9 Mock Test

Time : 3 hrs. **Max. Marks : 360**

INSTRUCTIONS

- **Physics (120 marks)** : Question No. 1 to 30 are of **4 marks** each.
- **Chemistry (120 marks)** : Question No. 31 to 60 are of **4 marks** each.
- **Mathematics (120 marks)** : Question No. 61 to 90 are of **4 marks** each.
- **Negative Marking** : One fourth (¼) marks will be deducted for indicating incorrect response of each question.

PHYSICS

1. Radioactive material 'A' has decay constant '8 λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'A' to that 'B' will be $\frac{1}{e}$?

   (a) $\frac{1}{7\lambda}$ (b) $\frac{1}{8\lambda}$ (c) $\frac{1}{9\lambda}$ (d) $\frac{1}{\lambda}$

2. Two sources of equal emf are connected to an external resistance R. The internal resistances of the two sources are R_1 and R_2 ($R_2 > R_1$). If the potential difference across the source having internal resistance R_2 is zero then

   (a) $R = R_1R_2/(R_1 + R_2)$

   (b) $R = R_1R_2/(R_2 - R_1)$

   (c) $R = R_2 \times (R_1 + R_2)/(R_2 - R_1)$

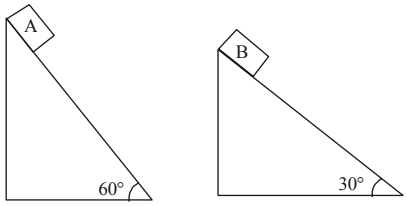
   (d) $R = R_2 - R_1$

3. A ball projected from ground at an angle of 45° just clears a wall in front. If point of projection is 4 m from the foot of wall and ball strikes the ground at a distance of 6 m on the other side of the wall, the height of the wall is :

   (a) 4.4m (b) 2.4m

   (c) 3.6m (d) 1.6m

4. Two fixed frictionless inclined planes making an angle 30° and 60° with the vertical are shown in the figure. Two blocks A and B are placed on the two planes. What is the relative vertical acceleration of A with respect to B ?



Space for Rough Work

(a) 4.9 ms^{-2} (in horizontal direction)
(b) 9.8 ms^{-2} (in vertical direction)
(c) Zero
(d) 4.9 ms^{-2} (in vertical direction)

5. A satellite is revolving round the earth with velocity v. The minimum percentage increase in its velocity necessary for the escape of satellite will be
(a) 100% (b) 50%
(c) 82.3% (d) 41.4%

6. A capillary tube (A) is dipped in water. Another identical tube (B) is dipped in a soap -water solution. Which of the following shows the relative nature of the liquid columns in the two tubes.

(a) 

(b) 

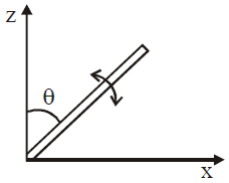
(c) 

(d) 

7. A refrigerator takes heat from water at 0°C inside it and rejects it to the room at a temperature of 27°C. The latent heat of ice is 336×10^3 J kg^{-1}. If 5 kg of water at 0°C is converted into ice at 0°C by the refrigerator, then the energy consumed by the refrigerator is close to :
(a) 1.51×10^5 J (b) 1.68×10^6 J
(c) 1.71×10^7 J (d) 1.67×10^5 J

8. A particle of charge 16×10^{-16} C moving with velocity 10 ms^{-1} along x-axis enters a region where magnetic field of induction $\vec{B}$ is along the y-axis and an electric field of magnitude 10^4 Vm^{-1} is along the negative z-axis. If the charged particle continues moving along x-axis, the magnitude of $\vec{B}$ is :
(a) 16×10^3 Wb m^{-2} (b) 2×10^3 Wb m^{-2}
(c) 1×10^3 Wb m^{-2} (d) 4×10^3 Wb m^{-2}

9. A slender uniform rod of mass M and length ℓ is pivoted at one end so that it can rotate in a vertical plane (see figure). There is negligible friction at the pivot. The free end is held vertically above the pivot and then released. The angular acceleration of the rod when it makes an angle θ with the vertical is



(a) $\frac{3g}{2\ell}\cos\theta$ (b) $\frac{2g}{3\ell}\cos\theta$
(c) $\frac{3g}{2\ell}\sin\theta$ (d) $\frac{2g}{2\ell}\sin\theta$

10. The rectangular surface of area 8 cm × 4 cm of a black body at temperature 127°C emits energy E per second. If the length and breadth are reduced to half of the initial value and the temperature is raised to 327°C, the rate of emission of energy becomes
(a) $\frac{3}{8}$E (b) $\frac{81}{16}$E
(c) $\frac{9}{16}$E (d) $\frac{81}{64}$E

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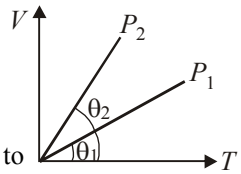
11. The figure shows the volume V versus temperature T graphs for a certain mass of a perfect gas at two constant pressures of P_1 and P_2. What inference can you draw from the graphs?



(a) $P_1 > P_2$
(b) $P_1 < P_2$
(c) $P_1 = P_2$
(d) No interference can be drawn due to insufficient information.

12. What should be the maximum acceptance angle at the air core interface of an optical fibre if n_1 and n_2 are the refractive indices of the core and the cladding, respectively

(a) $\sin^{-1}(n_2/n_1)$ (b) $\sin^{-1}\sqrt{n_1^2 - n_2^2}$

(c) $\left[\tan^{-1}\frac{n_2}{n_1}\right]$ (d) $\left[\tan^{-1}\frac{n_1}{n_2}\right]$

13. When Uranium is bombarded with neutrons, it undergoes fission. The fission reaction can be written as :

$${}_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3x + Q(\text{energy})$$

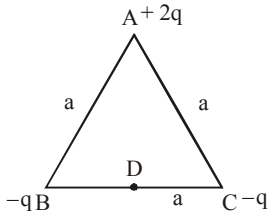
where three particles named x are produced and energy Q is released. What is the name of the particle x ?

(a) electron (b) α-particle
(c) neutron (d) neutrino

14. Given that K = energy, V = velocity, T = time. If they are chosen as the fundamental units, then what is dimensional formula for surface tension?

(a) $[KV^{-2}T^{-2}]$ (b) $[K^2V^2T^{-2}]$
(c) $[K^2V^{-2}T^{-2}]$ (d) $[KV^2T^2]$

15. Three charges of (+ 2q), (– q) and (– q) are placed at the corners A, B and C of the equilateral triangle of side a as shown in the given figure. Then the dipole moment of this combination is



(a) qa (b) zero
(c) qa $\sqrt{3}$ (d) $\frac{2}{\sqrt{3}}$ qa

16. The work function of a metallic surface is 5.01 eV, photoelectrons are emitted when light of wavelength 2000Å falls on it. The minimum potential difference required to stop the fastest photoelectrons ($h = 4.14 \times 10^{-15}$ eV–s)

(a) 1.2 volts (b) 2.4 volt
(c) 3.6 volt (d) 4.8 volt

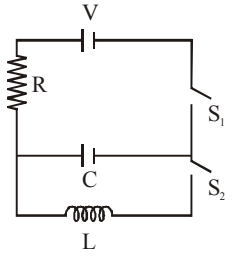
17. The potential energy of a 1 kg particle free to move along the x-axis is given by

$$V(x) = \left(\frac{x^4}{4} - \frac{x^2}{2}\right) J .$$

The total mechanical energy of the particle is 2 J. Then, the maximum speed (in m/s) is

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

18. In an LCR circuit as shown below both switches S_1 and S_2 are open initially. Now switch S_1 is closed, S_2 kept open. (q is charge on the capacitor and $\tau = RC$ is capacitive time constant). Which of the following statements is correct ?



Space for Rough Work

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(a) Work done by the battery is half of the energy dissipated in the resistor

(b) At $t = \tau$, $q = CV/2$

(c) At $t = 2\tau$, $q = CV(1 - e^{-2})$

(d) At $t = \frac{\tau}{2}$, $q = CV(1 - e^{-1})$

19. Torques τ_1 and τ_2 are required for a magnetic needle to remain perpendicular to the magnetic fields at two different places. The magnetic fields at the those places are B_1 and B_2 respectively; then ratio $\frac{B_1}{B_2}$ is

(a) $\frac{\tau_2}{\tau_1}$ (b) $\frac{\tau_1}{\tau_2}$

(c) $\frac{\tau_1 + \tau_2}{\tau_1 - \tau_2}$ (d) $\frac{\tau_1 - \tau_2}{\tau_1 + \tau_2}$

20. A stuntman plans to run across a roof top and horizontally jumps on to another roof 4.9 m below the first one and at a distance of 6.2 m away. What is the minimum velocity, he must have before the jump ?

(a) 3.1 m/s (b) 4.0 m/s

(c) 4.9 m/s (d) 6.2 m/s

21. The transverse displacement $y(x, t)$ of a wave is given by $y(x,t) = e^{-\left(ax^2 + bt^2 + 2\sqrt{ab}xt\right)}$
This represents a:

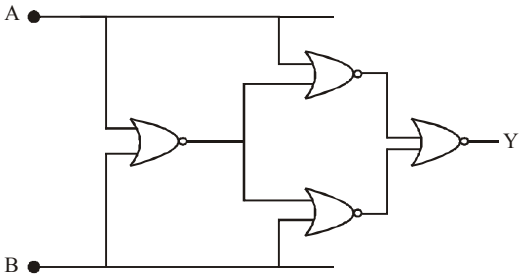
(a) wave moving in $-x$ direction with speed $\sqrt{\frac{b}{a}}$

(b) standing wave of frequency $\sqrt{b}$

(c) standing wave of frequency $\frac{1}{\sqrt{b}}$

(d) wave moving in $+x$ direction speed $\sqrt{\frac{a}{b}}$

22. A system of four gates is set up as shown. The 'truth table' corresponding to this system is :



(a)

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

(b)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

(c)

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

(d)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

23. A particle of mass m is under a potential $v(x) = (1/2)k_1x^2$ for $x > 0$ and $v(x) = k_1x^2$ for $x < 0$. When disturbed a little from the position $x = 0$, it will

(a) not execute SHM

(b) execute SHM with $T = 2\pi\sqrt{\frac{m}{3k_1}}$

(c) execute SHM with $T^2 = 2\pi^2 m/(k_1{}^2)$

(d) execute SHM with $T = \frac{\pi\sqrt{m}}{\sqrt{k_1\left(1 + \frac{1}{\sqrt{2}}\right)}}$

24. Two identical short bar magnets, each having magnetic moment M, are placed a distance of 2d apart with axes perpendicular to each other in a horizontal plane. The magnetic induction at a point midway between them is

(a) $\frac{\mu_0}{4\pi}(\sqrt{2})\frac{M}{d^3}$ (b) $\frac{\mu_0}{4\pi}(\sqrt{3})\frac{M}{d^3}$

(c) $\left(\frac{2\mu_0}{\pi}\right)\frac{M}{d^3}$ (d) $\frac{\mu_0}{4\pi}(\sqrt{5})\frac{M}{d^3}$

Space for Rough Work

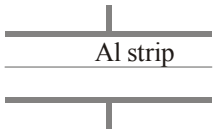
25. The radiation corresponding to $3 \rightarrow 2$ transition of hydrogen atom falls on a metal surface to produce photoelectrons. These electrons are made to enter a magnetic field of 3×10^{-4} T. If the radius of the largest circular path followed by these electrons is 10.0 mm, the work function of the metal is close to:
(a) 1.8 eV (b) 1.1 eV
(c) 0.8 eV (d) 1.6 eV

26. Inside a cylinder closed at both ends is a movable piston. On one side of the piston is a mass m of a gas, and on the other side a mass 2m of the same gas. What fraction of volume of the cylinder will be occupied by the larger mass of the gas when the piston is in equilibrium? The temperature is the same throughout.
(a) 1/4 (b) 1/2
(c) 2/3 (d) 1/3

27. A hydrogen atom emits green light when it changes from n = 4 energy level to the n = 2 level. Which colour of light would the atom emit when it changes from n = 5 level to the n = 2 level?
(a) red (b) yellow
(c) green (d) violet

28. A thin sheet of glass ($\mu = 1.5$) of thickness 6 microns introduced in the path of one of interfering beams in a double slit experiment shifts the central fringe to a position previously occupied by fifth bright fringe. Then the wave length of the light used is
(a) 6000 Å (b) 3000 Å
(c) 4500 Å (d) 7500 Å

29. As shown in the figure, a very thin sheet of aluminium is placed in between the plates of the condenser. Then the capacity



(a) Will increase
(b) Will decrease
(c) Remains unchanged
(d) May increase or decrease

30. A coil having n turns and resistance $R\Omega$ is connected with a galvanometer of resistance $4R\Omega$. This combination is moved in time t seconds from a magnetic field W_1 weber to W_2 weber. The induced current in the circuit is
(a) $-\frac{(W_2 - W_1)}{Rnt}$ (b) $-\frac{n(W_2 - W_1)}{5\ Rt}$
(c) $-\frac{(W_2 - W_1)}{5\ Rnt}$ (d) $-\frac{n(W_2 - W_1)}{Rt}$

CHEMISTRY

31. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below:

$$\frac{1}{2}Cl_2(g) \xrightarrow{\frac{1}{2}\Delta_{diss}H^\circ} Cl(g) \xrightarrow{\Delta_{eg}H^\circ} Cl^-(g) \xrightarrow{\Delta_{hyd}H^\circ} Cl^-(aq)$$

(using the data,
$\Delta_{diss}H^\circ_{Cl_2} = 240$ kJ mol^{-1},
$\Delta_{eg}H^\circ_{Cl} = -349$ kJ mol^{-1},
$\Delta_{hyd}H^\circ_{Cl^-} = -381$ kJ mol^{-1}), will be
(a) $+152$ kJ mol^{-1} (b) -610 kJ mol^{-1}
(c) -850 kJ mol^{-1} (d) $+120$ kJ mol^{-1}

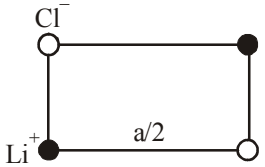
32. A hydrocarbon with five carbon atoms in the molecule, decolourizes alkaline $KMnO_4$, but does not give a precipitate with ammonical Cu_2Cl_2 solution. The hydrocarbon is possibly
(a) 1-pentyne (b) 1, 3-pentadiyne
(c) 2-pentyne (d) 1, 4-pentadiyne

33. The threshold frequency of a metal is $1 \times 10^{15}\ s^{-1}$. The ratio of maximum kinetic energies of the photoelectrons when the metal is irradiated with radiations of frequencies $1.5 \times 10^{15}\ s^{-1}$ and $2 \times 10^{15}\ s^{-1}$ respectively would be
(a) 3 : 4 (b) 1 : 2
(c) 2 : 1 (d) 4 : 3

34. Bond distance in HF is 9.17×10^{-11} m. Dipole moment of HF is 6.104×10^{-30} Cm. The percentage ionic character in HF will be : (electron charge = 1.60×10^{-19} C)
(a) 61.0% (b) 38.0%
(c) 35.5% (d) 41.5%

35. The vapour pressure (at the standard boiling point of water) of an aqueous solution containing 28% by mass of a non-volatile normal solute (molecular mass = 28) will be
(a) 152 torr (b) 608 torr
(c) 760 torr (d) 547 torr

36. Lithium chloride has a cubic structure as shown below. If the edge length is 400 pm., then the radii of Cl^- ions is



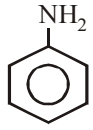
(a) 100 pm (b) 200 pm
(c) 141.4 pm (d) 282.8 pm

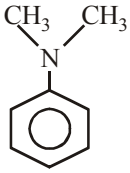
37. Which of the following order of root mean square speed of different gases at same temperature is true?
(a) $(u_{rms})_{H_2} > (u_{rms})_{CH_4} > (u_{rms})_{NH_3} > (u_{rms})_{CO_2}$
(b) $(u_{rms})_{H_2} < (u_{rms})_{CH_4} < (u_{rms})_{NH_3} < (u_{rms})_{CO_2}$
(c) $(u_{rms})_{H_2} < (u_{rms})_{CH_4} > (u_{rms})_{NH_3} > (u_{rms})_{CO_2}$
(d) $(u_{rms})_{H_2} > (u_{rms})_{CH_4} < (u_{rms})_{NH_3} < (u_{rms})_{CO_2}$

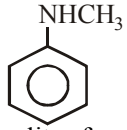
38. A solution containing a group–IV cation gives a precipitate on passing H_2S. A solution of this precipitate in dil.HCl produces a white precipitate with NaOH solution and bluish–white precipitate with basic potassium ferrocyanide. The cation is :
(a) Co^{2+} (b) Ni^{2+}
(c) Mn^{2+} (d) Zn^{2+}

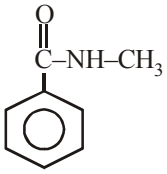
39. Identify the feasible reaction among the following:
(a) $K_2CO_3 \xrightarrow{\Delta} K_2O + CO_2$
(b) $Na_2CO_3 \xrightarrow{\Delta} Na_2O + CO_2$
(c) $Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$
(d) $Rb_2CO_3 \xrightarrow{\Delta} Rb_2O + CO_2$

40. Which of the following gives N-nitrosoamine on reaction with nitrous acid?

(a) 

(b) 

(c) 

(d) 

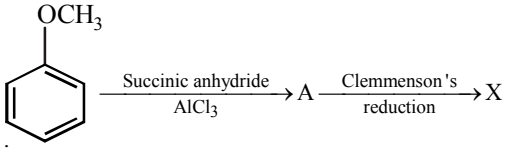
41. Normality of a mixed solution of sulphuric acid and hydrochloric acid is 0.6 N. 20 mL of this solution gives 0.4305 g of AgCl on reacting with $AgNO_3$ solution. The strength of H_2SO_4 in g/L in the mixed solution is
(a) 42.05 g/L (b) 22.05 g/L
(c) 28.56 g/L (d) 37.05 g/L

42. Consider the reaction
$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ in a closed container at equilibrium. What would be the effect of addition of $CaCO_3$ on the equilibrium concentration of CO_2?

Space for Rough Work

(a) Increases
(b) Decreases
(c) Data insufficient
(d) Remains unaffected

43. Consider the reaction sequence below :



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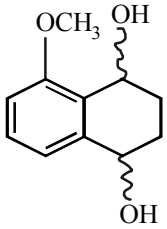
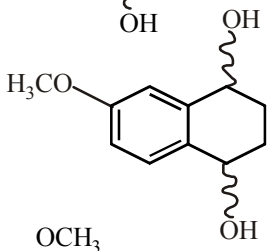
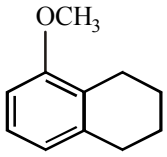
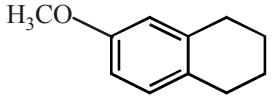
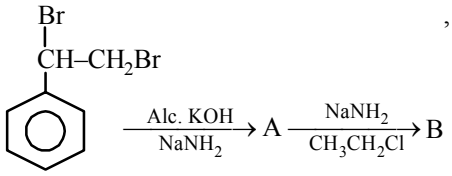
(a) 

(b) 

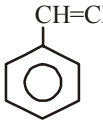
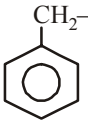
(c) 

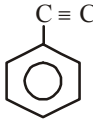
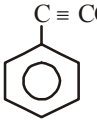
(d) 

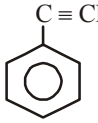
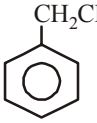
44. How many P–H and O–H bonds respectively, are present in $H_4P_2O_7$ molecule?
(a) 1 and 3 (b) 0 and 4
(c) 4 and 0 (d) 2 and 3

45. 

A and B are

(a) A =  ; B = 

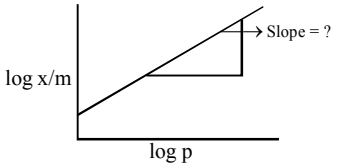
(b) A =  ; B = 

(c) A =  ; B = 

(d) None of these

46. The half life of a first order reaction is 10 min. If initial amount is 0.08 mol L^{-1} and concentration at some instant is 0.01 mol L^{-1}. What is the time elapsed ?
(a) 10 min (b) 20 min
(c) 30 min (d) 40 min

47. In the Freundlich adsorption isotherm equation graph. The slope is equal to



(a) n (b) 1/n
(c) log k (d) log k – 1/n

48. Which one of the following on treatment with 50% aqueous sodium hydroxide yields the corresponding alcohol and acid?
(a) C_6H_5CHO (b) $CH_3CH_2CH_2CHO$
(c) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$ (d) $C_6H_5CH_2CHO$

49. The complexes of Nickel (II) can be
(a) Square planar, tetrahedral and octahedral
(b) Square planar and octahedral
(c) Tetrahedral and octahedral
(d) Square planar only

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50. Which of the following represents the correct order of stability?
(a) $H-C\equiv C^{-}: > H_2C=CH^{-}: > H_3C-CH_2^{-}:$
(b) $H_3C-CH_2^{-}: > H_2C=CH^{-}: > H-C\equiv C^{-}:$
(c) $H_3C-CH_2^{-}: > H_2C=CH^{-}: = H-C\equiv C^{-}:$
(d) None of these

51. Which of the metal is extracted by Hall-Heroult process?
(a) Al (b) Cu
(c) Ni (d) Zn

52. $\Delta G = \Delta H - T\Delta S$ and $\left[\frac{d(\Delta G)}{dT}\right]_p = -\Delta S$

The enthalpy of cell reaction, ΔH, is then given by

(a) $T\left[\frac{dE_{cell}}{dT}\right]_p - E_{cell}$

(b) $nF\left[T\left(\frac{dE_{cell}}{dT}\right)_p - E_{cell}\right]$

(c) $nF\left[E_{cell} - T\left(\frac{dE_{cell}}{dT}\right)_p\right]$

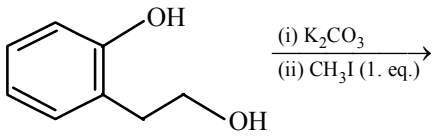
(d) $nFT\left(\frac{dE_{cell}}{dT}\right)_p$

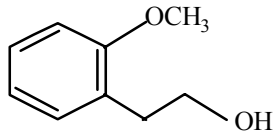
53. Given $E^{\circ}_{Au^{3+}/Au} = 1.52V$ and

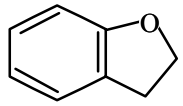
$E^{\circ}_{Au^{3+}/Au^{+}} = 1.36V$.

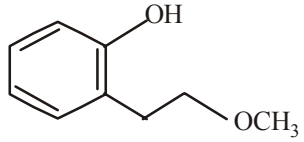
Point out the correct statement of the following
(a) Au^{3+} disproportionates into Au^{4+} and Au^{2+} in aqueous solution
(b) Au^{3+} disproportionates into Au^{4+} and Au^{+} in aqueous solution
(c) Au^{+} disproportionates into Au^{3+} and Au in aqueous solution
(d) Au^{+} disproportionates into Au^{2+} and Au in aqueous solution

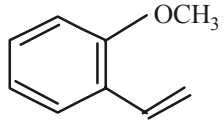
54. The major product of the following reaction is :



(a) 

(b) 

(c) 

(d) 

55. The hybridization states of the central atoms in the complexes $[Fe(CN)_6]^{3-}$, $[Fe(CN)_6]^{4-}$ and $[Co(NO_2)_6]^{3-}$ are
(a) d^2sp^3, sp^3 and d^4s^2 respectively
(b) d^2sp^3, sp^3d and sp^3d^2 respectively
(c) d^2sp^3, sp^3d^2 and dsp^2 respectively
(d) all d^2sp^3

56. Among the acids given below
CH_3CH_2COOH (X); $CH_2 = CHCOOH$ (Y) and $CH\equiv C\text{-}COOH$ (Z)
The correct order of increasing acid strength is
(a) X < Y < Z (b) X < Z < Y
(c) Y < X < Z (d) Z < Y < X

Space for Rough Work

57. Which series of reactions correctly represents chemical reactions related to iron and its compound?

(a) $Fe \xrightarrow{\text{dil. } H_2SO_4} FeSO_4 \xrightarrow{H_2SO_4, O_2} Fe_2(SO_4)_3 \xrightarrow{\text{heat}} Fe$

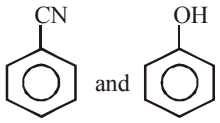
(b) $Fe \xrightarrow{O_2, \text{heat}} FeO \xrightarrow{\text{dil. } H_2SO_4} FeSO_4 \xrightarrow{\text{heat}} Fe$

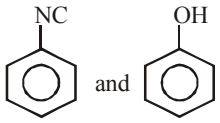
(c) $Fe \xrightarrow{Cl_2, \text{heat}} FeCl_3 \xrightarrow{\text{heat, air}} FeCl_2 \xrightarrow{Zn} Fe$

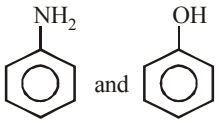
(d) $Fe \xrightarrow{O_2, \text{heat}} Fe_3O_4 \xrightarrow{CO, 600°C} FeO \xrightarrow{CO, 700°C} Fe$

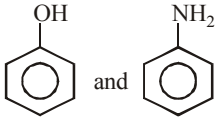
58. The form of BN which is as hard as diamond is
(a) hexagonal form
(b) Cubic form with ZnS structure
(c) both of these
(d) none of these

59. A mixture of two aromatic compounds A and B is separated by dissolving in chloroform followed by extraction with aq. KOH solution. The alkaline aqueous layer gives a mixture of two isomeric compounds on treatment with carbon tetrachloride. The organic layer containing compound A gives an unpleasant odour on treatment with alcoholic solution of KOH. Compounds A and B respectively are

(a) 

(b) 

(c) 

(d) 

60. A weak base BOH is titrated with a strong acid HA. When 10 ml of HA is added, the pH is found to be 9.00 and when 25 ml is added, pH is 8.00. The volume of the acid required to reach the equivalence point
(a) 35 mL (b) 40 mL
(c) 30 mL (d) 50 mL

MATHEMATICS

61. If $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{b} = -3\hat{i} + \hat{j} - \hat{k}$ and $\vec{r} \times \vec{a} = \vec{b} \times \vec{a}, \vec{r} \cdot \vec{b} - \vec{a} \cdot \vec{b}$ then a unit vector in the direction of $\vec{r}$ is

(a) $\frac{1}{3}(-2\hat{i} + \hat{j} - \hat{k})$ (b) $\frac{1}{3}(-2\hat{i} - \hat{j} + 2\hat{k})$

(c) $\frac{1}{3}(-2\hat{i} - \hat{j} - 2\hat{k})$ (d) None of these

62. The acute angle between two lines such that the direction cosines l, m, n, of each of them satisfy the equations $l + m + n = 0$ and $l^2 + m^2 - n^2 = 0$ is :
(a) 15° (b) 30° (c) 60° (d) 45°

63. In a two player game that always has a winner, A beats B with probability 2/3; B beats C with probability 2/3 & C beats A with the same probability. If B plays with C and then the winner plays with A, the chance that A will be the final winner is
(a) 5/9 (b) 4/9 (c) 3/9 (d) None

64. If $P=\{x\in\mathbf{R}:f(x)=0\}$ and $Q=\{x\in\mathbf{R}:g(x)=0\}$ then $P\cup Q$ is

(a) $\{x\in\mathbf{R}:f(x)+g(x)=0\}$

(b) $\{x\in\mathbf{R}:f(x)\,g(x)=0\}$

(c) $\{x\in\mathbf{R}:(f(x))^2+(g(x))^2=0\}$

(d) None of these

65. If $\vec{a}=\vec{i}+\vec{j}+\vec{k}$, $\vec{b}=4\vec{i}+3\vec{j}+4\vec{k}$ and $\vec{c}=\vec{i}+\alpha\vec{j}+\beta\vec{k}$ are linearly independent vectors and $|\vec{c}|=\sqrt{3}$, then-

(a) $\alpha=1,\beta=-1$ (b) $\alpha=1,\beta=\pm1$

(c) $\alpha=-1,\beta=\pm1$ (d) $\alpha=\pm1,\beta=1$

66. If $\text{cosec}\,\theta=\dfrac{p+q}{p-q}$ $(p\neq q\neq 0)$, then $\left|\cot\left(\dfrac{\pi}{4}+\dfrac{\theta}{2}\right)\right|$ is equal to:

(a) $\sqrt{\dfrac{p}{q}}$ (b) $\sqrt{\dfrac{q}{p}}$

(c) $\sqrt{pq}$ (d) pq

67. The expression satisfying the differential equation $(x^2-1)\dfrac{dy}{dx}+2xy=1$ is

(a) $x^2y-xy^2=c$

(b) $(y^2-1)x=y+c$

(c) $(x^2-1)y=x+c$

(d) None of these

68. $\int e^{(\log x+ax^2)}\cos(bx^2+c)\,dx$ is equal to

(a) $\dfrac{1}{\sqrt{a^2+b^2}}e^{ax^2}\cos(bx^2+c+\tan^{-1}\dfrac{b}{a})+A$

(b) $\dfrac{1}{2\sqrt{a^2+b^2}}e^{ax^2}\cos(bx^2-c-\tan^{-1}\dfrac{b}{a})+A$

(c) $\dfrac{1}{\sqrt{a^2+b^2}}e^{ax^2}\cos(bx^2+c-\tan^{-1}\dfrac{b}{a})+A$

(d) $\dfrac{1}{2\sqrt{a^2+b^2}}e^{ax^2}\cos(bx^2+c-\tan^{-1}\dfrac{b}{a})+A$

69. Find the area lying between the curves $y=\tan x$, $y=\cot x$ and x-axis, $x\in\left[0,\dfrac{\pi}{2}\right]$

(a) $\log 2$ (b) $\dfrac{1}{2}\log 2$

(c) $2\log\left(\dfrac{1}{\sqrt{2}}\right)$ (d) None of these

70. If $\int\sqrt{1+\sec x}\,dx=2(fog)(x)+C$, then

(a) $f(x)=\sec x-1$

(b) $f(x)=2\tan^{-1}x$

(c) $g(x)=\sqrt{\sec x-1}$

(d) None of these

71. If $y^2=P(x)$ is a polynomial of degree 3, then $2\dfrac{d}{dx}\left[y^3\dfrac{d^2y}{dx^2}\right]$ is equal to

(a) $P(x)+P'(x)$ (b) $P(x)+P'''(x)$

(c) $P(x)\,P'''(x)$ (d) None of these

72. Which of the following is an even function?

(a) $f(x)=\log\left(\dfrac{1-x}{1+x}\right)$

(b) $f(x)=\log(x+\sqrt{1+x^2})$

(c) $f(x)=\dfrac{x}{e^x-1}+\dfrac{x}{2}+1$

(d) $f(x)=e^{2x}+\sin x$

Space for Rough Work

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73. A plane meets the coordinate axes in points A, B, C and the centroid of the triangle ABC is (α, β, γ). The equation of the plane is

(a) $\frac{x}{\alpha}+\frac{y}{\beta}+\frac{z}{\gamma}=3$ (b) $\alpha x+\beta y+\gamma z=3\alpha\beta\gamma$

(c) $\frac{x}{\alpha}+\frac{y}{\beta}+\frac{z}{\gamma}=\frac{1}{2}$ (d) None of these

74. Equation of the latus rectum of the hyperbola $(10x-5)^2+(10y-2)^2=9(3x+4y-7)^2$ is

(a) $y-\frac{1}{5}=-\frac{3}{4}\left(x-\frac{1}{2}\right)$

(b) $x-\frac{1}{5}=-\frac{3}{4}\left(y-\frac{1}{2}\right)$

(c) $y+\frac{1}{5}=-\frac{3}{4}\left(x+\frac{1}{2}\right)$

(d) $x+\frac{1}{5}=-\frac{3}{4}\left(y+\frac{1}{2}\right)$

75. From the point (15, 12) three normals are drawn to the parabola $y^2 = 4x$, then centroid of triangle formed by three co-normal points is –

(a) $\left(\frac{16}{3},0\right)$ (b) (4, 0)

(c) $\left(\frac{26}{3},0\right)$ (d) (6, 0)

76. The point (2a, a) lies inside the region bounded by the parabola $x^2 = 4y$ and its latus rectum. Then,

(a) $0 \le a \le 1$ (b) $0 < a < 1$
(c) $a > 1$ (d) $a < 0$

77. If ΔABC is right angled at A then the inradius of the triangle is

(a) $2(a+b-2)$ (b) $2(b+c-a)$

(c) $\frac{b+c-a}{2}$ (d) $\frac{b+c-a}{4}$

78. If $\frac{1}{\sqrt{b}+\sqrt{c}}, \frac{1}{\sqrt{c}+\sqrt{a}}, \frac{1}{\sqrt{a}+\sqrt{b}}$ are in A.P. then $9^{ax+1}, 9^{bx+1}, 9^{cx+1}, x \neq 0$ are in :

(a) G.P. (b) G.P. only if $x < 0$
(c) G.P. only if $x > 0$ (d) None of these

79. If $a_k = \int_0^{\pi} \frac{\sin(2k-1)x}{\sin x} dx$, then –

(a) $a_1, a_2, \ldots$ are in A.P.
(b) $a_1, a_2, \ldots$ are in G.P.
(c) $a_1, a_2, \ldots$ are in H.P.
(d) $a_1, a_2, \ldots$ form a constant sequence

80. If $a + b + c = 3$ and $a > 0, b > 0, c > 0$, then the greatest value of $a^2 b^3 c^2$ is

(a) $\frac{3^{10}.2^4}{7^7}$ (b) $\frac{3^9.2^4}{7^7}$

(c) $\frac{3^8.2^4}{7^7}$ (d) None of these

81. If z_1, z_2, z_3, z_4 be the vertices of a quadrilateral taken in order such that $z_1 + z_3 = z_2 + z_4$ and $|z_1 - z_3| = |z_2 - z_4|$ then $\arg\left(\frac{z_1-z_2}{z_3-z_2}\right) =$

(a) $\frac{\pi}{2}$ (b) $\pm\frac{\pi}{2}$

(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{6}$

82. Let $f(x)=e^x$, $g(x)=\sin^{-1}x$ and $h(x)=f(g(x))$, then $h'(x)/h(x)=$

(a) $e^{\sin^{-1}x}$ (b) $1/\sqrt{1-x^2}$

(c) $\sin^{-1}x$ (d) $1/(1-x^2)$

83. Which of the following functions is differentiable at $x=0$?

(a) $\cos(|x|)+|x|$ (b) $\cos(|x|)-|x|$

(c) $\sin(|x|)+|x|$ (d) $\sin(|x|)-|x|$

84. The largest interval lying in $\left(\frac{-\pi}{2},\frac{\pi}{2}\right)$ for which the function,

$$f(x)=4^{-x^2}+\cos^{-1}\left(\frac{x}{2}-1\right)+\log(\cos x) \text{ is}$$

defined, is

(a) $\left[-\frac{\pi}{4},\frac{\pi}{2}\right)$ (b) $\left[0,\frac{\pi}{2}\right)$

(c) $[0,\pi]$ (d) $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$

85. If $f(x)=\sin x+\cos x$, $g(x)=x^2-1$, then $g(f(x))$ is invertible in the domain

(a) $\left[0,\frac{\pi}{2}\right]$ (b) $\left[-\frac{\pi}{4},\frac{\pi}{4}\right]$

(c) $\left[-\frac{\pi}{2},\frac{\pi}{2}\right]$ (d) $[0,\pi]$

86. Which of the following functions is NOT one-one ?

(a) $f:\mathrm{R}\to\mathrm{R}$ defined by $f(x)=6x-1$.

(b) $f:\mathrm{R}\to\mathrm{R}$ defined by $f(x)=x^2+7$.

(c) $f:\mathrm{R}\to\mathrm{R}$ defined by $f(x)=x^3$.

(d) $f:\mathrm{R}-\{7\}\to\mathrm{R}$ defined by $f(x)=\frac{2x+1}{x-7}$.

87. The function defined by

$$f(x)=\begin{cases}\left(x^2+e^{\frac{1}{2-x}}\right)^{-1}, & x\neq 2,\\ k, & x=2\end{cases} \text{ is}$$

continuous from right at the point x =2, then k is equal to

(a) 0 (b) 1/4

(c) –1/4 (d) None of these

88. $\lim_{n\to\infty}\left[\frac{1}{n^2}\sec^2\frac{1}{n^2}+\frac{2}{n^2}\sec^2\frac{4}{n^2}.\ldots\ldots\ldots+\frac{1}{n}\sec^2 1\right]$ equals

(a) $\frac{1}{2}\sec 1$ (b) $\frac{1}{2}\operatorname{cosec} 1$

(c) $\tan 1$ (d) $\frac{1}{2}\tan 1$

89. Consider a rectangle whose length is increasing at the uniform rate of 2 m/sec, breadth is decreasing at the uniform rate of 3 m/sec and the area is decreasing at the uniform rate of 5 m^2/sec. If after some time the breadth of the rectangle is 2 m then the length of the rectangle is

(a) 2m (b) 4m

(c) 1m (d) 3m

90. The differential equation of the family of curves represented by $c(y+c)^2=x^3$ is

(a) $y\frac{d^2y}{dx^2}-y^2\left(\frac{dy}{dx}\right)^2=27x$

(b) $12y\left(\frac{dy}{dx}\right)^2=8x\left(\frac{dy}{dx}\right)^3-27x$

(c) $8y\left(\frac{dy}{dx}\right)^3=12x\left(\frac{dy}{dx}\right)^2-27x$

(d) $\left(\frac{dy}{dx}\right)^3-\left(\frac{dy}{dx}\right)^2+\left(\frac{dy}{dx}\right)-y=27x$.

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