

## General Instructions

- (i) This question paper contains 150 questions. All questions are compulsory.
- (ii) It comprises 150 single-correct multiple-choice questions.
- (iii) Attempt every question; detailed solutions are provided in the companion solutions booklet.

## Physics

Questions 1 to 50 | 1 mark each | 50 marks

1. The period of oscillation of a simple pendulum is  $T = 2\pi(L/g)^{1/2}$ . Measured value of 'L' is 10 cm known to 1 mm accuracy and time for 100 oscillations is 50 second, using a watch of 1 second resolution. The percentage error in the measurement of 'g' is

- (A) 2%
- (B) 4%
- (C) 5%
- (D) 8%

2. The vector sum of the two forces  $\vec{A}$  and  $\vec{B}$  is perpendicular to their vector difference. Hence forces  $\vec{A}$  and  $\vec{B}$  are

- (A) perpendicular to each other
  - (B) unequal in magnitude
  - (C) parallel to each other
  - (D) equal in magnitude
- 

**3.** According to Boyle's law, the product  $PV$  remains constant. The SI unit of  $PV$  is same as that of

- (A) momentum
  - (B) energy
  - (C) force
  - (D) impulse
- 

**4.** A string of length ' $L$ ' fixed at one end carries a mass ' $m$ ' at the other end. The string makes  $\frac{3}{\pi}$  r.p.s. around the vertical axis through fixed end. The tension in the string is

- (A)  $72mL$
  - (B)  $36mL$
  - (C)  $18mL$
  - (D)  $9mL$
- 

**5.** A stationary body explodes into two parts of masses  $M_1$  and  $M_2$ . They move in opposite directions with velocities  $V_1$  and  $V_2$ . The ratio of their kinetic energies is

- (A)  $\frac{M_1}{M_2}$   
(B)  $\frac{M_2}{M_1}$   
(C)  $\frac{M_1^2}{M_2^2}$   
(D)  $\frac{M_2^2}{M_1^2}$
- 

**6.** A body slides down a smooth inclined plane of inclination  $\theta$  and reaches the bottom with velocity 'V'. If the same body is a ring which rolls down the same inclined plane then linear velocity at the bottom of the plane is

- (A)  $\frac{V}{\sqrt{2}}$   
(B)  $\frac{V}{2}$   
(C)  $V$   
(D)  $2V$
- 

**7.** The relative angular speed of hour hand and minute hand of clock is

- (A)  $\frac{2\pi}{60}$   
(B)  $\frac{11\pi}{360}$   
(C)  $\frac{11\pi}{21600}$   
(D)  $\frac{2\pi}{3600}$
- 

**8.** A disc of radius 0.4 m and mass 1 kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration is  $10 \text{ rad/s}^2$ . The tangential force applied to the rim of the disc is

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

**9.** A body is projected vertically from earth's surface of radius  $R$  with velocity equal to half the escape velocity. The maximum height reached by the body is

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

**10.** Two small drops of liquid of same radius coalesce to form a big drop. The ratio of the total surface energies after and before the change is

- (A) 2 : 1
  - (B)  $\sqrt{2} : 1$
  - (C)  $2^{-1/3} : 1$
  - (D) 1 : 2
- 

**11.** Three liquids have same surface tension and have densities  $\rho_1, \rho_2$  and  $\rho_3$  ( $\rho_1 > \rho_2 > \rho_3$ ). In three identical capillaries rise of liquid is same. The corresponding angles of contact  $\theta_1, \theta_2$  and  $\theta_3$  are related as

- (A)  $\theta_1 > \theta_2 > \theta_3$
  - (B)  $\theta_1 < \theta_2 < \theta_3$
  - (C)  $\theta_1 = \theta_2 = \theta_3$
  - (D)  $\theta_1 > \theta_2 < \theta_3$
- 

**12.** The work done in splitting a water drop of radius 'R' into 64 droplets is (T is the surface tension of water)

- (A)  $8\pi R^2 T$
  - (B)  $12\pi R^2 T$
  - (C)  $4\pi R^2 T$
  - (D)  $16\pi R^2 T$
- 

**13.** A celsius and a Fahrenheit thermometer are dipped in boiling water. The temperature of water is lowered until the Fahrenheit thermometer shows  $140^\circ$ . What is the fall in temperature on the Celsius thermometer?

- (A)  $60^\circ \text{ C}$
  - (B)  $40^\circ \text{ C}$
  - (C)  $50^\circ \text{ C}$
  - (D)  $80^\circ \text{ C}$
- 

**14.** Rate of radiation by a black body is 'R' at temperature 'T'. Another body has same area but emissivity is 0.2 and temperature 3T. Its rate of radiation is

- (A)  $R$
  - (B)  $2R$
  - (C)  $16.2R$
  - (D)  $0.2R$
- 

**15.** A black rectangular surface of area  $A$  emits energy  $E$  per unit time at  $27^\circ \text{C}$ . If length and breadth is reduced to  $(\frac{1}{4})^{th}$  of initial value and temperature is raised to  $327^\circ \text{C}$ , then energy emitted per unit time becomes

- (A)  $E$
  - (B)  $2E$
  - (C)  $\frac{E}{2}$
  - (D)  $\frac{E}{4}$
- 

**16.** The change in internal energy of the mass of gas, when the volume changes from  $V$  to  $2V$  at constant pressure  $P$  is ( $\gamma$  is the ratio of specific heat at constant pressure to that of volume) ( $\gamma = \frac{C_p}{C_v}$ )

- (A)  $\frac{PV}{\gamma-1}$
  - (B)  $\frac{PV}{\gamma+1}$
  - (C)  $\frac{(\gamma-1)}{PV}$
  - (D)  $\frac{(\gamma+1)}{PV}$
- 

**17.** An ideal gas expands adiabatically ( $\gamma = 1.5$ ). To reduce the r.m.s. velocity of the molecules 3 times the gas has to be expanded

- (A) 9 times
  - (B) 81 times
  - (C) 3 times
  - (D) 27 times
- 

**18.** A simple pendulum oscillates with an angular amplitude  $\theta$ . If the maximum tension in the string is twice the minimum tension then  $\theta$  is

- (A)  $\cos^{-1}(0.75)$
  - (B)  $\cos^{-1}(0.5)$
  - (C)  $\sin^{-1}(0.5)$
  - (D)  $\sin^{-1}(0.75)$
- 

**19.** A spring executes S.H.M. with mass 10 kg attached to it. The force constant of spring is 10 N/m. If at any instant its velocity is 40 cm/s, the displacement at that instant is

(Amplitude of S.H.M. is 0.5 m)

- (A) 0.1 m
  - (B) 0.3 m
  - (C) 0.5 m
  - (D) 0.6 m
- 

**20.** Waves having a velocity 10m/s, strike a stationary boat near the sea shore. The distance between two consecutive crests of the waves is 40m. After how many second, the consecutive waves strike the boat?

- (A) 8 s
  - (B) 6 s
  - (C) 4 s
  - (D) 2 s
- 

**21.** A musical instrument P produces sound waves of frequency 'n' and amplitude 'A'. Another musical instrument Q produces sound waves of frequency  $n/4$ . The waves produced by P and Q have equal energies. The amplitude of waves produced by Q will be

- (A) A
  - (B) 2A
  - (C) 4A
  - (D) 8A
- 

**22.** In a stationary wave, all the particles

- (A) except at node vibrate in S.H.M. of same period but of different amplitudes
  - (B) vibrate in S.H.M. of same period and amplitude
  - (C) except at nodes vibrate in S.H.M. of same period and same amplitude
  - (D) vibrate in S.H.M. of different periods and different amplitudes
- 

**23.** In fundamental mode, the time required for the sound wave to reach upto the closed end of a pipe filled with air is  $t$  second. The frequency of vibration of air column is  
( $\lambda$  = wavelength of the wave)

- (A)  $\frac{1}{t}$
  - (B)  $\frac{0.25}{t}$
  - (C)  $\frac{\lambda}{4t}$
  - (D)  $t$
- 

**24.** A sonometer wire is vibrating in third overtone. There are

- (A) 5 nodes and 4 antinodes
  - (B) 4 nodes and 5 antinodes
  - (C) 4 nodes and 4 antinodes
  - (D) 5 nodes and 5 antinodes
- 

**25.** A charge 'Q' C is placed at the centre of a cube. The electric flux through two opposite faces of the cube is  
( $\epsilon_0$  = permittivity of free space)

- (A)  $\frac{Q}{6\epsilon_0}$
  - (B)  $\frac{Q}{3\epsilon_0}$
  - (C)  $\frac{Q}{\epsilon_0}$
  - (D)  $\frac{Q}{2\epsilon_0}$
- 

**26.** The capacitance of a capacitor becomes  $\frac{7}{6}$  times the original value if dielectric slab of thickness  $t = \frac{2d}{3}$  is introduced between the plates, where 'd' is the distance of separation between the plates. The dielectric constant of the slab is

- (A)  $\frac{9}{11}$
  - (B)  $\frac{14}{11}$
  - (C)  $\frac{8}{11}$
  - (D)  $\frac{12}{11}$
- 

**27.** Two identical parallel plate air capacitors are connected in series to a battery of e.m.f. 'V'. If one of the capacitor is inserted in liquid of dielectric constant 'K' then potential difference of the other capacitor will become

- (A)  $\frac{KV}{K+1}$
  - (B)  $\frac{KV}{K-1}$
  - (C)  $\frac{K+1}{KV}$
  - (D)  $\frac{K-1}{KV}$
- 

**28.** A condenser of capacity  $C_1$  is charged to potential  $V_1$  and then disconnected. Uncharged capacitor of capacity  $C_2$  is connected in parallel with  $C_1$ . The resultant potential  $V_2$  is

- (A)  $\frac{C_1 V_1}{C_2}$
  - (B)  $\frac{C_1 V_1}{C_1 + C_2}$
  - (C)  $\frac{C_2 V_1}{C_1}$
  - (D)  $\frac{C_2 V_1}{C_1 + C_2}$
- 

**29.** A potentiometer wire is 4 m long and potential difference of 3V is maintained between the ends. The e.m.f. of the cell which balances against a length of 100 cm of the potentiometer wire is

- (A) 0.25 V
  - (B) 0.50 V
  - (C) 0.75 V
  - (D) 1.0 V
- 

**30.** Two wires A and B of equal lengths are connected in left and right gap respectively of a metre bridge, null point is obtained at 40 cm from left end. Diameters of the wires A and B are in the ratio 3:1 respectively, the ratio of specific resistance of A to that of B is

- (A) 2 : 1
  - (B) 3 : 1
  - (C) 6 : 1
  - (D) 12 : 1
- 

**31.** An iron rod is placed parallel to magnetic field intensity 2000 A/m. The magnetic flux through rod is  $6 \times 10^{-4}$  wb and its cross sectional area is  $3 \text{ cm}^2$ . The magnetic permeability of the rod in wb/A-m is

- (A)  $10^{-1}$
  - (B)  $10^{-2}$
  - (C)  $10^{-3}$
  - (D)  $10^{-4}$
-

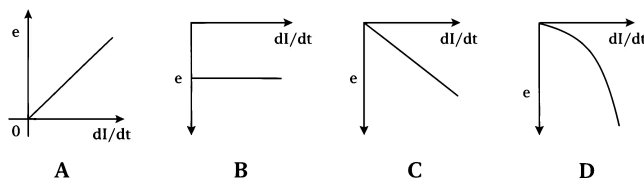
**32.** The magnetic flux near the axis and inside the air core solenoid of length 60 cm carrying current  $I$  is  $\frac{\pi}{2} \times 10^{-6}$  Wb. Its magnetic moment will be (cross-sectional area is very small as compared to length of solenoid,  $\mu_0$  = Permeability of free space =  $4\pi \times 10^{-7}$  SI unit)

- (A)  $0.75 \text{ Am}^2$
- (B)  $0.25 \text{ Am}^2$
- (C)  $0.50 \text{ Am}^2$
- (D)  $1.0 \text{ Am}^2$

**33.** If the number of turns in the coil of a moving coil galvanometer decreases, the resistance of the galvanometer,

- (A) decreases
- (B) increases
- (C) remains the same
- (D) may increase or decrease

**34.** The current flowing through the inductor of self inductance 'L' is continuously increasing at constant rate. The variation of induced e.m.f. (e) versus  $\frac{dI}{dt}$  is shown graphically by figure



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

**35.** Two coils P and Q have mutual inductance 'M' H. If the current in the coil P is  $I = I_0 \sin \omega t$ , then the maximum value of e.m.f. induced in coil Q is

- (A)  $\frac{\omega}{MI_0}$
  - (B)  $\frac{M\omega}{I_0}$
  - (C)  $M\omega I_0$
  - (D)  $\frac{MI_0}{\omega}$
- 

**36.** In series LCR circuit  $C = 2 \mu\text{F}$ ,  $L = 1 \text{ mH}$  and  $R = 10 \Omega$ . What is the ratio of energies stored in the capacitor and inductor when maximum current flows through circuit?

- (A) 0.1 : 1
  - (B) 0.4 : 1
  - (C) 0.2 : 1
  - (D) 1 : 1
- 

**37.** In series LCR resonant circuit,  $R = 800 \Omega$ ,  $C = 2 \mu\text{F}$  and voltage across resistance is 200 V. The angular frequency is 250 rad/s. At resonance the voltage across the capacitance is

- (A) 250 V
  - (B) 500 V
  - (C) 1000 V
  - (D) 750 V
- 

**38.** An alternating e.m.f. is given by  $e = e_0 \sin \omega t$ . In what time the e.m.f. will have half its maximum value, if 'e' starts from zero? ( $\sin 30^\circ = 0.5$ )

- (A)  $\frac{T}{4}$
  - (B)  $\frac{T}{8}$
  - (C)  $\frac{T}{12}$
  - (D)  $\frac{T}{16}$
- 

**39.** A resistor of  $100 \Omega$ , inductor of self inductance  $(\frac{4}{\pi^2})$  H and a capacitor of unknown capacity are connected in series to an a.c. source of 200 V and 50 Hz. When the current and voltage are in phase, the value of capacity is

- (A)  $40\mu F$
  - (B)  $50\mu F$
  - (C)  $20\mu F$
  - (D)  $25\mu F$
- 

**40.** If a parallel beam of light is incident on spherical mirrors then after reflection they pass through focal point. If F is the focal length and R is the radius of curvature of mirror then

- (A)  $R = F$
  - (B)  $R = 2F$
  - (C)  $R = F/2$
  - (D)  $R = F/4$
- 

**41.** Choose the correct statement from the following.

Brewster's angle for a transparent medium is

- (A) different for light of different colours
  - (B) same for lights of different colours
  - (C) independent of refractive index of the medium
  - (D) different for lights of same colour
- 

**42.** In Young's double slit experiment, the angular width of a fringe is found to be  $0.2^\circ$  on a screen placed 1m away. The wavelength of light used is 600 nm. If the entire apparatus is immersed in water of refractive index  $4/3$ , the angular width of the fringe will be

- (A)  $0.10^\circ$
  - (B)  $0.15^\circ$
  - (C)  $0.20^\circ$
  - (D)  $0.25^\circ$
- 

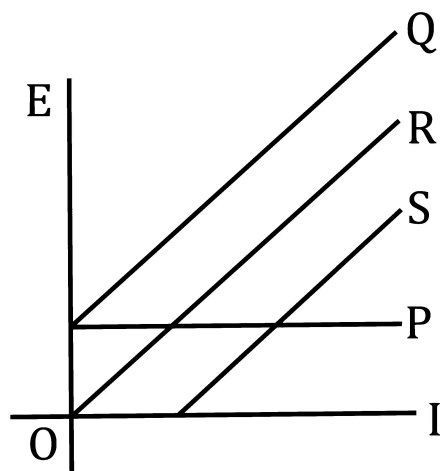
**43.** According to corpuscular theory of light, Which is NOT the property of light?

- (A) The velocity of light does not change after reflection
  - (B) Light travels in a straight line
  - (C) The velocity of light in air is greater than in glass
  - (D) The velocity of light changes after refraction
- 

**44.** Energy of the incident photons on the photosensitive metal surface is  $3W$  and then  $5W$  where ' $W$ ' is the work function of that metal. The ratio of velocities of the emitted photoelectrons is

- (A) 1 : 1
  - (B)  $1 : \sqrt{2}$
  - (C) 1 : 2
  - (D) 1 : 4
- 

**45.** Which one of the four graphs showing lines P, Q, R and S between maximum kinetic energy (E) and intensity of incident radiation (I) is correct?



- (A) P
- (B) Q
- (C) R
- (D) S

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**46.** The ratio of centripetal acceleration for an electron revolving in 3rd and 5th Bohr orbit of hydrogen atom is

- (A) 25 : 9
- (B) 125 : 27
- (C) 625 : 81
- (D) 5 : 3

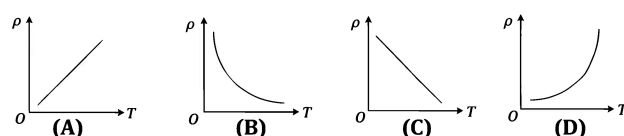
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**47.** An electron is revolving in a circular orbit of radius 'r' in hydrogen atom. Using Bohr's theory, the angular momentum of the electron is (M = magnetic dipole moment, m = mass of electron)

- (A)  $\frac{mM}{e}$
- (B)  $\frac{e}{mM}$
- (C)  $\frac{2mM}{e}$
- (D)  $\frac{e}{2mM}$

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**48.** Which of the following graph represents the temperature (T) dependence of resistivity ( $\rho$ ) of a semiconductor?



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

**49.** In common emitter mode of transistor, the d.c. current gain is 20, the emitter current is 7 mA. The collector current is

- (A)  $\frac{20}{3}$  mA
  - (B)  $\frac{14}{5}$  mA
  - (C)  $\frac{1}{3}$  mA
  - (D)  $\frac{8}{13}$  mA
- 

**50.** In transistor amplifier, base emitter junction is forward biased and collector base junction is reversed biased. The current gain is

- (A)  $\frac{\Delta I_C}{\Delta I_B}$
- (B)  $\frac{\Delta I_B}{\Delta I_C}$
- (C)  $\frac{\Delta I_E}{\Delta I_B}$
- (D)  $\frac{\Delta I_B}{\Delta I_E}$

# Chemistry

Questions 51 to 100 | 1 mark each | 50 marks

**51.** Which of the following contains maximum number of molecules?

- (A) 0.4 g  $\text{H}_2$  gas
- (B) 3.2 g of  $\text{O}_2$  gas
- (C)  $16.8 \text{ dm}^3$  of  $\text{H}_2$  gas at STP
- (D)  $11.2 \text{ dm}^3$  of  $\text{O}_2$  gas at STP

**52.** What is the atomic number of an element having  $ns^1$  electronic configuration and belonging to 3d transition series?

- (A) Only 24
- (B) Only 25
- (C) Only 29
- (D) 24 and 29

**53.** The electronic configurations of elements are as-

$$A = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$$

$$B = 1s^2 2s^2 2p^6 3s^2 3p^5$$

Which of the following is formula of ionic compound that could be formed between these two elements A and B?

- (A)  $\text{A}_2\text{B}$
- (B)  $\text{AB}_2$
- (C)  $\text{AB}_5$
- (D)  $\text{A}_5\text{B}_2$

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**54.** Which of the following pairs represents isobars?

- (A)  ${}^3\text{He}_2$  and  ${}^4\text{He}_2$
- (B)  ${}^{24}\text{Mg}_{12}$  and  ${}^{25}\text{Mg}_{12}$
- (C)  ${}^{40}\text{K}_{19}$  and  ${}^{40}\text{Ca}_{20}$
- (D)  ${}^{40}\text{K}_{19}$  and  ${}^{39}\text{K}_{19}$

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**55.** Identify the type of hybridization of carbon that is attached to the OH group, in benzylic alcohol?

- (A)  $sp$
- (B)  $sp^2$
- (C)  $sp^3$
- (D)  $dsp^2$

---

**56.** Calculate the temperature of 2 moles of gas occupying a volume of 5.0 liters at 24.6 atmospheres?

( $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$ )

- (A)  $476^\circ\text{C}$
- (B)  $480^\circ\text{C}$
- (C)  $440^\circ\text{C}$
- (D)  $450^\circ\text{C}$

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**57.** For a certain reaction  $\Delta H = -50 \text{ kJ}$  and  $\Delta S = -100 \text{ J/K}$  find the temperature so that the reaction is spontaneous.

- (A) 650 K
  - (B) 600 K
  - (C) 550 K
  - (D) 450 K
- 

**58.** Calculate the enthalpy change of the reaction,



if bond energies ( $\text{kJ mol}^{-1}$ ):

$$\text{H}-\text{H} = 436, \text{Cl}-\text{Cl} = 242, \text{H}-\text{Cl} = 431$$

- (A)  $-184 \text{ kJ/mol}$
  - (B)  $-246 \text{ kJ/mol}$
  - (C)  $-242 \text{ kJ/mol}$
  - (D)  $-431 \text{ kJ/mol}$
- 

**59.** A weak monobasic acid is 0.04 % dissociated in 0.25 M solution. What is pH of the solution?

- (A) 2.5
  - (B) 4
  - (C) 5
  - (D) 10
- 

**60.** What is the relationship between the degree of dissociation of a weak base and its concentration?

- (A) The degree of dissociation of a weak base is directly proportional to square root of its concentration.
- (B) The degree of dissociation of a weak base is inversely proportional to square root of its concentration.
- (C) The degree of dissociation of a weak base doesn't depend on concentration.
- (D) The degree of dissociation of a weak base is directly proportional to its concentration
- 

**61.** Which of the following sentences is true for a basic solution?

- (A) For basic solution,  $[\text{H}_3\text{O}^+] = [\text{OH}^-]$
- (B) In basic solution, the excess of  $\text{OH}^-$  ions are present.
- (C) In the basic solution, there is excess of  $\text{H}_3\text{O}^+$  ions.
- (D) The pOH of a basic solution can be calculated by  $\text{pOH} = -\log[\text{H}^+]$
- 

**62.** Which of the following is NOT a redox reaction?

- (A)  $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- (B)  $\text{Al}(\text{OH})_3 + 3\text{HCl} \rightarrow \text{AlCl}_3 + 3\text{H}_2\text{O}$
- (C)  $\text{Mg} + 1/2\text{O}_2 \rightarrow \text{Mg}^{2+} + \text{O}^{2-}$
- (D)  $\text{Fe}_{(s)} + \text{Cu}_{(aq)}^{2+} \rightarrow \text{Fe}_{(aq)}^{2+} + \text{Cu}_{(s)}$
- 

**63.** Identify the false statement regarding chirality from the following.

- (A)  $SN^1$  reaction yields 1:1 mixture of both enantiomers
  - (B) A racemic mixture shows zero dipole rotation
  - (C) Enantiomers are superimposable mirror images of each other
  - (D) The product obtained by  $SN^2$  reaction of haloalkane having chirality at the reactive site shows inversion of configuration
- 

**64.** Which of the following statements are TRUE?

- (I) Inductive effect operates through the sigma bond
  - (II) Resonance effect operates through the pi bond
  - (III) Inductive effects operate through the pi bond
  - (IV) Resonance effect operates through the sigma bond
- (A) (I) and (II)
  - (B) (II) and (III)
  - (C) (III) and (IV)
  - (D) (I) and (IV)
- 

**65.** The cyclic  $\pi$ -molecular orbital formed by overlap of p-orbitals must contain,

- (A)  $(4n + 2)$  p electrons.
  - (B)  $(2n + 2)$  p electrons.
  - (C)  $(4n - 2)$  p electrons.
  - (D)  $(2n - 2)$  p electrons.
- 

**66.** Identify the reagent used in Etard reaction

- (A) Acetic anhydride
  - (B) Anhydrous aluminum chloride
  - (C) DIBAL-H
  - (D) Chromyl chloride
- 

**67.** An element with a molar mass  $27\text{g mol}^{-1}$  forms a cubic unit cell. Calculate the number of atoms present in a unit cell if the density of metal is  $2.7\text{g cm}^{-3}$ .

$$[a^3 \times N_A = 40\text{ cm}^3\text{ mol}^{-1}]$$

- (A) 1
  - (B) 2
  - (C) 4
  - (D) 6
- 

**68.** A compound formed by elements A and B crystallizes in a cubic structure where A atoms are at the corner of the cube and B atoms are at the center of the cube. What is the formula of the compound?

- (A) AB
  - (B)  $\text{A}_2\text{B}$
  - (C)  $\text{AB}_2$
  - (D)  $\text{A}_2\text{B}_2$
- 

**69.** Which of the following dopant is NOT used in Ge to obtain n-type semiconductor?

- (A) P
  - (B) As
  - (C) Sb
  - (D) B
- 

**70.** 2 g nonelectrolyte solute when dissolved in 50 g water increases its boiling point by 0.13 K.

Calculate the molar mass of solute if molal elevation constant of water is  $0.52 \text{ K kg mol}^{-1}$

- (A) 140 g/mol
  - (B) 150 g/mol
  - (C) 160 g/mol
  - (D) 170 g/mol
- 

**71.** Which of the following aqueous solutions will show maximum vapour pressure at 300K?

- (A) 1 M NaCl
  - (B) 1 M  $\text{CaCl}_2$
  - (C) 1 M  $\text{AlCl}_3$
  - (D) 1 M  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
- 

**72.** Identify a pair of gases from following that does not obey Henry's law.

- (A)  $\text{NH}_3$  and  $\text{CO}_2$
  - (B)  $\text{CO}_2$  and  $\text{O}_2$
  - (C)  $\text{NH}_3$  and  $\text{N}_2$
  - (D)  $\text{N}_2$  and  $\text{CH}_4$
- 

**73.** Calculate the molar conductivity of 0.2 M KCl solution at 298 K ( $k = 0.0248\Omega^{-1}\text{cm}^{-1}$ )

- (A)  $143\Omega^{-1}\text{cm}^2\text{mol}^{-1}$
  - (B)  $98\Omega^{-1}\text{cm}^2\text{mol}^{-1}$
  - (C)  $124\Omega^{-1}\text{cm}^2\text{mol}^{-1}$
  - (D)  $87\Omega^{-1}\text{cm}^2\text{mol}^{-1}$
- 

**74.** Identify from following cell reactions that is spontaneous under standard state of conditions.

- (A)  $\text{Ca(s)} + \text{Cd}^{2+}(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{Cd(s)}$ , [ $E_{\text{Ca}}^0 = -2.866\text{ V}$  &  $E_{\text{Cd}}^0 = -0.403\text{ V}$ ]
  - (B)  $2\text{Br}^-(\text{s}) + \text{Sn}^{2+}(\text{aq}) \rightarrow \text{Br}_2(\text{l}) + \text{Sn(s)}$ , [ $E_{\text{Br}}^0 = 1.08\text{ V}$  &  $E_{\text{Sn}}^0 = -0.136\text{ V}$ ]
  - (C)  $2\text{Ag(s)} + \text{Ni}^{2+}(\text{aq}) \rightarrow 2\text{Ag}^+(\text{aq}) + \text{Ni(s)}$ , [ $E_{\text{Ag}}^0 = 0.799\text{ V}$  &  $E_{\text{Ni}}^0 = -0.257\text{ V}$ ]
  - (D)  $2\text{Au(s)} + \text{Zn}^{2+}(\text{aq}) \rightarrow 2\text{Au}^+(\text{aq}) + \text{Zn(s)}$ , [ $E_{\text{Au}}^0 = 1.68\text{ V}$  &  $E_{\text{Zn}}^0 = -0.763\text{ V}$ ]
-

75. Identify the correct name of law.

"At infinite dilution each ion migrates independent of co-ion and contributes to total molar conductivity of an electrolyte irrespective of the nature of other ion to which it is associated."

- (A) Henry's law
  - (B) Raoult's law
  - (C) Nernst derivative law
  - (D) Kohlrausch's law of independent migration of ions
- 

76. For the reaction,  $A + B \rightarrow P$ , the rate law is  $\text{rate} = k[A][B]^2$ . The rate of reaction is  $0.25 \text{ Ms}^{-1}$  when  $[A] = 1 \text{ M}$ ,  $[B] = 0.2 \text{ M}$  at  $25^\circ\text{C}$ . Calculate the rate constant of the reaction at the same temperature.

- (A)  $6.25 \text{ M}^{-2}\text{s}^{-1}$
  - (B)  $6.0 \text{ M}^{-2}\text{s}^{-1}$
  - (C)  $6.5 \text{ M}^{-2}\text{s}^{-1}$
  - (D)  $6.75 \text{ M}^{-2}\text{s}^{-1}$
- 

77. In first order reaction, 20 % concentration remains after 10 min. What would be the rate constant of reaction if  $\log_{10}(5) = 0.6989$ ?

- (A)  $1.609 \text{ min}^{-1}$
  - (B)  $6.989 \text{ min}^{-1}$
  - (C)  $16.09 \text{ min}^{-1}$
  - (D)  $0.1609 \text{ min}^{-1}$
-

**78.** Identify a type of order of reaction that its unit of rate constant is  $\text{mol dm}^{-3}\text{s}^{-1}$  from the following.

- (A) Zero-order reaction
  - (B) First-order reaction
  - (C) Second-order reaction
  - (D) Third-order reaction
- 

**79.** Identify the dimensional nature of nanoparticles by the following.

- (A) one dimensional
  - (B) two dimensional
  - (C) four dimensional
  - (D) zero dimensional
- 

**80.** Which of the following statements is correct for the spontaneous adsorption of a gas?

- (A)  $\Delta S$  is negative and, therefore  $\Delta H$  should be highly positive
  - (B)  $\Delta S$  is negative and therefore,  $\Delta H$  should be highly negative.
  - (C)  $\Delta S$  is positive and therefore,  $\Delta H$  should be negative.
  - (D)  $\Delta S$  is positive and therefore,  $\Delta H$  should also be highly positive.
- 

**81.** Identify the correct statement regarding lyophilic colloid from the following.

- (A) It is irreversible.
  - (B) It is solvent hating colloid.
  - (C) It is formed only by special methods.
  - (D) It is solvent loving colloid.
- 

**82.** In the Charring process, concentrated sulfuric acid reacts with sugar to give sugar charcoal. What is the role of conc.  $\text{H}_2\text{SO}_4$  in this reaction?

- (A) An oxidizing agent
  - (B) A sulfonating agent
  - (C) A dehydrating agent
  - (D) A decomposing agent
- 

**83.** Which of the following is the correct decreasing order of oxidizing power of perhalate ions?

- (A)  $\text{BrO}_4^- < \text{IO}_4^- < \text{ClO}_4^-$
  - (B)  $\text{IO}_4^- > \text{BrO}_4^- > \text{ClO}_4^-$
  - (C)  $\text{IO}_4^- < \text{BrO}_4^- < \text{ClO}_4^-$
  - (D)  $\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$
- 

**84.** Which of the following elements is doped to a fiber amplifier in an optical fiber communication system?

- (A) Tm
  - (B) Yb
  - (C) Er
  - (D) Nd
- 

**85.** Which of the following comparisons is correct for  $\Delta_0$  of the following complexes?

- I-  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- II-  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- III-  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
- IV-  $[\text{Fe}(\text{CN})_6]^{3-}$

- (A)  $\text{I} < \text{II}$
  - (B)  $\text{I} < \text{III}$
  - (C)  $\text{IV} < \text{II}$
  - (D)  $\text{II} < \text{I}$
- 

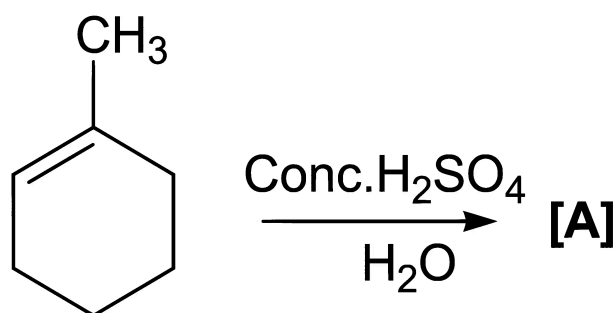
**86.** Among the given ligands, the negative ligand is

- (A) Ammonia
  - (B) Methylamine
  - (C) Hydrazinium
  - (D) Nitrate
- 

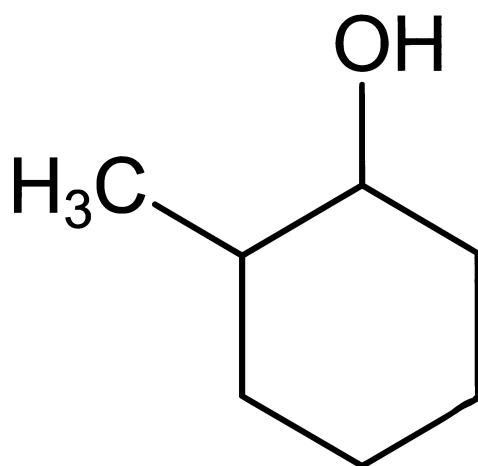
**87.** Which of the following compounds is obtained when Bromoethane is reacted with silver acetate?

- (A) propanal
  - (B) acetic acid
  - (C) ethyl acetate
  - (D) methyl acetate
- 

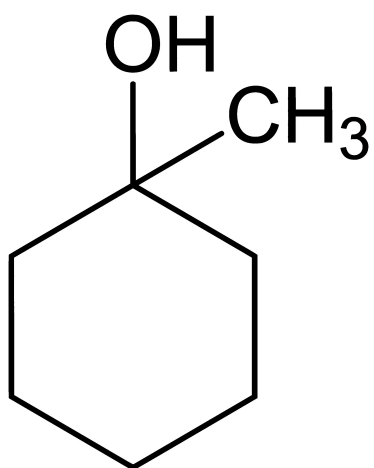
**88.** Find the structure of A in following reaction



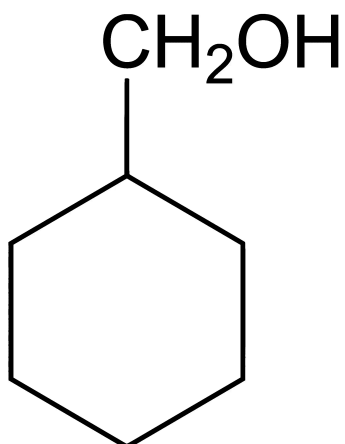
(A)



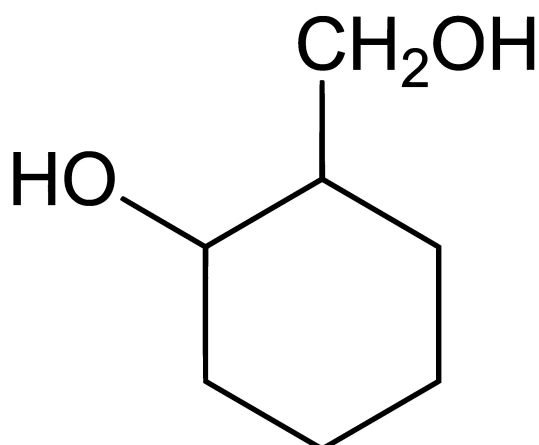
(B)



(C)



(D)



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**89.** Identify the alcohol obtained when aldehyde other than formaldehyde is treated with Grignard's reagent followed by hydrolysis.

- (A) Primary alcohol
  - (B) Secondary alcohol
  - (C) Tertiary alcohol
  - (D) Ketone
-

**90.** Identify the reagent used in the transformation of Ketone into semicarbazone.

- (A)  $\text{NH}_2 - \text{OH}$
  - (B)  $\text{NH}_2 - \text{NH}_2$
  - (C)  $\text{NH}_2 - \text{NH} - \text{CONH}_2$
  - (D)  $\text{NH}_2 - \text{NH} - \text{C}_6\text{H}_5$
- 

**91.** Identify the product obtained when ketone reacts with  $\text{NH}_2\text{-NH}_2$ .

- (A) Aniline
  - (B) Hydrazone
  - (C) Phenyl hydrazone
  - (D) Anisole
- 

**92.** Which of the following reagents is used to convert  $-\text{CN}$  group to  $-\text{CH}_2\text{NH}_2$  group?

- (A)  $\text{CrO}_3$
  - (B)  $\text{Na} + \text{C}_2\text{H}_5\text{OH}$
  - (C)  $\text{H}_3\text{PO}_4$
  - (D)  $\text{Al}_2\text{O}_3$
- 

**93.** Which of the following reactions is exhibited only by primary amines?

- (A) acetylation
  - (B) alkylation
  - (C) reaction with nitrous acid
  - (D) carbyl amine test
- 

**94.** Which from following reagents is used to prepare alkyl isocyanides from RX?

- (A) AgCN (alco)
  - (B)  $\text{NH}_3$  (alco)
  - (C)  $\text{KNO}_2$
  - (D)  $\text{AgNO}_2$
- 

**95.** Which carbon atoms of glucose, numbered from 1 to 6 forms a hemiacetal structure between -CHO and -OH groups.?

- (A) C-2
  - (B) C-3
  - (C) C-4
  - (D) C-5
- 

**96.** Which one of the following is a globular protein?

- (A) Insulin
  - (B) Myosin
  - (C) Keratin in hair
  - (D) Keratin in wool
-

---

**97.** Identify the cation present in chlorophyll in green plants.

- (A)  $\text{Mg}^{2+}$
  - (B)  $\text{Ca}^{2+}$
  - (C)  $\text{Fr}^{+}$
  - (D)  $\text{Na}^{+}$
- 

**98.** Identify the monomer used to prepare orlon.

- (A) vinyl chloride
  - (B) acrylonitrile
  - (C) styrene
  - (D) tetrafluoroethylene
- 

**99.** What type of polymer the natural rubber is?

- (A) Fibre
  - (B) Elastomer
  - (C) Thermoplastic
  - (D) Thermosetting plastic
- 

**100.** Identify the use of antipyretic drugs.

- (A) To kill microorganism.
- (B) To relieve pain.
- (C) To reduce fever.
- (D) To prevent pregnancy.

# Mathematics

Questions 101 to 150 | 2 marks each | 100 marks

**101.** The polar form of the complex number  $z = \frac{1}{1+i}$ , (where  $i = \sqrt{-1}$ ) is

- (A)  $\frac{1}{\sqrt{2}}(\cos \frac{7\pi}{4} + i \sin \frac{7\pi}{4})$
- (B)  $\frac{1}{\sqrt{2}}(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4})$
- (C)  $\frac{1}{2}(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4})$
- (D)  $\frac{1}{2}(\cos \frac{7\pi}{4} + i \sin \frac{7\pi}{4})$

**102.** The number of cubic equations that can be formed with the coefficients 0, 3, 2, 4, 5, 6 when repetition of coefficients is allowed, is....

- (A) 720
- (B) 1296
- (C) 864
- (D) 1080

**103.**  $\tan 105^\circ = \dots\dots$

- (A)  $\frac{\sqrt{3}-1}{2\sqrt{2}}$
- (B)  $\frac{\sqrt{3}+1}{2\sqrt{2}}$
- (C)  $\frac{1+\sqrt{3}}{1-\sqrt{3}}$
- (D)  $\frac{2\sqrt{2}}{\sqrt{3}+1}$

**104.** The number of solutions in  $[0, \frac{\pi}{2})$  of the equation  $\cos 3x \cdot \tan 5x = \sin 7x$  is

- (A) 4
- (B) 5
- (C) 7
- (D) 6

---

**105.** The area of the triangle formed by the co-ordinate axes and a line  $px + qy = r$  (where p, q and r are positive real numbers) is  $\frac{1}{54}$  sq.units, then ....

- (A) p, 3r, q are in G.P.
- (B)  $p^2 + q^2 = r^2$
- (C) p,  $3\sqrt{3}r$ , q are in G.P.
- (D) p, 27r, q are in G.P.

---

**106.** The joint equation of the pair of lines through the origin and making an angle of  $\frac{\pi}{4}$  with the line  $3x + y - 6 = 0$  is

- (A)  $2x^2 + 3xy - 2y^2 = 0$
- (B)  $2x^2 + 3xy + 2y^2 = 0$
- (C)  $x^2 + 3xy - y^2 = 0$
- (D)  $x^2 - 3xy + y^2 = 0$

---

**107.** If a circle with center  $(-1, 1)$  touches the line  $x + 2y + 4 = 0$ , then the co-ordinates of the point of contact are

- (A)  $(-2, -1)$
  - (B)  $(8, -2)$
  - (C)  $(2, -3)$
  - (D)  $(4, -4)$
- 

**108.** A point on the parabola  $y^2 = \frac{36}{5}x$  at which the ordinate increases at thrice the rate of the abscissa is .....

- (A)  $(\frac{6}{5}, \frac{1}{5})$
  - (B)  $(\frac{1}{5}, \frac{6}{5})$
  - (C)  $(5, 6)$
  - (D)  $(\frac{3}{5}, \frac{9}{5})$
- 

**109.** The area of the triangle formed by the lines joining the vertex of the parabola  $x^2 = 48y$  to the ends of its latus rectum, is .....

- (A) 144 sq. units
  - (B) 288 sq. units
  - (C) 72 sq. units
  - (D) 576 sq. units
- 

**110.**  $\lim_{x \rightarrow 0} \left[ \frac{\log|2+x| - \log|2-x|}{\tan x} \right] = \dots\dots$

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

---

**111.** Consider the statement patterns

A.  $(q \rightarrow p) \vee (p \rightarrow q)$

B.  $(\sim p \vee \sim q) \leftrightarrow \sim (p \wedge q)$

C.  $[(p \vee q) \wedge \sim p] \wedge \sim q$

D.  $(p \wedge q) \wedge (\sim p \vee \sim q)$

then statement patterns

(A) A and B are contradictions, C and D are tautologies.

(B) A and B are tautologies, C and D are contradictions.

(C) A, B, C, D all are tautologies.

(D) A, B, C, D all are contradictions.

---

**112.** The statement pattern  $(p \wedge q) \rightarrow (r \vee \sim s)$  is false. Then the truth values of  $p, q, r$  and  $s$  are respectively

(A) T, F, T, T

(B) T, T, F, T

(C) T, T, T, F

(D) T, T, F, F

---

**113.** In a triangle ABC, with usual notations if  $\frac{s-a}{11} = \frac{s-b}{12} = \frac{s-c}{13}$  and  $\lambda \tan^2 \frac{A}{2} = 455$ , then  $\lambda =$

(A) 1155

(B) 1255

(C) 1355

(D) 1055

---

**114.** With usual notations, in  $\triangle ABC$ , if  $2a^2 = b^2 + c^2$ , then  $\frac{\cos 3A}{\cos A} + 2 =$

- (A)  $\frac{b^2 - c^2}{2bc}$
- (B)  $(\frac{b^2 - c^2}{2bc})^2$
- (C)  $(\frac{c^2 - b^2}{bc})^2$
- (D)  $\frac{c^2 - b^2}{bc}$



**115.** With usual notations, in  $\triangle ABC$ ,  $(b - c)^2 \cos^2 \frac{A}{2} + (b + c)^2 \sin^2 \frac{A}{2} =$

- (A)  $a^2$
- (B)  $b^2 - c^2$
- (C)  $a^2 + b^2 + c^2$
- (D) 0



**116.** Let  $A = \begin{bmatrix} -5 & -3 \\ 2 & 1 \end{bmatrix}$ . The Row transformation  $R_1 \rightarrow R_1 + 3R_2$  will transform matrix A into

- (A) an upper triangular matrix
- (B) a lower triangular matrix
- (C) an identity matrix
- (D) a singular matrix



**117.** If  $A = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}_{3 \times 3}$ , and  $A^{-1} = \begin{bmatrix} \gamma & -1 & 1 \\ \alpha & 6 & -5 \\ \beta & -2 & 2 \end{bmatrix}_{3 \times 3}$ , then  $|\alpha \cdot \beta$

$\cdot \gamma| = \underline{\hspace{2cm}}$  (where  $|\cdot|$  denotes the absolute value)

- (A) 125
  - (B) 220
  - (C) 225
  - (D) -225
- 

**118.** If  $y = \tan^{-1}\left\{\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}\right\}$ , where  $|x| < 1$ , then  $\frac{dy}{dx}$  is equal to

- (A)  $\frac{-x}{\sqrt{1-x^4}}$
  - (B)  $\frac{x}{\sqrt{1-x^4}}$
  - (C)  $\frac{-2x}{\sqrt{1-x^4}}$
  - (D)  $\frac{2x}{\sqrt{1-x^4}}$
- 

**119.** The value of  $\tan^{-1}(\sqrt{3}) + \sec^{-1}(-2) - \sin^{-1}(-\frac{1}{2})$  is

- (A)  $\frac{5\pi}{6}$
  - (B)  $\frac{2\pi}{3}$
  - (C)  $\frac{7\pi}{6}$
  - (D)  $\frac{4\pi}{3}$
- 

**120.** The domain of the function  $f(x) = e^{\sqrt{5x-3-2x^2}}$  is

- (A) (1, 2)
  - (B)  $(-1, \frac{3}{2})$
  - (C)  $[1, \frac{3}{2}]$
  - (D) (-1, 0)
-

121. If  $f(x) = \begin{cases} \frac{(8-2x)^{\frac{1}{3}}-2}{3-(243+5x)^{\frac{1}{5}}}, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$  is continuous at  $x = 0$ , then  $k =$

- (A)  $\frac{5}{2}$
- (B)  $-\frac{5}{2}$
- (C)  $\frac{27}{2}$
- (D)  $-\frac{27}{2}$

122. If  $y = x + e^x$ , then  $\frac{d^2x}{dy^2}$  is equal to

- (A)  $\frac{e^x}{(1+e^x)^2}$
- (B)  $\frac{-e^x}{(1+e^x)^2}$
- (C)  $\frac{e^x}{(1+e^x)^3}$
- (D)  $\frac{-e^x}{(1+e^x)^3}$

123. Let  $f(x) = x - 5$ .

If  $g(x) = [f(4h(x) + 3)]^2$  and Missing open brace for superscript, then Missing open brace for superscript .....

- (A)  $-242$
- (B)  $-224$
- (C)  $-112$
- (D)  $-640$

124. The equation of the normal to the curve  $xy + 7 = 0$  is  $Ax + By + C = 0$ , then

- (A)  $A > 0, B > 0$  or  $A < 0, B < 0$
- (B)  $A > 0, B < 0$
- (C)  $A < 0, B > 0$
- (D)  $C = 0$

---

**125.** A wire 40 metre in length is to be cut into two pieces. One piece is formed into a square and the other piece into a circle. The lengths of the two pieces so that the combined area of the square and the circle is minimum, are respectively

- (A)  $\frac{160}{\pi+4}, \frac{40\pi}{\pi+4}$
- (B)  $\frac{\pi+4}{160}, \frac{40\pi}{\pi+4}$
- (C)  $\frac{160}{\pi+4}, \frac{\pi+4}{40\pi}$
- (D) 30, 10

---

**126.** If a spherical balloon has a variable diameter  $3x + \frac{9}{2}$  units, then the rate of change of its volume with respect to  $x$  is

- (A)  $\frac{27\pi}{4}(2x + 3)^2$
- (B)  $\frac{2\pi}{3}(2x + 3)^2$
- (C)  $\frac{27\pi}{8}(2x + 3)^2$
- (D)  $\frac{27\pi}{2}(2x + 3)^2$

---

**127.**  $\int \frac{30x^{14} + 15^x \log 225}{x^{15} + 15^x} dx =$

- (A)  $x^{15} + 15x^{14} + 30x^{13} + c$ , where  $c$  is the constant of integration
- (B)  $\frac{\log(x^{15}+15^x)}{2} + c$ , where  $c$  is the constant of integration
- (C)  $\log(x^{15} + 15^x)^2 + c$ , where  $c$  is the constant of integration
- (D)  $\log(x^{15} + 15^x) + c$ , where  $c$  is the constant of integration
- 

**128.** If  $\int \frac{\sin 2x}{\sin^4 x + \cos^4 x} dx = f(x) + c$  where  $c$  is constant of integration, then the value of  $\tan(f(x))$  is

- (A)  $\tan x$
- (B)  $\tan^2 x$
- (C)  $\tan^4 x$
- (D)  $\cot^4 x$
- 

**129.**  $\int e^{2x} \frac{2(\sin 2x \cos 2x - 1)}{2\sin^2 2x} dx = A e^{2x} \cot 2x + c$

(Where  $c$  is the constant of integration.), then  $A^3 =$

- (A)  $\frac{1}{8}$
- (B) 64
- (C) 8
- (D)  $\frac{1}{64}$
- 

**130.** If  $\int_0^a \frac{dx}{1+4x^2} = \frac{\pi}{8}$ , then  $a =$

- (A)  $\frac{1}{3}$
- (B)  $\frac{1}{2}$
- (C)  $\frac{1}{4}$
- (D) 1
-

---

**131.** The value of the integral  $\int_{-\sqrt{3}}^{\sqrt{3}} \frac{(2x^9+3x^8-5x^7+9x^6+4x^3-x+3)}{x^2+3} dx$  is

- (A)  $\frac{162}{7} + \sqrt{3}\frac{\pi}{4}$
  - (B)  $\frac{162\sqrt{3}}{7} + \sqrt{3}\frac{\pi}{2}$
  - (C)  $\frac{162\sqrt{3}}{7} + \frac{\pi}{2}$
  - (D)  $\frac{162\sqrt{3}}{7} - \frac{\pi}{2}$
- 

**132.** The area of the region (in sq.units) bounded by the curve  $y = 2\sqrt{1-x^2}$  and the X-axis is \_\_\_\_\_

- (A)  $\frac{\pi}{2}$
  - (B)  $\frac{\pi^2}{2}$
  - (C)  $\pi$
  - (D)  $\frac{2\pi}{3}$
- 

**133.** If  $\frac{dy}{dx} = y + 5$  and  $y(0) = 4$  then  $y(\log 2)$  is equal to

- (A) 2
  - (B) 5
  - (C) 7
  - (D) 13
- 

**134.** The solution of the differential equation  $\frac{dy}{dx} = \frac{x+y}{x-y}$  is

- (A)  $c(x^2 + y^2)^{\frac{1}{2}} + e^{\tan^{-1}(\frac{y^2}{x})} = 0$ , where  $c$  is an arbitrary constant
- (B)  $c(x^2 + y^2)^{\frac{1}{2}} = e^{\tan^{-1}(\frac{y}{x})}$ , where  $c$  is an arbitrary constant
- (C)  $c(x^2 - y^2) = e^{\tan^{-1}(\frac{y}{x})}$ , where  $c$  is an arbitrary constant
- (D)  $c(x^2 + y^2) = e^{\tan^{-1}(\frac{y}{x})}$ , where  $c$  is an arbitrary constant

**135.** A spherical balloon expands at a rate proportional to its surface area. Initially its radius is 2 cm and 5 minutes later it increases upto 7 cm, then surface area of spherical balloon after 12 minutes will be

- (A) 2480 sq.cm.
- (B) 2460 sq.cm.
- (C) 2464 sq.cm.
- (D) 2400 sq.cm.

**136.** Let  $\vec{a}, \vec{b}, \vec{c}$  be three vectors having magnitudes 1, 1 and 2 respectively. If  $\vec{a} \times (\vec{a} \times \vec{c}) + \vec{b} = \vec{0}$ , then the acute angle between  $\vec{a}$  and  $\vec{c}$  is

- (A)  $\frac{\pi}{4}$
- (B)  $\frac{\pi}{6}$
- (C)  $\frac{\pi}{3}$
- (D)  $\frac{\pi}{8}$

**137.** The volume of a tetrahedron with vertices  $5\hat{i} - \hat{j} + \hat{k}, 7\hat{i} - 4\hat{j} + p\hat{k}, \hat{i} - 6\hat{j} + 10\hat{k}$  and  $-\hat{i} - 3\hat{j} + 7\hat{k}$  is 11 cubic units, then one of the values of  $p$  is

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



**138.** Let  $\vec{a}, \vec{b}, \vec{c}$  be unit vectors such that  $\vec{a}$  is perpendicular to the plane of  $\vec{b}$  and  $\vec{c}$ . If the angle between  $\vec{b}$  and  $\vec{c}$  is  $\frac{\pi}{3}$ , then  $|\vec{a} + \vec{b} + \vec{c}| =$

- (A) 1
- (B) 2
- (C) 4
- (D) 16



**139.** If a parallelogram is constructed on the vectors  $\vec{a} = 3\vec{p} - \vec{q}, \vec{b} = \vec{p} + 3\vec{q}$  and  $|\vec{p}| = 3, |\vec{q}| = 2$  and angle between  $\vec{p}$  and  $\vec{q}$  is  $\frac{\pi}{3}$ , then the ratio of the lengths of adjacent sides  $\vec{a}$  and  $\vec{b}$  of the parallelogram is

- (A)  $\sqrt{57} : \sqrt{54}$
- (B)  $\sqrt{67} : \sqrt{63}$
- (C)  $\sqrt{63} : \sqrt{47}$
- (D)  $\sqrt{57} : \sqrt{52}$



**140.** A vector  $\vec{r}$  of magnitude  $3\sqrt{2}$  units which makes angles of  $\frac{\pi}{4}$  and  $\frac{\pi}{2}$  respectively with Y and Z axes is

- (A)  $\vec{r} = \pm 3\hat{i} + 3\hat{j}$   
(B)  $\vec{r} = \hat{i} + \hat{j}$   
(C)  $\vec{r} = \pm 2\hat{i} + 3\hat{j}$   
(D)  $\vec{r} = \pm 5\hat{i} + \hat{j}$
- 

**141.** The point having position vector  $4\hat{i} - 11\hat{j} + 2\hat{k}$  lies on the line

- (A)  $\vec{r} = (6\hat{i} - 4\hat{j} + 5\hat{k}) + \lambda(\hat{i} + 7\hat{j} + 3\hat{k})$   
(B)  $\vec{r} = (6\hat{i} - 4\hat{j} + 5\hat{k}) + \lambda(2\hat{i} + \hat{j} + 3\hat{k})$   
(C)  $\vec{r} = (6\hat{i} - 4\hat{j} + 5\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + \hat{k})$   
(D)  $\vec{r} = (6\hat{i} - 4\hat{j} + 5\hat{k}) + \lambda(2\hat{i} + 7\hat{j} + 3\hat{k})$
- 

**142.** The shortest distance between the lines, where the first line passes through  $(0, 0, 0)$  and  $(2, 0, 3)$  and the second line passes through  $(2, 5, 0)$  and  $(0, 4, 0)$  is

- (A)  $\frac{24}{7}$  units  
(B)  $\frac{9}{7}$  units  
(C)  $\frac{1}{7}$  units  
(D)  $\frac{36}{7}$  units
- 

**143.** The co-ordinates of the foot of the perpendicular from the origin to the plane  $2x - 3y - 6z = 49$  are...

- (A)  $(2, -3, -6)$
  - (B)  $(\frac{2}{7}, \frac{-3}{7}, \frac{-6}{7})$
  - (C)  $(-2, 3, 6)$
  - (D)  $(\frac{-2}{7}, \frac{3}{7}, \frac{6}{7})$
- 

**144.** Let a plane P pass through the point  $(3, 7, -7)$  and contain the line  $\frac{x-2}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ . If the distance of the plane P from the origin is d, then  $d^2$  is

- (A) 2
  - (B) 3
  - (C) 4
  - (D) 6
- 

**145.** The plane  $\frac{x}{2} + \frac{y}{3} + \frac{z}{4} = 1$  cuts the co-ordinate axes at the points A, B, C respectively. Then the area of triangle ABC is

- (A)  $\sqrt{61}$  sq. units
  - (B)  $\frac{\sqrt{61}}{2}$  sq. units
  - (C)  $\frac{\sqrt{61}}{4}$  sq. units
  - (D)  $\frac{\sqrt{71}}{2}$  sq. units
- 

**146.** In L.P.P., the corner points of the feasible region for the constraints  $3x - y \geq 6, x \leq 3, y \leq 2, y \geq 0, x \geq 0$  are .....

- (A)  $(3, 2), (3, 0), (2, 0)$   
 (B)  $(\frac{8}{3}, 2), (3, 2), (3, 0), (2, 0)$   
 (C)  $(0, 0), (2, 0), (\frac{8}{3}, 2), (0, 2)$   
 (D)  $(3, 2), (0, 3), (0, 2)$
- 

**147.** The odds in favour of A winning a game of table tennis against B are 1:2. If 3 games are to be played, then the probability of A winning at least two games out of the three is.....

- (A)  $\frac{1}{27}$   
 (B)  $\frac{2}{27}$   
 (C)  $\frac{5}{27}$   
 (D)  $\frac{7}{27}$
- 

**148.** A random variable X has the following probability distribution

|            |      |      |      |      |      |      |      |      |
|------------|------|------|------|------|------|------|------|------|
| $X = x$    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    |
| $P(X = x)$ | 0.15 | 0.23 | 0.10 | 0.12 | 0.20 | 0.08 | 0.07 | 0.05 |

For the events  $E = \{X \text{ is a prime number}\}$ ,  $F = \{X < 4\}$ ,  $P(E \cup F)$  is

- (A) 0.5  
 (B) 0.77  
 (C) 0.35  
 (D) 0.75
-

**149.** A random variable  $X$  takes the values 0, 1, 2, 3 and its mean is 1.3. If  $P(X = 3) = 2P(X = 1)$  and  $P(X = 2) = 0.3$ , then  $P(X = 0)$  is

- (A) 0.3
- (B) 0.4
- (C) 0.2
- (D) 0.5



**150.** Let  $X \sim B(6, \frac{1}{2})$ . Then the maximum probability occurs at

- (A)  $X = 1$
- (B)  $X = 2$
- (C)  $X = 3$
- (D)  $X = 4$