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All The Best...!

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## Part - A Physics

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### Section - I: Single Correct

*This section contains a total of 20 questions.  
All questions in this section are mandatory.  
For every correct response you shall be awarded 4 marks.  
For every incorrect response -1 marks shall be deducted.  
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1. If the temperature of the source is increased (keeping the temperature of the sink constant), the efficiency of the Carnot engine
  - (a) increases
  - (b) decreases
  - (c) remains unchanged
  - (d) first increases and then becomes constant

2. The heat ( $Q$ ) supplied to a solid, is plotted as a function of its absolute temperature,  $\theta$ . It is found that they are related by the equation,  $Q = a\theta^2 + b\theta^4$  ( $a, b$  are constants). The heat capacity of the solid is given by

(a)  $\frac{a\theta^3}{3} + \frac{b\theta^5}{5}$

(b)  $a\theta + b\theta^3$

(c)  $\frac{a\theta}{3} + \frac{b\theta^3}{5}$

(d)  $2a\theta + 4b\theta^3$

3. A magnetic dipole is placed at right angles to the direction of the lines of force of magnetic induction  $B$ . If it is slowly rotated through an angle of  $180^\circ$ , then the work done by the external agent is
- (a)  $2MB$
  - (b)  $MB$
  - (c)  $-2MB$
  - (d) Zero

4. Will photoelectrons be emitted by a copper surface, whose threshold wavelength is  $2800 \text{ \AA}$  when illuminated by visible light?
- (a) No
  - (b) Yes
  - (c) Yes, if the light is very intense
  - (d) Yes, if light is very bright

5. Which one of the following statements is **not** true about the motion of a projectile?
- (a) The time of flight of a projectile is proportional to the speed with which it is projected at a given angle of projection
  - (b) The horizontal range of a projectile is proportional to the square root of the speed with which it is projected
  - (c) For a given speed of projection, the angle of projection for maximum range is  $45^\circ$
  - (d) At maximum height, the acceleration due to gravity is perpendicular to the velocity of the projectile

6. The absolute temperature of a body  $A$  is four times that of another body  $B$ . For the two bodies, the difference in wavelengths, at which energy radiated is maximum is  $30 \mu\text{m}$ . The wavelength at which the body  $B$  radiates maximum energy, in micrometers is
- (a) 20
  - (b) 25
  - (c) 40
  - (d) 45

7. A body takes  $1\frac{1}{3}$  times as much time to slide down a rough inclined plane as it takes to slide down an identical but smooth inclined plane. if the angle of inclination is  $45^\circ$ , find the coefficient of friction.

(a)  $\frac{1}{16}$

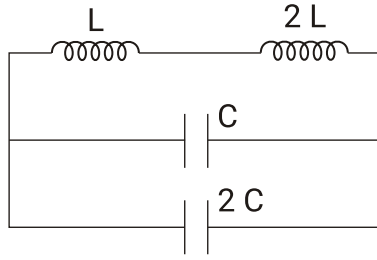
(b)  $\frac{3}{16}$

(c)  $\frac{5}{16}$

(d)  $\frac{7}{16}$



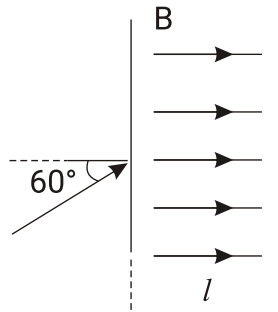
8. The frequency of oscillations of current in the inductors is:



- (a)  $\frac{1}{3\sqrt{LC}}$
- (b)  $\frac{1}{6\pi\sqrt{LC}}$
- (c)  $\frac{1}{\sqrt{LC}}$
- (d)  $\frac{1}{2\pi\sqrt{LC}}$

9. Morning breakfast gives 5000 cal to a 60 kg person. The efficiency of the person is 30%. The height up to which the person can climb up by using the energy obtained from breakfast is ( $g = 10 \text{ m/s}^2$  and  $1 \text{ cal} = 4.2 \text{ J}$ )
- (a) 5 m
  - (b) 10.5 m
  - (c) 15 m
  - (d) 16.5 m

10. The figure shows a region of length  $l$  with a uniform magnetic field of  $0.3 \text{ T}$  in it and a proton entering the region with velocity  $4 \times 10^5 \text{ m/s}$  making an angle  $60^\circ$  with the field. If the proton completes 10 revolutions by the time it crosses the region shown,  $l$  is close to (mass of proton =  $1.67 \times 10^{-27} \text{ kg}$ , the charge of the proton =  $1.6 \times 10^{-19} \text{ C}$ )



- (a) 0.11 m
- (b) 0.22 m
- (c) 0.44 m
- (d) 0.88 m

11. An inductor coil stores energy  $U$  when a current  $i$  is passed through it and dissipates heat energy at the rate of  $P$ . The time constant of the circuit when this coil is connected across a battery of zero internal resistance is:
- (a)  $\frac{4U}{P}$
  - (b)  $\frac{U}{P}$
  - (c)  $\frac{2U}{P}$
  - (d)  $\frac{2P}{U}$

12. A source of light is hung at a height  $a$  directly above a straight horizontal path on which a boy of height  $b$  is walking. How fast is the shadow of the boy on the ground lengthening when he is walking away from the light at the rate of  $c$ ?

(a)  $\frac{bc}{a - b}$

(b)  $\frac{bc}{a + b}$

(c)  $\frac{bc}{2(a - b)}$

(d)  $\frac{bc}{2(a + b)}$

13. The dimensional formula of linear charge density  $\lambda$  is

- (a)  $[M^{-1}L^{-1}T^1A]$
- (b)  $[M^0L^{-1}T^1A]$
- (c)  $[M^{-1}L^{-1}T^1A^{-1}]$
- (d)  $[M^0L^{-1}T^1A^{-1}]$

14. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.170 s. The frequency of the wave is
- (a) 0.73 Hz
  - (b) 0.36 Hz
  - (c) 1.47 Hz
  - (d) 2.94 Hz

15. The root mean square speed of the molecules of an ideal gas is:
- (a) Independent of its pressure but directly proportional to its Kelvin temperature
  - (b) Directly proportional to the square roots of both its pressure and its Kelvin temperature
  - (c) Independent of its pressure but directly proportional to the square root of its Kelvin temperature
  - (d) Directly proportional to both its pressure and its Kelvin temperature.



16. The rms value of the electric field of a plane electromagnetic wave is 314 V/m. The average energy density of the electric field and the average energy density are
- (a)  $4.36 \times 10^{-7} \text{ Jm}^{-3}$ ;  $12.66 \times 10^{-7} \text{ Jm}^{-3}$
  - (b)  $4.36 \times 10^{-7} \text{ Jm}^{-3}$ ;  $8.72 \times 10^{-7} \text{ Jm}^{-3}$
  - (c)  $2.15 \times 10^{-7} \text{ Jm}^{-3}$ ;  $4.36 \times 10^{-7} \text{ Jm}^{-3}$
  - (d)  $8.72 \times 10^{-7} \text{ Jm}^{-3}$ ;  $4.36 \times 10^{-7} \text{ Jm}^{-3}$

17. An object is placed beyond the centre of curvature C of the given concave mirror. If the distance of the object is  $d_1$  from C and the distance of the image formed is  $d_2$  from C, the radius of curvature of this mirror is:

(a)  $\frac{2d_1d_2}{d_1 - d_2}$

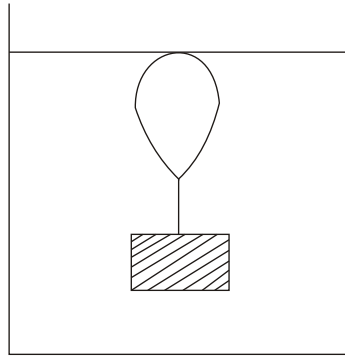
(b)  $\frac{2d_1d_2}{d_1 + d_2}$

(c)  $\frac{d_1d_2}{d_1 + d_2}$

(d)  $\frac{d_1d_2}{d_1 - d_2}$

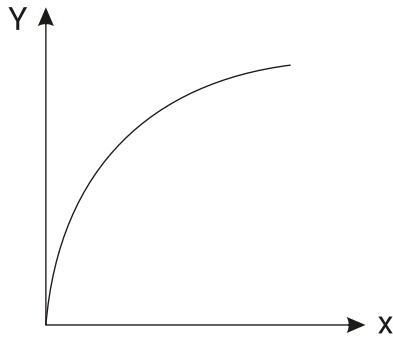
18. If the angular velocity of a disc depends on the angle rotated ( $\theta$ ) as,  $\omega = \theta^2 + 2\theta$ , then its angular acceleration ( $\alpha$ ) at  $\theta = 1$  rad is :
- (a) 8 rad/sec<sup>2</sup>
  - (b) 10 rad/sec<sup>2</sup>
  - (c) 12 rad/sec<sup>2</sup>
  - (d) None

19. A balloon filled with air is attached to a weight as shown below, so that it barely floats in water. When it is pushed down very slowly so that it gets submerged a small distance in water and then released, then the balloon:



- (a) Will come up again to its former position
- (b) Will remain in the position it is left
- (c) Will sink to the bottom
- (d) Will emerge out of the liquid

20. The graph shows the behavior of a steel wire in the region for which the wire obeys Hooke's law. The graph is a parabola. The x and y axes, respectively can be [where  $\sigma$  is stress,  $\epsilon$  is strain and  $U$  is elastic potential energy]



- (a)  $U, \sigma$
- (b)  $U, \epsilon$
- (c)  $\sigma, \epsilon$
- (d) None of these

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**Section - II: Numerical**

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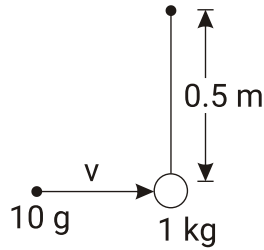
21. A carrier wave with an amplitude of 250 V is amplitude modulated by a sinusoidal baseband signal of amplitude 150 V. The ratio of minimum amplitude to maximum amplitude for the amplitude modulated wave is  $50 : x$ , then value of  $x$  is .....

22. A point source of electromagnetic radiation has an average power output of 800 W. The maximum value of electric field at a distance of 4.0 m from the source is? (in v/m).

23. A particle moving along a straight line with speed 10 m/s changes its direction of motion by  $60^\circ$  without changing its speed. Find the magnitude of the change in the velocity of the particle.



24. A bullet of 10 g, moving with velocity  $v$ , collides head-on with the stationary bob of a pendulum and recoils with velocity of 100 m/s. The length of the pendulum is 0.5 m and mass of the bob is 1 kg. The minimum value of  $v = \underline{\hspace{2cm}}$  m/s so that the pendulum describes a circle is (Assume the string to be inextensible and  $g = 10 \text{ m/s}^2$ )



25. Four resistances of  $15\ \Omega$ ,  $12\ \Omega$ ,  $4\ \Omega$  and  $10\ \Omega$  respectively in cyclic order to form Wheatstone's network. The resistance that is to be connected in parallel with the resistance of  $10\ \Omega$  to balance the network is \_\_\_\_\_  $\Omega$ .

26. In a compound microscope, the magnified virtual image is formed at a distance of 25 cm from the eye-piece. The focal length of its objective lens is 1 cm. If the magnification is 100 and the tube length of the microscope is 20 cm, then the focal length of the eye-piece lens (in cm) is \_\_\_\_\_.

Note:  $\frac{19}{106} = 0.18$

27. Gravitational acceleration on the surface of a planet is  $\frac{\sqrt{6}}{11}g$ , where  $g$  is the acceleration due to gravity on the surface of the Earth. The average mass density of the planet is  $\frac{2}{3}$  times that of the Earth. If the escape speed on the surface of the earth is taken to be  $11 \text{ km s}^{-1}$ , then find the escape speed on the surface of the planet (in  $\text{km s}^{-1}$ ).

28. The magnetic moment of a magnet of mass 75 g is  $9 \times 10^{-7} \text{ Am}^2$ . If the density of the material of magnet is  $7.5 \times 10^3 \text{ kg/m}^3$ , then the intensity of magnetization (in A/m) will be

29. Water is filled upto a height of 12 m in a tank having vertical sidewalls. A hole is made in one of the walls at a depth  $h$  below the water level. The value of  $h$  for which the emerging stream of water strikes the ground at the maximum range is \_\_\_ m.

30. In a series LCR resonant circuit, the quality factor is measured as 100. If the inductance is increased by two fold and resistance is decreased by two fold, then the quality factor after this change will be\_\_\_\_\_.

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## Part - B Chemistry

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### Section - I: Single Correct

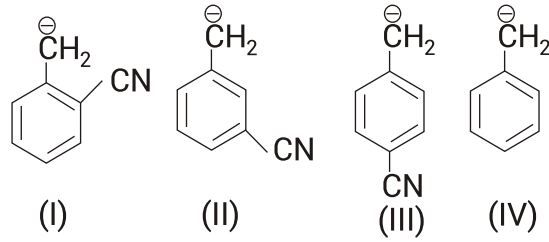
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31. 0.5 M solution of urea is isotonic with-
- (a) 0.5 M NaCl solution
  - (b) 0.5 M sugar solution
  - (c) 0.5 M BaCl<sub>2</sub> solution
  - (d) 0.5 M solution benzoic acid in benzene



32. The correct stability order for the following species is –

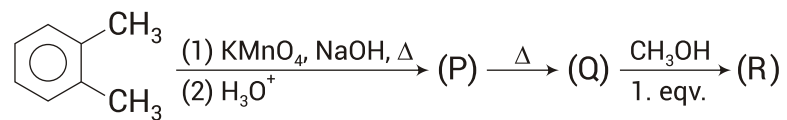


- (a) (I) > (II) > (III) > (IV)
- (b) (II) > (III) > (IV) > (I)
- (c) (I) > (III) > (II) > (IV)
- (d) (III) > (IV) > (I) > (II)

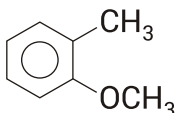
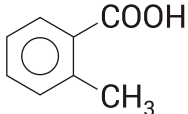
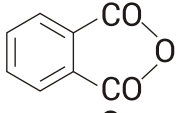
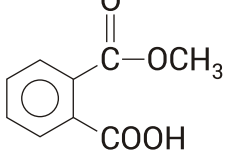
33. A first-order reaction completes 60% in 20 minutes. The time required for the completion of 90% of the reaction is approx.
- (a) 30 minutes
  - (b) 40 minutes
  - (c) 50 minutes
  - (d) 60 minutes

34. Carbonic acid is a
- (a) Weak tribasic acid
  - (b) Weak dibasic acid
  - (c) Strong tribasic acid
  - (d) Strong dibasic acid

35.



Considering the above sequence of reactions the product (R) is:

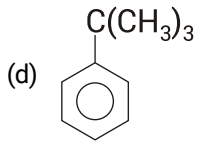
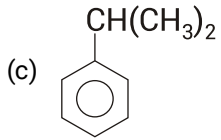
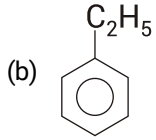
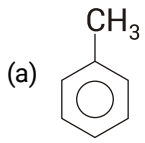
- (a) 
- (b) 
- (c) 
- (d) 

36. In iodination; for preparation of the iodomethane compound used is
- (a)  $\text{HIO}_3$
  - (b)  $\text{HgO}$
  - (c) Both (A) & (B)
  - (d)  $\text{HI}$

37. Tautomerism is shown by
- (a)  $\text{CH}_3 - \text{O} - \text{NO}$
  - (b)  $\text{CH}_3 - \text{CH}_2 - \text{NO}_2$
  - (c)  $\text{CH}_3\text{CH}_2\text{CN}$
  - (d)  $\text{CH}_3\text{CH}_2\text{OH}$

38. Which of the following statements is not true about the complex ion  $[\text{CrCl}_2(\text{en})_2]^+$  :
- (a) It has two geometrical isomers – cis and –trans
  - (b) Both the cis and trans isomers display optical activity
  - (c) Only the cis isomer displays optical activity
  - (d) Only the cis isomer has non-superimposable mirror image

39. In the nitration of the following compound using a mixture of conc.  $\text{HNO}_3$  and conc.  $\text{H}_2\text{SO}_4$ , o/p ratio will be more in the case of





40. In the estimation of Duma's method 1.18g of an organic compound gave 224 ml of  $N_2(g)$  at NTP. The percentage of N in the compound is about
- (a) 20.0
  - (b) 11.8
  - (c) 47.5
  - (d) 23.7

41. A compound 'A' when treated with  $\text{HNO}_3$  (in presence of  $\text{H}_2\text{SO}_4$ ) gives compound B, which is then reduced with Sn and HCl to aniline. The compound is
- (a) Toluene
  - (b) Benzene
  - (c) Ethane
  - (d) Acetamide

42. The specific conductance of saturated solution of  $\text{CaF}_2$  is  $3.86 \times 10^{-5} \text{ mho cm}^{-1}$  and that of water used for the solution is  $0.15 \times 10^{-5} \text{ mho cm}^{-1}$ . The specific conductance of  $\text{CaF}_2$  alone is (in  $\text{mho cm}^{-1}$ )

- (a)  $3.71 \times 10^{-5}$
- (b)  $4.01 \times 10^{-5}$
- (c)  $3.7 \times 10^{-4}$
- (d)  $3.86 \times 10^{-4}$

43.  $\text{Ph-CHO} + \text{NH}_2\text{-NH}_2 \xrightarrow{\text{H}^+} (\text{A})$ .  
Product (A) is known as:
- (a) Aldo-Oxime
  - (b) Hydrazone
  - (c) Hydrate
  - (d) Phenyl hydrazone

44. When  $\text{SO}_2$  is passed in acidified potassium dichromate solution, the oxidation number of S is changed from
- (a) + 4 to zero
  - (b) + 4 to + 2
  - (c) + 4 to + 6
  - (d) + 6 to + 4

45. Which one of the following can be used in place of  $\text{NH}_4\text{Cl}$  for the identification of the third group radicals
- (a)  $\text{NH}_4\text{NO}_3$
  - (b)  $(\text{NH}_4)_2\text{SO}_4$
  - (c)  $(\text{NH}_4)_2\text{CO}_3$
  - (d)  $\text{NaCl}$

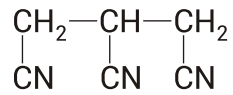
46. For a reaction,  $4M(s) + nO_2(g) \rightarrow 2M_2O_n(s)$ , the free energy change is plotted as a function of temperature. The temperature below which the oxide is stable could be inferred from the plot as the point at which:
- (a) The slope changes from positive to zero
  - (b) The free energy change shows a change from negative to a positive value
  - (c) The slope changes from negative to positive
  - (d) The slope changes from positive to negative

47. The solubility of an ionic compound is compared in heavy and simple water. It is
- (a) Higher in heavy water
  - (b) Lower in heavy water
  - (c) Same in heavy water and simple water
  - (d) Ionic compounds are insoluble in heavy water



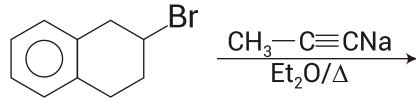
48. A compound A on treatment with Na gives B and with Red P + I<sub>2</sub> gives C. B and C react together to give a solvent used commonly in the preparation of Grignard reagent. A, B, and C respectively are
- (a) C<sub>2</sub>H<sub>5</sub>-I, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>5</sub>OH
  - (b) C<sub>2</sub>H<sub>5</sub>OH, C<sub>2</sub>H<sub>5</sub>I, C<sub>2</sub>H<sub>5</sub>ONa
  - (c) C<sub>2</sub>H<sub>5</sub>OH, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>5</sub>I
  - (d) C<sub>2</sub>H<sub>5</sub>OH, C<sub>2</sub>H<sub>5</sub>ONa, C<sub>2</sub>H<sub>5</sub>-I

49. The IUPAC name of the compound is

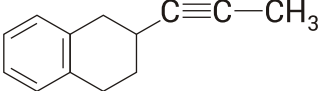
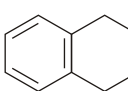
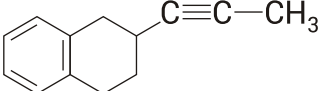
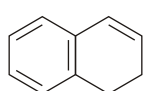
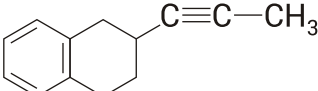
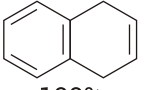


- (a) 1, 2, 3-Cyanopropene
- (b) 1, 2, 3-Cyanopropane
- (c) 3-Cyanopentan-1, 5,-dinitrile
- (d) Propane-1,2,3-tricarbonitrile

50. In the given reaction :



The products are :

- (a)  20% and  80%
- (b)  20% +  80%
- (c)  100%
- (d)  100%

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**Section - II: Numerical**

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51.  $AB_2$  is 10% dissociated in water to  $A^{2+}$  and  $B^-$ . The boiling point of a 10.0 molal aqueous solution of  $AB_2$  is \_\_\_\_\_ $^{\circ}C$ .  
(Round off to the Nearest Integer).  
[Given: Molal elevation constant of water  $K_b = 0.5 \text{ K kg mol}^{-1}$  boiling point of pure water =  $100^{\circ}C$ ]

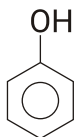
52. Compound  $S_4N_4$  decomposes completely into  $S_x(g)$  and  $N_2(g)$ . If all measurements are made at the same P and T each volume of  $S_4N_4$  gives 4.0 volume of gaseous product. The value of x is

53. How many of the following compounds decolorize Br<sub>2</sub> water solution?

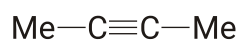
(I)



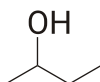
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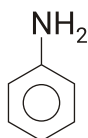
(III)



(IV)



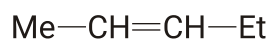
(V)



(VI)



(VII)

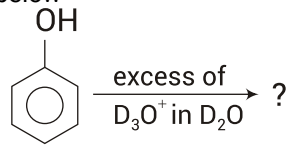


(VIII)



54.  $\text{CO}_2$  gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of  $\text{CO}_2$  adsorbed becomes 64 times when the pressure of  $\text{CO}_2$  is doubled. The value of  $n$  in the Freundlich isotherm equation is \_\_\_\_\_  $\times 10^{-2}$ . (Round off to the nearest integer)

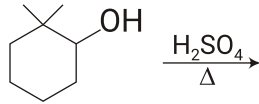
55. Consider the reaction given below



How many hydrogen atoms are replaced by deuterium atoms in the major product ?

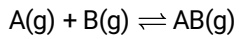


56. Number of products formed during dehydration of the following compounds are:



57. The amount of water produced (in g) in the oxidation of 1 mole of rhombic sulphur by conc.  $\text{HNO}_3$  to a compound with the highest oxidation state of sulphur is\_\_\_\_\_
- (Given data : Molar mass of water =  $18 \text{ g mol}^{-1}$ )

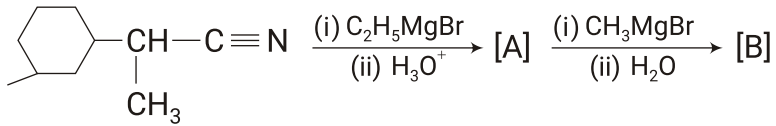
58. Consider the following reversible reaction,



The activation energy of the backward reaction exceeds that of the forward reaction by  $2 RT$  (in  $J mol^{-1}$ ). If the pre-exponential factor of the forward reaction is 4 times that of the reverse reaction, the absolute value of  $\Delta G^0$  (in  $J mole^{-1}$ ) for the reaction at 300 K is \_\_\_\_\_.

(Given :  $\ln(2) = 0.7$ ,  $RT = 2500 J mol^{-1}$  at 300 K and G is the Gibbs energy)

59. The number of chiral centres present in [B] is \_\_\_\_\_.



60. A nano peptide contains how many peptide linkages?

## Part - C Mathematics

### Section - I: Single Correct

*This section contains a total of 20 questions.  
All questions in this section are mandatory.  
For every correct response you shall be awarded 4 marks.  
For every incorrect response -1 marks shall be deducted.  
For more details refer the first page of this booklet.*

61.

If  $f[x]$  denotes the greatest integer less than or equal to  $x$ , then the value of the integral  $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} ([x] - \sin x) dx$  is equal

to:

- (a)  $-\pi$
- (b) 0
- (c)  $\pi$
- (d) 1

62. Which among the following is the greatest:  $\sqrt{5}$ ,  $\sqrt[3]{11}$ ,  $\sqrt[6]{123}$  ?
- (a)  $\sqrt{5}$
  - (b)  $\sqrt[3]{11}$
  - (c)  $\sqrt[6]{123}$
  - (d) All are equal

63. If  $a^2 + b^2 + c^2 = -2$  and  $\begin{vmatrix} 1 + a^2x & (1 + b^2)x & (1 + c^2)x \\ (1 + a^2)x & 1 + b^2x & (1 + c^2)x \\ (1 + a^2)x & (1 + b^2)x & 1 + c^2x \end{vmatrix}$  then  $f(x)$  is a polynomial of degree

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



64. For any  $2 \times 2$  matrix  $A$ ,  $A(\text{adj}A) = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}$ , then  $|A|$  equals:

- (a) 0
- (b) 3
- (c) 6
- (d) 9

65. In how many ways can 5 prizes be distributed among four students when every student can take one or more prizes
- (a) 1024
  - (b) 625
  - (c) 120
  - (d) 600

66. Find the equation of the tangent to the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  which make equal intercepts on the axes.

(a)  $y = -x + \sqrt{a^2 + b^2}$  &  $y = -x - \sqrt{a^2 + b^2}$

(b)  $y = -x \pm \sqrt{a^2 - b^2}$  &  $y = x \pm \sqrt{a^2 + b^2}$

(c)  $y = x + \sqrt{a^2 - b^2}$  &  $y = x - \sqrt{a^2 - b^2}$

(d) None of these

67. In  $\triangle ABC$ , if  $\sin^2 \frac{A}{2}, \sin^2 \frac{B}{2}, \sin^2 \frac{C}{2}$  be in H.P. then  $a, b, c$  will be in
- (a) A.P.
  - (b) G.P.
  - (c) H.P.
  - (d) None of these

68. If  $ABCDE$  is a pentagon, then  $\vec{AB} + \vec{AE} + \vec{BC} + \vec{DC} + \vec{ED} + \vec{AC}$  equals -
- (a)  $3\vec{AD}$
  - (b)  $3\vec{AC}$
  - (c)  $3\vec{BE}$
  - (d)  $3\vec{CE}$

69.  $\operatorname{cosec} \left[ 2 \cot^{-1}(5) + \cos^{-1} \left( \frac{4}{5} \right) \right]$  is equal to :

(a)  $\frac{56}{33}$

(b)  $\frac{65}{56}$

(c)  $\frac{65}{33}$

(d)  $\frac{75}{56}$

70. The eccentricity of the hyperbola whose latus rectum is 8 and conjugate axis is equal to half the distance between the foci is-
- (a)  $\frac{4}{3}$
- (b)  $\frac{4}{\sqrt{3}}$
- (c)  $\frac{2}{\sqrt{3}}$
- (d) None of these

71. Let  $\sigma$  be the standard deviation of  $n$  observations. Each of the  $n$  observations is multiplied by a constant  $c$ . Then the standard deviation of the resulting numbers is -
- (a)  $\sigma$
  - (b)  $|c| \cdot \sigma$
  - (c)  $\sigma\sqrt{c}$
  - (d) None of these



72. If  $(\lambda^2 + \lambda - 2)x^2 + (\lambda + 2)x < 1$  for all  $x \in \mathbb{R}$ , then  $\lambda$  belong to interval.

(a)  $\left(-2, \frac{2}{5}\right)$

(b)  $(-2, 1)$

(c)  $\left(\frac{2}{5}, 1\right)$

(d) None of these

73. The area of the region bounded  $y^2 = x$  and  $x = 36$  is divided in the ratio 1 : 7 by the line  $x = a$ , then  $a$  equals
- (a) 7
  - (b) 8
  - (c) 9
  - (d) 0

74. Let  $f(x) = \begin{cases} \frac{\sin \pi x}{5x}, & x \neq 0 \\ k, & x = 0 \end{cases}$ . If  $f(x)$  is continuous at  $x = 0$ , then  $k =$

- (a)  $\frac{\pi}{5}$
- (b)  $\frac{5}{\pi}$
- (c) 1
- (d) 0

75. The equation of the latus rectum of the parabola  $x^2 + 4x + 2y = 0$  is
- (a)  $3y = 2$
  - (b)  $2y + 3 = 0$
  - (c)  $2y = 3$
  - (d)  $3y + 2 = 0$

76. If  $x = \log_b a$ ,  $y = \log_c b$ ,  $z = \log_a c$ , then  $xyz$  is
- (a) 0
  - (b) 1
  - (c) 3
  - (d) None of these

77. The coefficient of  $x^7$  and  $x^8$  in the expansion of  $\left(2 + \frac{x}{3}\right)^n$  are equal, then  $n$  is equal to -
- (a) 35
  - (b) 45
  - (c) 55
  - (d) None

78. If  $\tan a\theta - \tan b\theta = 0$ , then the values of  $\theta$  for a series in -
- (a) A.P.
  - (b) G.P.
  - (c) H.P.
  - (d) None of these

79. The general solution of the differential equation  $\frac{dy}{dx} + \sin\left(\frac{x+y}{2}\right) = \sin\left(\frac{x-y}{2}\right)$  is

(a)  $\log \tan\left(\frac{y}{2}\right) = c - 2 \sin x$

(b)  $\log \tan\left(\frac{y}{4}\right) = c - 2 \sin\left(\frac{x}{2}\right)$

(c)  $\log \tan\left(\frac{y}{2} + \frac{\pi}{4}\right) = c - 2 \sin x$

(d)  $\log \tan\left(\frac{y}{4} + \frac{\pi}{4}\right) = c - 2 \sin\left(\frac{x}{2}\right)$



80.

Range of the function  $f(x) = \begin{vmatrix} \cos \frac{x}{2} & 1 & 1 \\ 1 & \cos \frac{x}{2} & -\cos \frac{x}{2} \\ -\cos \frac{x}{2} & 1 & -1 \end{vmatrix}$  is

- (a)  $[0, 2]$
- (b)  $[0, 4]$
- (c)  $[2, 4]$
- (d)  $[1, 3]$

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**Section - II: Numerical**

*This section contains a total of 10 questions.  
Out of the 10 questions, 5 questions are mandatory.  
For every correct response you shall be awarded 4 marks.  
For every incorrect response -1 marks shall be deducted.  
For more details refer the first page of this booklet.*

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81. Let  $(1 + x^2)^2(1 + x)^n = \sum_{k=0}^{n+4} a_k x^k$ . If  $a_1, a_2$  and  $a_3$  are in Arithmetic Progression then the sum of all possible value of  $n$  is:

82.

If  $\tan \theta = 4$ , then the value of  $\left( \frac{\tan \theta}{\frac{\sin^3 \theta}{\cos \theta} + \sin \theta \cos \theta} \right)$  is equal to

83. A boy was asked to multiply a certain number by 53. Instead, he divided it by 53 and got his answer to be less than the correct one by 5616. If the number to be multiplied was  $x$ , then the sum of digits in the value of  $x$  is equal to

84. If the line passing through  $(4, 3)$  and  $(2, k)$  is perpendicular to  $y = 2x + 3$ , then the value of  $k$  is equal to

85. Let  $n$  be an odd natural number such that the variance of  $1, 2, 3, 4, \dots, n$  is 14. Then  $n$  is equal to .....

86. The shortest distance of the point  $(6, -8)$  from the circle  $x^2 + y^2 = 36$ , is equal to

87. If  $\int \frac{2x^2 + 3 \cdot dx}{(x^2 - 1)(x^2 - 4)} = \log \left( \frac{x - 2}{x + 2} \right)^a \left( \frac{x + 1}{x - 1} \right)^a + c$  then the value of  $12(a + b)$  is:



88. If the sum of the integral values of  $x$  satisfying the equation  $|x - 1|^{\log^2 x - \log x^2} = |x - 1|^3$  is  $N$ , then find characteristic of logarithm of  $N$  to the base 5.

89. If the tangent on the point  $(3 \sec \phi, 4 \tan \phi)$  (which is in first quadrant) of the hyperbola  $\frac{x^2}{9} - \frac{y^2}{16} = 1$  is perpendicular to  $3x + 8y - 12 = 0$ , then the value of  $\phi$  is (in degree)

90. For  $x \in [0, 3\pi]$ , the number of integral values of  $x$  satisfying  $\sec^2 x - 4 \tan x < 0$  is: