Sample Papers

JEE Mains

Time: 3 Hours | *Maximum Marks: 360*

Topics Covered:

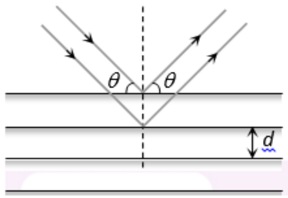
Physics	:	11^{th} & 12^{th} *Complete Syllabus*
Chemistry	:	11^{th} & 12^{th} *Complete Syllabus*
Mathematics	:	11^{th} & 12^{th} *Complete Syllabus*

Important Instructions :

1. *The test is of* **3 hours** *duration.*
2. *The Test consists of 90 questions. The maximum marks are* ***360***.
3. *There are three parts in the question paper A, B, C consisting of* **Physics, Chemistry** *and* **Mathematics** *having 30 questions in each part of equal weightage. Each question is allotted 4 (four) marks for each correct response.*
4. *Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. ¼ (one-fourth) marks of the total marks allotted to the question (i.e. 1 mark) will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
5. *There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.*
6. *For writing particulars/marking responses on Answer Sheet use* **only Black/Blue Ball Point Pen** *provided in the examination hall.*
7. *No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall/room.*

PART-A : PHYSICS

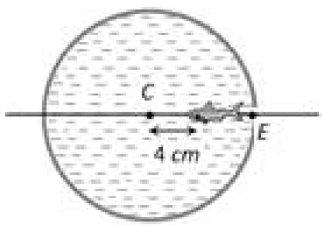
1. A light beam of wavelength λ falls on a stack of partially reflecting planes with separation d. The angle θ that the beam should make with the planes so that the beams reflected from successive planes may interfere constructively is (where n =1, 2, ……)



(A) $\sin^{-1}\left(\frac{n\lambda}{d}\right)$ (B) $\tan^{-1}\left(\frac{n\lambda}{d}\right)$ (C) $\sin^{-1}\left(\frac{n\lambda}{2d}\right)$ (D) $\cos^{-1}\left(\frac{n\lambda}{2d}\right)$

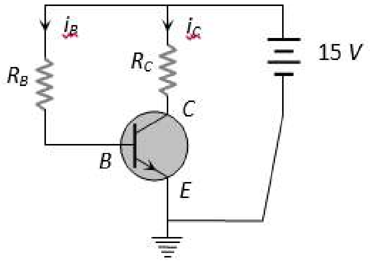
2. A particle of mass m and charge q moves with a constant velocity v along the positive x direction. It enters a region containing a uniform magnetic field B directed along the negative z direction, extending from x = a to x = b. The minimum value of v required so that the particle can just enter the region $x > b$ is
(A) $qb\ B/m$ (B) $q(b-a)B/m$ (C) $qa\ B/m$ (D) $q(b+a)B/2m$

3. In a thin spherical bowl of radius 10 *cm* filled with water of refractive index 4/3 there is a small fish at a distance of 4 *cm* from the centre *C* as shown in figure. Where will the image of fish appears, if seen from *E*



(A) 5.2 *cm* (B) 7.2 *cm* (C) 4.2 *cm* (D) 3.2 *cm*

4. In the following common emitter circuit if β = 100, V_{CE} = 7V, V_{BE} = Negligible R_C = 2 $k\Omega$ then I_B = ?

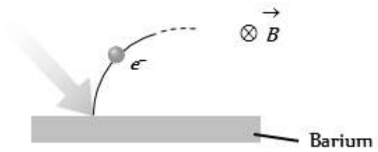


(A) 0.01 *mA* (B) 0.04 *mA* (C) 0.02 *mA* (D) 0.03 *mA*

5. At a given instant there are 25% undecayed radioactive nuclei in a same. After 10 *sec* the number of undecayed nuclei reduces to 6.25%, the mean life of the nuclei is
(A) 14.43 *sec* (B) 7.21 *sec* (C) 5 *sec* (D) 10 *sec*

6. If the series limit of Lymen series for Hydrogen atom is equal to the series limit of Balmer series for a hydrogen like atom, then atomic number of this hydrogen like atom will be
(A) 1 (B) 2 (C) 3 (D) 4

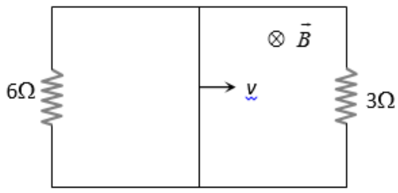
7. Light of wavelength 2475 Å is incident on barium. Photoelectrons emitted describe a circle of radius 100 *cm* by a magnetic field of flux density $\frac{1}{\sqrt{17}} \times 10^{-5}$ *Tesla*. Work function of the barium is (Given $\frac{e}{m} = 1.7 \times 10^{11}$)



(A) 1.8 *eV* (B) 2.1 *eV* (C) 4.5 *eV* (D) 3.3 *eV*

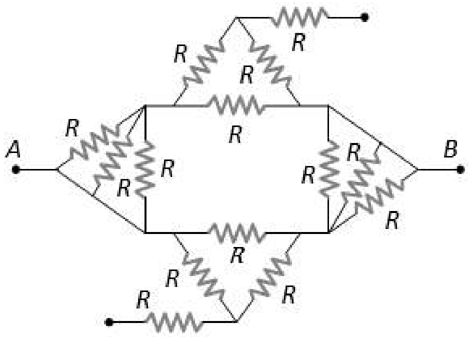
8. When 100 *volts* dc is supplied across a solenoid, a current of 1.0 amperes flows in it. When 100 *volts* ac is applied across the same coil, the current drops to 0.5 ampere. If the frequency of ac source is 50 *Hz*, then the impedance and inductance of the solenoid are
(A) 200 Ω and 0.55 *henry* (B) 100 Ω and 0.86 *henry*
(C) 200 Ω and 1.0 *henry* (D) 100 Ω and 0.93 *henry*

9. A rectangular loop with a sliding connector of length *l* = 1.0 *m* is situated in a uniform magnetic field *B* = 2*T* perpendicular to the plane of loop. Resistance of connector is *r* = 2Ω. Two resistance of 6Ω and 3Ω are connected as shown in figure. The external force required to keep the connector moving with a constant velocity *v* = 2*m/s* is



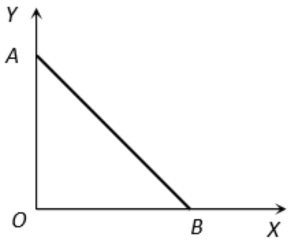
(A) 6 *N* (B) 4 *N* (C) 2 *N* (D) 1 *N*

10. Find equivalent resistance between *A* and *B*



(A) *R* (B) $\frac{3R}{4}$ (C) $\frac{R}{2}$ (D) 2*R*

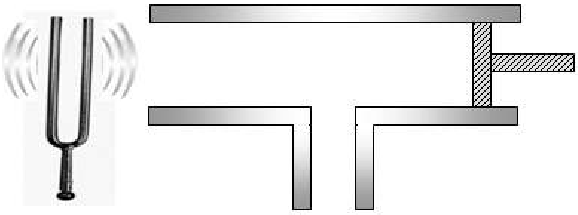
11. A point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point $A\ (0, a)$ to another point B(a, 0) along the straight path AB is



(A) Zero (B) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$ (C) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\frac{a}{\sqrt{2}}$ (D) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

12. A wire of density 9×10^3 kg /m^3 is stretched between two clamps 1 m apart and is subjected to an extension of 4.9×10^{-4} m. The lowest frequency of transverse vibration in the wire is (Y = 9×10^{10} N / m^2)
(A) 40 Hz (B) 35 Hz (C) 30 Hz (D) 25 Hz

13. Vibrating tuning fork of frequency n is placed near the open end of a long cylindrical tube. The tube has a side opening and is fitted with a movable reflecting piston. As the piston is moved through 8.75 cm, the intensity of sound changes from a maximum to minimum. If the speed of sound is 350 m/s. Then n is

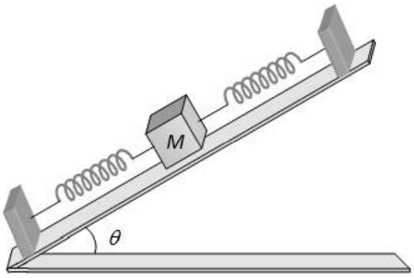


(A) 500 Hz (B) 1000 Hz (C) 2000 Hz (D) 4000 Hz

14. A clock which keeps correct time at 20^oC, is subjected to 40^oC. If coefficient of linear expansion of the pendulum is $12 \times 10^{-6} / °C$. How much will it gain or loose in time

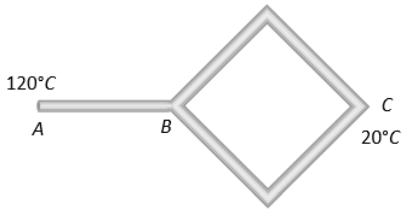
(A) 10.3 seconds / day (B) 20.6 seconds / day (C) 5 seconds / day (D) 20 minutes / day

15. On a smooth inclined plane, a body of mass M is attached between two springs. The other ends of the springs are fixed to firm supports. If each spring has force constant K, the period of oscillation of the body (assuming the springs as massless) is



(A) $2\pi\left(\frac{m}{2K}\right)^{1/2}$ (B) $2\pi\left(\frac{2M}{K}\right)^{1/2}$ (C) $2\pi\frac{Mg\sin\theta}{2K}$ (D) $2\pi\left(\frac{2Mg}{K}\right)^{1/2}$

16. Five identical rods are joined as shown in figure. Point A and C are maintained at temperature 120°C and 20°C respectively. The temperature of junction B will be



(A) 100°C (B) 80°C (C) 70°C (D) 0°C

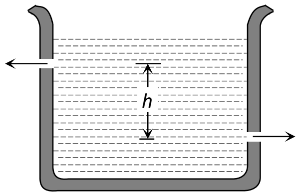
17. Three samples of the same gas A, B and $C(\gamma = 3/2)$ have initially equal volume. Now the volume of each sample is doubled. The process is adiabatic for A isobaric for B and isothermal for C. If the final pressures are equal for all three samples, the ratio of their initial pressures are

(A) $2\sqrt{2} : 2 : 1$ (B) $2\sqrt{2} : 1 : 2$ (C) $\sqrt{2} : 1 : 2$ (D) $2 : 1 : \sqrt{2}$

18. If there are no heat losses, the heat released by the condensation of x gm of steam at 100°C into water at 100°C can be used to convert y gm of ice at 0°C into water at 100°C. Then the ratio y : x is nearly

(A) 1 : 1 (B) 2.5 : 1 (C) 2 : 1 (D) 3 : 1

19. There are two identical small holes of area of cross-section a on the opposite sides of a tank containing a liquid of density ρ. The difference in height between the holes is h. Tank is resting on a smooth horizontal surface. Horizontal force which will has to be applied on the tank to keep it in equilibrium is



(A) $gh\rho a$ (B) $\frac{2gh}{\rho a}$ (C) $2\rho agh$ (D) $\frac{\rho gh}{a}$

20. In a surface tension experiment with a capillary tube water rises upto 0.1 m. If the same experiment is repeated on an artificial satellite, which is revolving around the earth, water will rise in the capillary tube upto a height of
(A) 0.1 m
(B) 0.2 m
(C) 0.98 m
(D) Full length of the capillary tube

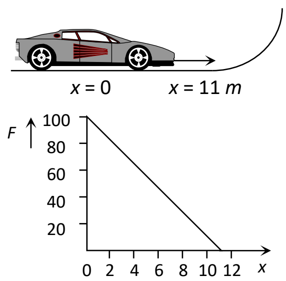
21. Two wires A and B of same length, same area of cross-section having the same Young's modulus are heated to the same range of temperature. If the coefficient of linear expansion of A is 3/2 times of that of wire B. The ratio of the forces produced in two wires will be
(A) 2/3 (B) 9/4 (C) 4/9 (D) 3/2

22. A rocket of mass M is launched vertically from the surface of the earth with an initial speed V. Assuming the radius of the earth to be R and negligible air resistance, the maximum height attained by the rocket above the surface of the earth is
(A) $R/\left(\frac{gR}{2V^2}-1\right)$ (B) $R\left(\frac{gR}{2V^2}-1\right)$ (C) $R/\left(\frac{2gR}{V^2}-1\right)$ (D) $R\left(\frac{2gR}{V^2}-1\right)$

23. Moment of inertia of uniform rod of mass M and length L about an axis through its centre and perpendicular to its length is given by $\frac{ML^2}{12}$. Now consider one such rod pivoted at its centre, free to rotate in a vertical plane. The rod is at rest in the vertical position. A bullet of mass M moving horizontally at a speed v strikes and embedded in one end of the rod. The angular velocity of the rod just after the collision will be
(A) v/L (B) $2v/L$ (C) $3v/2L$ (D) $6v/L$

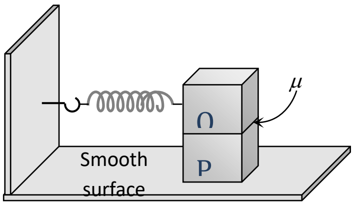
24. A horizontal heavy uniform bar of weight W is supported at its ends by two men. At the instant, one of the men lets go off his end of the rod, the other feels the force on his hand changed to
(A) W (B) $\frac{W}{2}$ (C) $\frac{3W}{4}$ (D) $\frac{W}{4}$

25. A toy car of mass 5 kg moves up a ramp under the influence of force F plotted against displacement x. The maximum height attained is given by



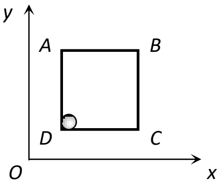
(A) $y_{max} = 20m$ (B) $y_{max} = 15m$ (C) $y_{max} = 11m$ (D) $y_{max} = 5m$

26. A block P of mass m is placed on a frictionless horizontal surface. Another block Q of same mass is kept on P and connected to the wall with the help of a spring of spring constant k as shown in the figure. μ_s is the coefficient of friction between P and Q. The blocks move together performing SHM of amplitude A. The maximum value of the friction force between P and Q is



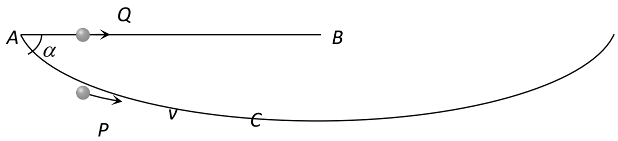
(A) kA (B) $\frac{kA}{2}$ (C) Zero (D) $\mu_s mg$

27. A solid sphere of mass 2 kg is resting inside a cube as shown in the figure. The cube is moving with a velocity $v = (5t\hat{i} + 2t\hat{j}) m/s$. Here t is the time in second. All surface are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphere on the cube. (Take g = 10 m/s^2)



(A) $\sqrt{29} N$ (B) 29 N (C) $26\ N$ (D) $\sqrt{89}\ N$

28. A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal component of its velocity is v. A bead Q of the same mass as P is ejected from A at $t = 0$ along the horizontal string AB (see figure) with the speed v. Friction between the bead and the string may be neglected. Let t_P and t_Q be the respective time taken by P and Q to reach the point B. Then

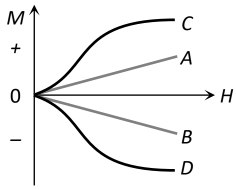


(A) $t_P < t_Q$ (B) $t_P = t_Q$ (C) $t_P > t_Q$ (D) All of these

29. The dimensions of $e^2 / 4\pi\varepsilon_0 hc$, where e, ε_0, h and c are electronic charge, electric permittivity, Planck's constant and velocity of light in vacuum respectively

(A) $[M^0L^0T^0]$ (B) $[M^1L^0T^0]$ (C) $[M^0L^1T^0]$ (D) $[M^0L^0T^1]$

30. The most appropriate magnetization M versus magnetising field H curve for a paramagnetic substance is



(A) A (B) B (C) C (D) D

PART-B : CHEMISTRY

31. $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ in the reversible reaction, the moles of PCl_5, PCl_3 and Cl_2 are a, b and c respectively at equilibrium and total pressure is P, then value of K_P is:

(A) $\frac{bc}{a}.RT$ (B) $\frac{b}{(a+b+c)}.P$ (C) $\frac{bc.P}{a(a+b+c)}$ (D) $\frac{c}{(a+b+c)}.P$

32. The value of the rate constant for the gas phase reaction, $2NO_2 + F_2 \rightarrow 2NO_2F$ is 38 $dm^3mol^{-1}s^{-1}$ at 300K. The order of the reaction is:

(A) 0 (B) 1 (C) 2 (D) 3

33. A fresh H_2O_2 solution is labelled 11.2V. This solution has the same concentration as a solution which is:

(A) 3.4% (w/v) (B) 3.4% (v/v) (C) 3.4% (w/w) (D) none of these

34. n-factor of $Ba(MnO_4)_2$ in acidic medium is:

(A) 5 (B) 3 (C) 10 (D) None

35. The mass of a unit cell of NaCl corresponds to:

(A) 1 Na^+ and 6 Cl^- (B) 1 Cl^- and 6 Na^+ (C) 1 Na^+ and 1 Cl^- (D) 4 Cl^- and 4 Na^+

36. At 30°C, the solubility of Ag_2CO_3 ($K_{sp} = 8 \times 10^{-12}$) would be greatest in 1L of:

(A) 0.05M Na_2CO_3 (B) 0.05M $AgNO_3$ (C) Pure water (D) 0.05M NH_3

37. The standard reaction gibbs energy for the electrochemical reaction.

$Cr_2O_7^{2-} + 2Fe + 14H^+ \longrightarrow 2Cr^{3+} + 2Fe^{3+} + 7H_2O$ is $-793 kJmol^{-1}$. The standard cell potential is:

(A) + 1.37V (B) + 4.11V (C) + 2.74V (D) + 2.05V

38. Gold number of some lyophilic sols are

(i) Casein	0.01
(ii) Haemoglobin	0.03
(iii) Gum Arabic	0.15
(iv) Sodium oleate	0.40

Which has maximum protective power?

(A) i (B) ii (C) iii (D) iv

39. If the critical constants for a hypothetical gas are $V_c = 150\ cm^3mol^{-1}$, $P_c = 50$ atm and $T_c = 300K$. Then the radius of the molecule is: [Take $R = \frac{1}{12}$ $Latmmol^{-1}K^{-1}$]

(A) $\left(\frac{75}{2\pi N_A}\right)^{1/3}$ (B) $\left(\frac{75}{8\pi N_A}\right)^{1/3}$ (C) $\left(\frac{3}{\pi N_A}\right)^{1/3}$ (D) $\left(\frac{3}{256\pi N_A}\right)^{1/3}$

40. An aqueous solution freezes at –2.55°C. What is it's boiling point?

$\left(K_b^{H_2O} = 0.52K/m;\ K_f^{H_2O} = 1.86K/m\right)$

(A) 107.0°C (B) 100.6°C (C) 100.1°C (D) 100.7°C

41. A 3p orbitals has:

(A) Two non-spherical nodes (B) Two spherical nodes

(C) One spherical and one non spherical nodes (D) One spherical and two non-spherical nodes.

42. Considering the elements B, Al, Mg and K, the correct order of their metallic character is:

(A) B > Al > Mg > K (B) Al > Mg > B > K (C) Mg > Al > K > B (D) K > Mg > Al > B

43. In the square ligand field, the 3d orbitals will split into:

(A) One level (B) Two levels (C) Three level (D) Four level

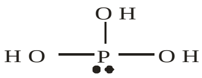
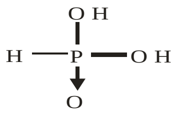
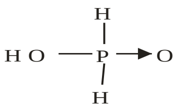
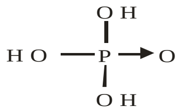
44. For Cu^{2+} ion in $[Cu(H_2O)_4(en)]^{2+}$, $[Cu(H_2O)_2(en)_2]^{2+}$ and $[Cu(en)_3]^{2+}$ with the stability constant k_1, k_2 and k_3 respectively, which of the following holds true?
(A) k_1 is far less than k_2 and k_3 and order is $k_1 < k_2 < k_3$
(B) $k_1 < k_2 < k_3$
(C) $k_2 < k_1 < k_3$
(D) k_3 is far less than k_2 and order is $k_1 > k_2$

45. On the basis of LCAO-MO theory, the magnetic characteristics of N_2 and N_2^+ are
(A) Both diamagnetic
(B) Both paramagnetic
(C) N_2 diamagnetic and N_2^+ paramagnetic
(D) N_2 paramagnetic and N_2^+ dimagnetic

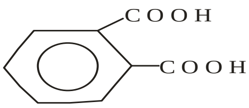
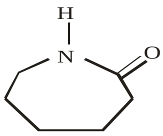
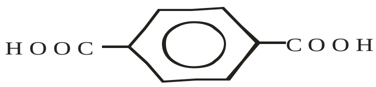
46. The oxides which are soluble in sodium hydroxide are:
1. As_2O_3
2. Sb_2O_3
3. SnO
The correct options is:
(A) 1 and 2 only (B) 2 and 3 only (C) 1 and 3 only (D) 1, 2 and 3

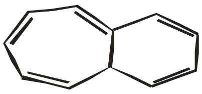
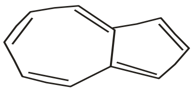
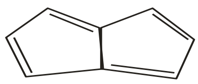
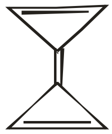
47. Which of the following compounds shows different geometry:
1. TlF_3
2. $TlCl_3$
3. TlI_3
(A) 1 (B) 2 (C) 3 (D) None

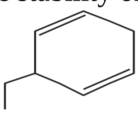
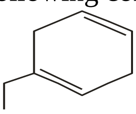
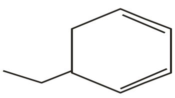
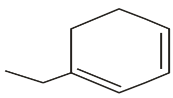
48. What is the hybridization of N_2O_5 in solid state H_3PO_3?
(A) sp and sp (B) sp and sp^2 (C) sp^2 and sp^3 (D) sp^2 and sp^2

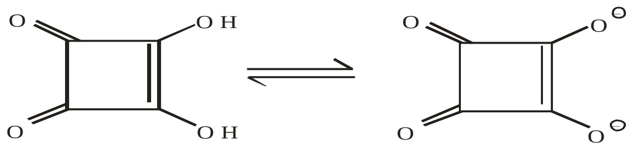
49. What is the structure of the oxy-acid?
(I) 
(II) 
(III) 
(IV) 
(A) I (B) II (C) III (D) IV

50. In which case, geometry of the molecule is pyramidal?
(A) $N(CH_3)_3$ (B) $N(SiH_3)_3$ (C) Both (A) and (B) (D) None of these

51. The monomer of dacron is/are:
(A) $HOCH_2$-CH_2OH and 
(B) 
(C) HOH_2C-CH_2OH and 
(D) $F_2C = CF_2$

52. Identify the aromatic compound
(A) 
(B) 
(C) 
(D) 

53. The stability order of alkene in following compounds is:
(I) 
(II) 
(III) 
(IV) 
(A) I < II < III < IV (B) II < I < III < IV (C) II < III < I < IV (D) II < IV < I < III

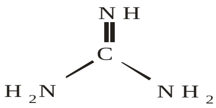
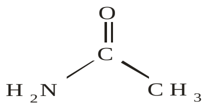
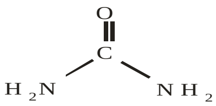
54. 

Squaric acid   Squaric acid dianion

Squaric acid dianion has:

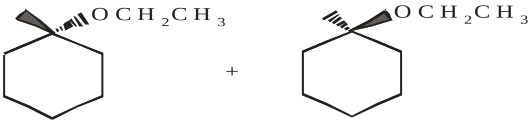
(A) 4-identical resonating structures
(B) C-C bond length is equal to C-O bond length
(C) 3 non identical resonating structures.
(D) Localised negative charge on oxygen.

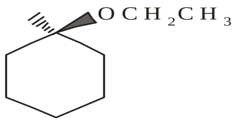
55. Arrange the following in the decreasing order of basicity:

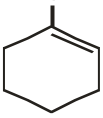
(I)  (II)  (III) 

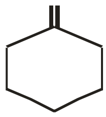
(A) I > II > III (B) I > III > II (C) III > II > I (D) II > I > III

56. What is the major product of the reaction shown?

(A) 

(B) 

(C) 

(D) 

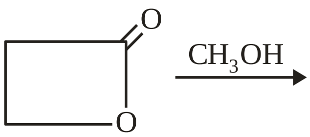
57. $\text{Phenol} \xrightarrow[\text{Distillation}]{\text{Zinc}} A \xrightarrow[\text{conc.}H_2SO_4 \text{ at } 60°C]{\text{conc.}HNO_3} B \xrightarrow[\text{NaOH}]{\text{Zn}} C$

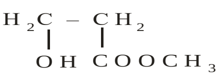
In the above reaction, compounds (A), (B) and (C) are:

(A) Benzene, nitrobenzene and aniline
(B) Benzene, dinitrobenzene and m-nitro aniline
(C) Toluene, m-nitrobenzene and m-toluidine
(D) Benzene, nitrobenzene and hydroxybenzene

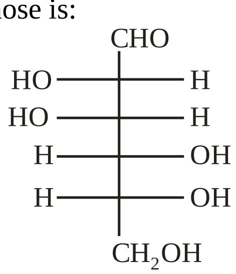
58. Mixture of C_6H_5CHO and HCHO is treated with NaOH, then Cannizaro's reaction involves:

(A) Oxidation of HCHO
(B) Reduction of HCHO
(C) Oxidation of C_6H_5CHO
(D) Reduction and oxidation of C_6H_5CHO

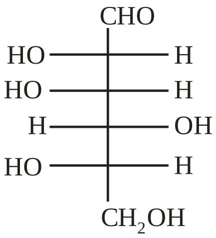
59.  A; A is

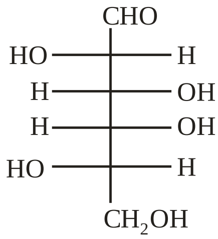
(A)  (B)  (C) Both are correct (D) None is correct

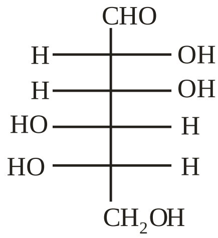
60. The structure of D-(+)-mannose is:

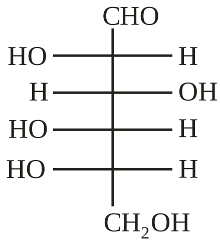


The structure of L-(–)-mannose is:

(A) 
CHO
HO H
HO H
H OH
HO H
CH2OH

(B) 
CHO
HO H
H OH
H OH
HO H
CH2OH

(C) 
CHO
H OH
H OH
HO H
HO H
CH2OH

(D) 
CHO
HO H
H OH
HO H
HO H
CH2OH

PART-C : MATHEMATICS

61. If $\frac{a}{\sqrt{bc}} - 2 = \sqrt{\frac{b}{c}} + \sqrt{\frac{c}{b}}$, where a, b, c > 0 then family of lines $\sqrt{a}x + \sqrt{b}y + \sqrt{c} = 0$ passes through the fixed point given by

(A) (1, 1) (B) (1, –2) (C) (–1, 2) (D) (–1, 1)

62. P is a point on the line y + 2x = 1 and Q and R are two points on the line 3y + 6x = 6 such that triangle PQR is an equilateral triangle. The length of the side of the triangle is

(A) $2/\sqrt{15}$ (B) $3/\sqrt{15}$ (C) $4/\sqrt{5}$ (D) none of these

63. The value of $\int_{-1}^{3} (|x-2| + [x])dx$, where [x] denotes the greatest integer less than or equal to x, is

(A) 7 (B) 5 (C) 4 (D) 3

64. $\int e^x \left(\frac{2\tan x}{1+\tan x} + \cot^2\left(x + \frac{\pi}{4}\right)\right)dx$ is equal to

(A) $e^x \tan\left(\frac{\pi}{4} - x\right) + c$ (B) $e^x \tan\left(x - \frac{\pi}{4}\right) + c$ (C) $e^x \tan\left(\frac{3\pi}{4} - x\right) + c$ (D) none of these

65. The solution of differential equation $\frac{x + y\frac{dy}{dx}}{y - x\frac{dy}{dx}} = \frac{x\cos^2(x^2+y^2)}{y^3}$ is

(A) $\tan(x^2 + y^2) = \frac{x^2}{y^2} + c$ (B) $\cot(x^2 + y^2) = \frac{x^2}{y^2} + c$ (C) $\tan(x^2 + y^2) = \frac{y^2}{x^2} + c$ (D) $\cot(x^2 + y^2) = \frac{y^2}{x^2} + c$

66. If A and B are two matrices such that AB = B and BA = A, then

(A) $(A^5 - B^5)^3 = A - B$ (B) $(A^5 - B^5)^3 = A^3 - B^3$ (C) A – B is idempotent (D) A – B is nilpotent

67. Consider the frequency distribution of the given numbers

Value	1	2	3	4
Frequency	5	4	6	f

If the mean is known to be 3, then the value of f is

(A) 3 (B) 7 (C) 10 (D) 14

68. A pack of playing cards was found to contain only 51 cards. If the first 13 cards, which are examined are all red, the probability that the missing card is black, is

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$ (C) $\frac{5}{9}$ (D) none

69. Assuming that the petrol in a motor boat varies as the cube of its velocity, then the most economical speed when going against a current of c km/hr is

(A) (3c/2) km/hr (B) +(3c/4) km/hr (C) +(5c/2)km/hr (D) +(1c/2)km/hr

70. Two men P & Q starts with velocities v at the same time from the junction of two roads inclined at 45° to each other. If they travel by different roads, the rate at which they are being separated, is

(A) $v\sqrt{2-\sqrt{2}}$ (B) $v\sqrt{2+\sqrt{2}}$ (C) $\sqrt{2}v$ (D) v

71. The area bounded by the normal at (1, 2) to the parabola $y^2 = 4x$, x-axis and the curve is given by

(A) 10/3 sq. units (B) 7/3 sq. units (C) 4/3 sq. units (D) 1/3 sq. units

72. If A, B, C, D are four points in a space and $|AB \times CD + BC \times AD + CA \times BD| = \lambda$ (area of the triangle ABC). Then the value of λ is

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

73. The vectors $\vec{a} = \hat{i} + \hat{j} + m\hat{k}$, $\vec{b} = \hat{i} + \hat{j} + (m+1)\hat{k}$ and $\vec{c} = \hat{i} - \hat{j} + m\hat{k}$ are coplanar, if m is equal to

(A) 1 (B) 4 (C) 3 (D) No real value

74. If θ denote the acute angle between the line

$\vec{r} = (\hat{i} + 2\hat{j} - \hat{k}) + \lambda\ (\hat{i} - \hat{j} + \hat{k})$ and the plane $\vec{r}.(2\hat{i} - \hat{j} + \hat{k}) = 4$, then $\sin\theta + \sqrt{2}\cos\theta =$

(A) $1/\sqrt{2}$ (B) 1 (C) $\sqrt{2}$ (D) $1 + \sqrt{2}$

75. If the line $\frac{x-1}{2} = \frac{y-3}{a} = \frac{z+1}{3}$ lies in the plane $bx + 2y + 3z - 4 = 0$, then

(A) a = 11/2, b = 1 (B) a = –5/2, b = –7 (C) a = –11/2, b = 1 (D) a = 1, b = –11/2

76. P is a point on the axis of the parabola $y^2 = 4ax$; Q and R are the extremities of its latus rectum, A is its vertex. If PQR is an equilateral triangle lying within the parabola and $\angle AQP = \theta$, then $\cos\theta =$

(A) $\frac{2-\sqrt{3}}{2\sqrt{5}}$ (B) $\frac{9}{8\sqrt{5}}$ (C) $\frac{\sqrt{5}-2}{2\sqrt{3}}$ (D) none of these

77. If P is a point on the rectangular hyperbola $x^2 - y^2 = a^2$, C is its centre and S, S' are the two foci, then SP. S'P =

(A) 2 (B) $(CP)^2$ (C) $(CS)^2$ (4) $(SS')^2$

78. For a positive integer n, let $a(n) = 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + ... + \frac{1}{2^n - 1}$ then

(A) a(100) < 100 (B) a(100) > 100 (C) a(200) < 100 (D) a(100) = 100

79. Two packs of 52 cards are shuffled together. The number of ways, in which a man can be dealt 26 cards, so that he does not get two cards of same suit & same denomination, is :

(A) ${}^{52}C_{26} . 2^{26}$ (B) ${}^{104}C_{26}$ (C) 2. ${}^{52}C_{26}$ (D) None

80. The number of solutions of the equation $|\cos x - \sin x| = 2\cos x$, $x \in [0, 2\pi]$ is:

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

81. For $x \in \left[0, \frac{1}{2}\right]$,

$f(x) = \tan\left(\sin^{-1}\left(\frac{x}{\sqrt{2}} + \sqrt{\frac{1-x^2}{2}}\right) - \sin^{-1}x\right)$ is

(A) discontinuous at one point (B) discontinuous at two point

(C) continuous throughout (D) discontinuous at infinite points

82. Let W denote the words in the English dictionary. Define the relation R by :
$R = \{(x, y) \in W \times W|$ the words x and y have at least one letter in common$\}$. Then R is :
(A) reflexive, symmetric and not transitive
(B) reflexive, symmetric and transitive
(C) reflexive, not symmetric and transitive
(D) not reflexive, symmetric and transitive

83. In a college of 300 students, every student reads 5 newspaper and every newspaper is read by 60 students. The number of newspaper is :
(A) at least 30
(B) at most 20
(C) exactly 25
(D) none of these

84. For all complex numbers z_1, z_2 satisfying $|z_1| = 12$ and $|z_2 - 3 - 4i| = 5$, then the minimum value of $|z_1 - z_2|$ is
(A) 0
(B) 2
(C) 7
(D) 17

85. Equation of smallest circle passing through points of intersection of line $x + y = 1$ & circle $x^2 + y^2 = 9$
(A) $x^2 + y^2 + x + y - 8 = 0$
(B) $x^2 + y^2 - x - y - 8 = 0$
(C) $x^2 + y^2 - x + y - 8 = 0$
(D) None

86. The function $f(x) = [x] \cos\left[\frac{(2x-1)}{2}\right]\pi$, (where [.] denotes the greatest integer function) is discontinuous at
(A) all real x
(B) $x = \frac{n}{2}, n \in I - \{1\}$
(C) $x \in N$
(D) $x \notin I - \{0\}$

87. Let $f: R \to R$ be such that $f(1) = 3$ and $f'(1) = 6$, Then, $\lim_{x\to 0}\left\{\frac{f(1+x)}{f(1)}\right\}^{1/x}$ is equal to
(A) 1
(B) $e^{1/2}$
(C) e^2
(D) e^3

88. The set of all real numbers x for which $x^2 - |x+2| + x > 0$, is
(A) $(-\infty, -2) \cup (2, \infty)$
(B) $(-\infty, -\sqrt{2}) \cup (\sqrt{2}, \infty)$
(C) $(-\infty, -1) \cup (1, \infty)$
(D) $(\sqrt{2}, \infty)$

89. The contrapositive of the statement “if I am not feeling well, then I will go to the doctor” is:
(A) If I am feeling well, then I will not go to the doctor.
(B) If I will go to the doctor, then I am feeling well.
(C) If I will not go to the doctor, then I am feeling well.
(D) If I will go to the doctor, then I am not feeling well.

90. The number of ways to put 5 identical balls in 3 identical boxes such that no box is empty, is
(A) 12
(B) 2
(C) 5
(D) 4