16. The position of a moving car at time t is given by $f(t) = at^2 + bt + c$, $t > 0$, where a , b and c are real numbers greater than 1. Then the average speed of the car over the time interval $[t_1, t_2]$ is attained at the point :
- (1) $a(t_2 - t_1) + b$ (2) $(t_2 - t_1)/2$
(3) $2a(t_1 + t_2) + b$ (4) $(t_1 + t_2)/2$

17. The region represented by $\{z = x + iy \in \mathbb{C} : |z| - \operatorname{Re}(z) \leq 1\}$ is also given by the inequality :
- (1) $y^2 \geq x + 1$ (2) $y^2 \geq 2(x + 1)$
(3) $y^2 \leq x + \frac{1}{2}$ (4) $y^2 \leq 2\left(x + \frac{1}{2}\right)$

18. If α and β be two roots of the equation $x^2 - 64x + 256 = 0$.

Then the value of $\left(\frac{\alpha^3}{\beta^5}\right)^{\frac{1}{8}} + \left(\frac{\beta^3}{\alpha^5}\right)^{\frac{1}{8}}$ is

- (1) 1 (2) 3
(3) 4 (4) 2

19. The shortest distance between the lines

$$\frac{x-1}{0} = \frac{y+1}{-1} = \frac{z}{1} \text{ and } x + y + z + 1 = 0,$$

$2x - y + z + 3 = 0$ is :

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

20. Let m and M be respectively the minimum and maximum values of

$$\begin{vmatrix} \cos^2 x & 1 + \sin^2 x & \sin 2x \\ 1 + \cos^2 x & \sin^2 x & \sin 2x \\ \cos^2 x & \sin^2 x & 1 + \sin 2x \end{vmatrix}.$$
 Then the

ordered pair (m,M) is equal to

- (1) (-3,-1) (2) (-4,-1)
(3) (1,3) (4) (-3,3)

21. Let AD and BC be two vertical poles at A and B respectively on a horizontal ground. If AD = 8 m, BC = 11 m and AB = 10 m; then the distance (in meters) of a point M on AB from the point A such that $MD^2 + MC^2$ is minimum is_.

22. The angle of elevation of the top of a hill from a point on the horizontal plane passing through the foot of the hill is found to be 45° . After walking a distance of 80 meters towards the top, up a slope inclined at an angle of 30° to the horizontal plane, the angle of elevation of the top of the hill becomes 75° . Then the height of the hill (in meters) is _.

23. Set A has m elements and Set B has n elements. If the total number of subsets of A is 112 more than the total number of subsets of B, then the value of m.n is _.

24. If \vec{a} and \vec{b} are unit vectors, then the greatest value of $\sqrt{3}|\vec{a} + \vec{b}| + |\vec{a} - \vec{b}|$ is _.

25. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as

$$f(x) = \begin{cases} x^5 \sin\left(\frac{1}{x}\right) + 5x^2 & , \quad x < 0 \\ 0 & , \quad x = 0 \\ x^5 \cos\left(\frac{1}{x}\right) + \lambda x^2 & , \quad x > 0 \end{cases} . \text{ The value}$$

of λ for which $f''(0)$ exists, is _.