

1. Eddy currents are not used in the application of

- (A) induction furnace
- (B) thermal generators
- (C) electromagnetic damping
- (D) electric power meters
- (E) magnetic braking in trains

Ans: (B)  
Thermal generators

2. The total intensity of earth's magnetic field at the poles is 7 units. Its value at the equator is

- (A)  $7\sqrt{2}$  units
- (B) 3.5 units
- (C) 7 units
- (D)  $\frac{7}{\sqrt{2}}$  units
- (E) 14 units

Ans: (B)

3. Electromagnetic waves against their detection devices are matched below. The mismatch is

- (A) Gamma rays - Ionization chamber
- (B) Microwaves - Point contact diode
- (C) X - rays - Photographic film
- (D) Ultraviolet rays - Thermopiles
- (E) Infrared rays - Bolometer

Ans: (D)  
Ultraviolet rays - Thermopiles

4. In an electromagnetic wave, the oscillating electric and magnetic field vectors are oriented in

- (A) mutually perpendicular directions with a phase difference of  $\pi/2$
- (B) the same direction and in the same phase
- (C) mutually perpendicular directions with a phase difference of  $\pi$
- (D) the same direction with a phase difference of  $\pi/2$

(E) mutually perpendicular directions and are in phase

Ans: (E)

In EM waves  $\vec{E} \perp \vec{B}$  and are in phase

5. Fresnel distance for an aperture of size  $a$  illuminated by a parallel beam of light of wavelength  $\lambda$ , deciding the validity of ray optics is

(A)  $\frac{\lambda}{a^2}$

(B)  $\lambda a$

(C)  $a^2 \lambda$

(D)  $\frac{a^2}{\lambda}$

(E)  $a^2 \lambda^2$

Ans: (D)

$$Z_F = \frac{a^2}{\lambda}$$

6. The apparent depth of a needle lying in a water beaker is found to be 9 cm. If water is replaced by a liquid of refractive index 1.5, then the apparent depth of needle will be ( $\mu$  of water is  $4/3$ )

(A) 10 cm

(B) 9 cm

(C) 12 cm

(D) 7 cm

(E) 8 cm

Ans: (E)

$$t' = \frac{t}{\mu} = \frac{9 \times 1.5}{4/3} = 8$$

7. An object is placed at 10 cm in front of a concave mirror. If the image is at 20 cm from the mirror on the same side of the object, then the magnification produced by the mirror is

(A) 3

(B) -0.5

(C) -2

(D) 0.33

(E) -1

Ans: (C)

$$m = \frac{-v}{u} = -\left(\frac{-20}{-10}\right) = -2$$

8. In Young's double-slit experiment, two different light beams of wavelengths  $\lambda_1$  and  $\lambda_2$  produce interference pattern with band widths  $\beta_1$  and  $\beta_2$  respectively. If the ratio between  $\beta_1$  and  $\beta_2$  is 3:2, then the ratio between  $\lambda_1$  and  $\lambda_2$  is
- (A) 3:1  
 (B) 1:3  
 (C) 2:3  
 (D) 3:2  
 (E) 4:5

Ans: (D)

$$\beta = \frac{\lambda D}{d} \Rightarrow \lambda_1 : \lambda_2 = \beta_1 : \beta_2 = 3 : 2$$

9. If  $\theta_p$  is the polarizing angle for a glass plate of refractive index  $\mu$  and critical angle  $\theta_c$ , then
- (A)  $\theta_p = \theta_c$   
 (B)  $\tan \theta_p \cdot \sin \theta_c = 1$   
 (C)  $\theta_p \theta_c = 1$   
 (D)  $\tan \theta_p = \sin \theta_c$   
 (E)  $\tan \theta_p \sin \theta_c = \mu$

Ans: (B)

$$\left. \begin{array}{l} \tan \theta_p = \mu \\ \sin \theta_c = \frac{1}{\mu} \end{array} \right\} \tan \theta_p \times \sin \theta_c = 1$$

10. Two materials  $A$  and  $B$  having respective work functions 3eV and 4eV are emitting photoelectrons of same maximum kinetic energy of 1 eV. If the wavelength of incident light on  $A$  is 500 nm, then that of light incident on  $B$  is
- (A) 400 nm  
 (B) 300 nm  
 (C) 350 nm  
 (D) 600 nm  
 (E) 250 nm

Ans: (A)

$$\frac{hc}{\lambda} = k + \phi \Rightarrow \frac{\lambda_2}{500} = \frac{4}{5} \Rightarrow \lambda_2 = 400$$

11. If the momentum of an  $\alpha$ -particle is half that of a proton, then the ratio between the wavelengths of their de-Broglie waves is
- (A) 1:2  
 (B) 4:1

- (C) 1:4  
 (D) 1:1  
 (E) 2:1

Ans: (E)

$$\lambda = \frac{h}{p} = \frac{\lambda_{\alpha}}{\lambda_p} = \frac{P_p}{P_{\alpha}} = 2:1$$

12. During  $\beta^{-}$  decay of a radioactive element there is an increase in its

- (A) mass number  
 (B) neutron number  
 (C) electron number  
 (D) proton number  
 (E) atomic weight

Ans: (D)

13.  $10^{18}$  fissions per second is required for producing power of 300MW in a nuclear power station. To increase the power output to 360MW the additional number of fissions required per second is

- (A)  $2 \times 10^{18}$   
 (B)  $5 \times 10^{18}$   
 (C)  $5 \times 10^{17}$   
 (D)  $6 \times 10^{17}$   
 (E)  $2 \times 10^{17}$

Ans: (E)

$$\text{No. of fission for } 1\text{MW}, = \frac{10^{18}}{300}$$

$$\text{No. of fission for } 60\text{MW}, = \frac{10^{18}}{300} \times 60 = 2 \times 10^{17}$$

14. The ratio of the total energy  $E$  of the electron to its kinetic energy  $K$  in hydrogen atom is

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

Ans: (D)

$$E:K = -1:1 = -1$$

15. If the mass numbers of two nuclei are in the ratio 3: 2, then the ratio of their nuclear densities is :

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

Ans: (D)

Density of all nucleus is same.

16. In p-type semiconductors

- (A) holes are minority carriers
- (B) the vacancy of electron is a hole with negative charge
- (C) the impurity element added is donor type
- (D) for every pentavalent impurity atom added an extra hole is created
- (E) the electron will move from one hole to another hole constituting a flow of current

Ans: (E)

Electron moves from one hole to another.

17. In a CB mode of a transistor the current through the emitter is 6 mA. If the current gain of the transistor is 0.95 then its base current is

- (A) 0.2 mA
- (B) 0.3 mA
- (C) 0.5 mA
- (D) 0.4 mA
- (E) 0.8 mA

Ans: (B)

$$\alpha = \frac{I_C}{I_E} \Rightarrow I_C = 6 \times 0.95$$

$$I_B = I_E - I_C = 6 - 6 \times 0.95 = 0.3 \text{ mA}$$

18. The compound semiconductor used for making LEDs of different colours is

- (A) Gallium Arsenide – Phosphide
- (B) Indium Arsenide – Phosphide
- (C) Indium Arsenide – Selenide
- (D) Gallium Arsenide – Selenide

(E) Scandium Arsenide - Phosphide

Ans: (A)

Gallium Arsenic – Phosphide is used for LED of different colors.

19. A transistor amplifier along with a tank circuit with positive feedback will act as

- (A) power amplifier
- (B) voltage amplifier
- (C) full wave rectifier
- (D) half-wave rectifier
- (E) oscillator

Ans: (E)

20. In a transmitter the audio signal of frequency  $\omega_m$  is modulated by the carrier signal  $\omega_c$  and the band pass filter in it rejects the frequencies

- (A)  $\omega_c$  and  $\omega_m$
- (B)  $\omega_c - \omega_m$  and  $\omega_c + \omega_m$
- (C)  $\omega_m$  and  $2\omega_c$
- (D)  $\omega_c - \omega_m$  and  $\omega_c$
- (E)  $\omega_c + \omega_m$  and  $\omega_c$

Ans: (C)

21. Pick out the INCORRECT statement from the following

- (A) Speech signal requires a bandwidth of 2800 Hz
- (B) The approximate bandwidth to transmit music is 20kHz
- (C) The bandwidth of video signals required to transmit pictures is 4.2MHz
- (D) The bandwidth usually allocated to transmit TV signals is 6MHz
- (E) Digital signals are usually in the form of sine waves

Ans: (E)

Digital signals are usually in the form of square waves or pulses.

22. A physical quantity  $A$  on multiplication with velocity results in another quantity  $B$ . If the quantity  $B$  is energy, then the quantity  $A$  is

- (A) Mass
- (B) Momentum
- (C) Force
- (D) Acceleration
- (E) Power

Ans: (B)

$$[A] \times LT^{-1} = ML^2T^{-2}$$

$$[A] = \frac{ML^2T^{-2}}{LT^{-1}} = MLT^{-1}$$

⇒ Momentum.

23. If the percentage errors in the measurements of mass, length and time are 1%, 2% and 3% respectively, then the maximum permissible error in the measurement of the acceleration of a particle is

- (A) 8%
- (B) 9%
- (C) 6%
- (D) 10%
- (E) 2%

Ans: (A)

$$\frac{\Delta m}{m} = 1\%, \quad \frac{\Delta l}{l} = 2\%, \quad \& \quad \frac{\Delta t}{t} = 3\%$$

$$[a] = LT^{-2} = \frac{L}{T^2}$$

$$\frac{\Delta a}{a} = \frac{\Delta l}{l} + 2 \times \frac{\Delta t}{t} = 2\% + 2 \times 3\% = 8\%$$

24. The radius of a circular plate is 1.05 m. Its area (in  $m^2$ ) up to correct significant figures is

- (A) 3.47
- (B) 3.475
- (C) 3.467
- (D) 3.82
- (E) 3.825

Ans: (A)

$$\text{Area} = \pi r^2 = \frac{22}{7} \times (1.05)^2 = 3.465 \Rightarrow 3.46$$

25. The velocity of a moving particle at any instant is  $\hat{i} + \hat{j}$ . The magnitude and direction of the velocity of the particle are

- (A) 2 units and  $45^\circ$  with the  $x$ -axis
- (B) 2 units and  $30^\circ$  with the  $z$ -axis
- (C)  $\sqrt{2}$  units and  $45^\circ$  with the  $x$ -axis
- (D)  $\sqrt{2}$  units and  $60^\circ$  with the  $y$ -axis
- (E) 2 units and  $60^\circ$  with the  $x$ -axis

Ans: (C)

$$\vec{v} = \hat{i} + \hat{j}$$

$$|\vec{v}| = \sqrt{1^2 + 1^2} = \sqrt{2} \text{ units.}$$

Direction  $45^\circ$  with  $x$ -axis.

26. A hammer is dropped into a mine. Its velocities at depths  $d$ ,  $2d$  and  $3d$  are in the ratio

- (A) 1:2:3
- (B)  $1:\sqrt{2}:\sqrt{3}$
- (C) 1:4:9
- (D) 6:3:2
- (E) 1:1:1

Ans: (B)

$$v = \sqrt{2gh}.$$

$$v \propto \sqrt{h}.$$

$$v_1:v_2:v_3 = \sqrt{d}:\sqrt{2d}:\sqrt{3d}$$

$$= 1:\sqrt{2}:\sqrt{3}$$

27. The stopping distance of a moving vehicle is proportional to the

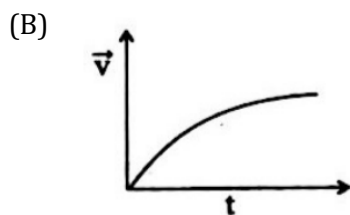
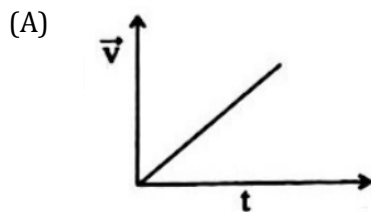
- (A) initial velocity
- (B) cube of the initial velocity
- (C) square of the initial velocity
- (D) cube root of the initial velocity
- (E) square root of the initial velocity

Ans: (C)

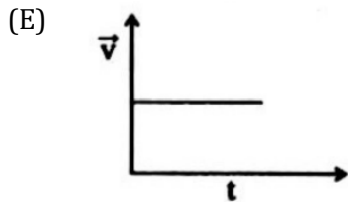
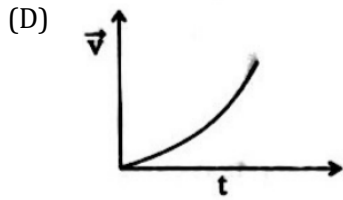
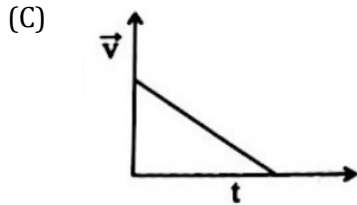
$$d_s = \frac{u^2}{2a}.$$

$$d_s \propto u^2$$

28. When a body starts from rest and moves with a constant acceleration, the velocity-time graph for its motion is







Ans: (A)

29. A wooden block of mass 10 kg is moving with an acceleration of  $3 \text{ ms}^{-2}$  on a rough floor. If the coefficient of friction is 0.3, then the applied force on it is ( $g = 10 \text{ ms}^{-2}$ )

- (A) 10 N
- (B) 30 N
- (C) 80 N
- (D) 60 N
- (E) 65 N

Ans: (D)

Net force,

$$ma = F - f$$

$$= F - \mu mg.$$

$$\therefore F = 10 \times 3 + 0.3 \times 10 \times 10$$

$$= 30 + 30 = 60 \text{ N}$$

30. Which one of the following statements is INCORRECT?

- (A) The state of rest or uniform linear motion both imply zero acceleration.
- (B) A net force is needed to keep a body in uniform motion.
- (C) Inertia means resistance to change.
- (D) The rate of change of momentum is proportional to the applied force.
- (E) Momentum is a vector quantity.

Ans: (B)

Newton's first law of motion

31. On a conveyor belt moving with a speed  $u$ , sand falls at a constant rate  $\left(\frac{dm}{dt}\right)$ , where  $m$  is the mass of sand. The extra force required to maintain the speed of the belt is

- (A)  $m\left(\frac{du}{dt}\right)$   
 (B)  $mu$   
 (C)  $\left(\frac{dm}{dt}\right)/u$   
 (D)  $u\left(\frac{dm}{dt}\right)$   
 (E)  $\frac{1}{m}\left(\frac{du}{dt}\right)$

Ans: (D)

$$F = u \frac{dm}{dt}$$

32. Area under the force-time graph gives the change in

- (A) Velocity  
 (B) Acceleration  
 (C) linear momentum  
 (D) Angular momentum  
 (E) Impulsive force

Ans: (C)

$$\begin{aligned} \text{Area under the graph} &= \text{Force} \times \text{time.} \\ &= \Delta p. \end{aligned}$$

33. When a metal spring is elongated within its elastic limit

- (A) work is done by the spring  
 (B) potential energy is stored in it  
 (C) its potential energy is lost  
 (D) its total energy remains constant  
 (E) its kinetic energy is increased

Ans: (B)

34. The instantaneous power in terms of force  $F$  and instantaneous velocity  $v$  is

- (A)  $P = F \cdot t$   
 (B)  $P = F \cdot v$   
 (C)  $P = F \cdot v^{-1}$   
 (D)  $P = F \cdot v^{-2}$

(E)  $P = F \cdot v \cdot t^{-1}$

Ans: (B)

$$P = \vec{F} \cdot \vec{v}$$

35. A ball with  $10^3$  J of kinetic energy collides with a horizontally mounted spring. If the maximum compression of the spring is 50 cm, then the spring constant of the spring is

(A)  $2 \times 10^3 \text{Nm}^{-1}$

(B)  $6 \times 10^3 \text{Nm}^{-1}$

(C)  $8 \times 10^3 \text{Nm}^{-1}$

(D)  $5 \times 10^3 \text{Nm}^{-1}$

(E)  $3 \times 10^3 \text{Nm}^{-1}$

Ans: (C)

K.E of ball = P.E of spring

$$10^3 = \frac{1}{2} kx^2$$

$$k = \frac{2 \times 10^3}{(50 \times 10^{-2})^2} = 8 \times 10^3 \text{ Nm}^{-1}$$

36. An object released from certain height  $h$  from the ground rebounds to a height  $\frac{h}{4}$  after striking the ground. The fraction of the energy lost by it is

(A)  $\frac{1}{4}$

(B)  $\frac{3}{4}$

(C)  $\frac{1}{2}$

(D)  $\frac{1}{8}$

(E)  $\frac{3}{8}$

Ans: (B)

$$V_i = mgh; \quad v_f = mg h/4$$

$$\Delta v = \frac{3}{4} mgh$$

$$\frac{\Delta v}{v_i} = 3/4$$

37. A solid metal ring and a disc of same radius and mass are rotating about their diameters with same angular frequency. The ratio of their respective rotational kinetic energy values is

(A) 1:1

- (B) 1:2  
 (C) 2:1  
 (D) 1:4  
 (E) 4:1

Ans: (C)

$$k = \frac{1}{2} I \omega^2$$

$$\frac{K_{\text{ring}}}{k_{\text{disc}}} = \frac{MR^2}{2} \times \frac{4}{MR^2} = 2:1$$

38. The  $X$  and  $Y$  coordinates of the three particles of masses  $m$ ,  $2m$  and  $3m$  are respectively  $(0,0)$ ,  $(1,0)$  and  $(-2,0)$ . The  $X$ -coordinate of the centre of mass of the system is

- (A)  $\frac{1}{3}$   
 (B)  $\frac{2}{3}$   
 (C)  $-\frac{1}{3}$   
 (D)  $-\frac{2}{3}$   
 (E)  $\frac{1}{6}$

Ans: (D)

$$x_{cm} = \frac{m \times 0 + 2m \times 1 + 3m \times -2}{6m}$$

$$= \frac{-4m}{6m} = -2/3$$

39. Radius of gyration of a solid cylinder of radius  $R$  and length  $L$  about its long axis of symmetry is

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

Ans: (B)

$$I = \frac{MR^2}{2} \quad \text{and} \quad I = Mk^2$$

$$Mk^2 = \frac{MR^2}{2} \Rightarrow k = R/\sqrt{2}$$

40. When no external torque acts on a rotating system,
- (A) angular momentum of the system is not conserved
  - (B) its rotational kinetic energy is conserved
  - (C) its rotational kinetic energy is independent of moment of inertia
  - (D) its rotational kinetic energy is directly proportional to moment of inertia
  - (E) its rotational kinetic energy is inversely proportional to moment of inertia

Ans: (E)

$$K = \frac{L^2}{2I} \Rightarrow k \propto 1/I$$

41. If  $T$  be the time period of a planet around the Sun and  $d$  is its mean distance from the Sun, then according to Kepler's third law

- (A)  $T \propto d$
- (B)  $T \propto d^2$
- (C)  $T^2 \propto d^3$
- (D)  $T^2 \propto d$
- (E)  $T^2 \propto d^{-1}$

Ans: (C)

$$T^2 \propto d^3$$

The square of the time period is directly proportional to the cube of the distance between the planet and the sun.

42. If the earth shrinks to half of its present size and its mass reduces to half of its actual mass, then the acceleration due to gravity ( $g$ ) on its surface will be

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

Ans: (C)

$$g = \frac{GM}{R^2}$$

$$g \propto \frac{M}{R^2}$$

$$g' \propto \frac{M/2}{(R/2)^2} \propto \frac{4M}{2R^2} \propto \frac{2M}{R^2}$$

$$\frac{g}{g'} = \frac{MR^2}{R^2} = \frac{1}{2}$$

$$g' = 2g$$

43. When two identical spheres each of radius  $r$  are kept in contact with each other, then the force of attraction between the two spheres is proportional to
- (A)  $r^2$
  - (B)  $r^4$
  - (C)  $r^6$
  - (D)  $r^{-2}$
  - (E)  $r^{-4}$

Ans: (B)

44. With the increase of temperature
- (A) surface tension of liquid increases
  - (B) viscosity of gases decreases
  - (C) viscosity of liquids increases
  - (D) both the surface tension and viscosity of liquids increase
  - (E) both the surface tension and viscosity of liquid decrease

Ans: (E)

Increase of temperature decreases both surface tension and viscosity of liquid.

45. The TRUE statement is
- (A) Young's modulus of a wire depends on its length
  - (B) The unit of Young's modulus is  $\text{Nm}^{-1}$
  - (C) Dimensional formula of stress is same as that of force
  - (D) The unit of strain is  $\text{kgm}^{-2}$
  - (E) Compressibility is the reciprocal of bulk modulus

Ans: (E)

$$\text{Compressibility} = \frac{1}{B} = -\frac{\Delta V}{PV}$$

B - Bulk modulus

46. When a body is strained, energy stored per unit volume is ( $Y = \text{Young's modulus}$ )
- (A)  $\frac{(\text{stress})}{Y}$
  - (B)  $\frac{Y \times \text{strain}}{2}$
  - (C)  $\frac{(\text{stress})^2}{2Y}$
  - (D)  $Y \times (\text{strain})^2$
  - (E)  $\frac{1}{2} \left( \frac{\text{stress}}{Y} \right)$

Ans: (C)

$$\begin{aligned} \text{Energy, } E &= \frac{1}{2} \times \text{stress} \times \text{strain} \\ &= \frac{1}{2} \times \text{stress} \times \frac{\text{stress}}{Y} = \frac{(\text{stress})^2}{2Y} \end{aligned}$$

47. According to equation of continuity when a liquid flows through a tube of variable cross section  $a$  with variable velocity  $v$ , the quantity that remains constant is

- (A)  $av^2$
- (B)  $a^2v$
- (C)  $av$
- (D)  $\frac{a}{v}$
- (E)  $\frac{a^2}{v}$

Ans: (C)

According to the equation of continuity,

$$\begin{aligned} a_1 v_1 &= a_2 v_2 \\ av &= \text{constant} \end{aligned}$$

48. Two thermally insulated identical vessels  $A$  and  $B$  are connected through a stopcock.  $A$  contains a gas at STP and  $B$  is completely evacuated. If the stopcock is suddenly opened then

- (A) temperature is halved
- (B) internal energy of the gas is halved
- (C) internal energy of the gas and pressure are halved
- (D) temperature and internal energy of the gas remain the same
- (E) pressure and internal energy of the gas remain the same

Ans: (D)

There will be no change in the internal energy of the gas as no work is done by/on the gas. Since no work is done by the gas during the expansion, temperature of the gas will not change.

49. A process in which there is no flow of heat between the system and surroundings is a/an

- (A) adiabatic process
- (B) cyclic process
- (C) isobaric process
- (D) isochoric process
- (E) isothermal process

Ans: (A)

In an adiabatic process there is no heat flow between the system and the surroundings.

50. When the temperature of the source of a Carnot engine is at 400 K, its efficiency is 25%. The required increase in temperature of the source to increase the efficiency to 50% is

- (A) 800 K
- (B) 600 K
- (C) 100 K
- (D) 400 K
- (E) 200 K

Ans: (E)

$$\eta = 1 - \frac{T_2}{T_1}$$

Initially

$$25\% \Rightarrow \frac{1}{4} = 1 - \frac{T_2}{400} \quad T_1 = 400\text{k}$$

$$\frac{T_2}{400} = \frac{3}{4}$$

$$T_2 = 300\text{k}$$

Finally,

$$50\% \Rightarrow \frac{1}{2} = 1 - \frac{T_2}{T_1}$$

$$\frac{1}{2} = 1 - \frac{300}{T_1}$$

$$\frac{300}{T_1} = \frac{1}{2}$$

$$T_1 = 600\text{k}$$

$$\text{increase of temperature} = 600 - 400 = 200 \text{ K}$$

51. When an ideal diatomic gas is heated at constant pressure, fraction of heat energy supplied that increases the internal energy of the gas is

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

Ans: (A)

$$\Delta U = nC_v\Delta T \quad \dots (i)$$



$$\Delta Q = nC_p\Delta T \quad \dots (ii)$$

Dividing eqs (i) by (ii), we get

$$\frac{\Delta U}{\Delta Q} = \frac{C_v}{C_p}$$

$$\frac{C_p}{C_v} = \gamma = \frac{7}{5} \text{ for a diatomic gas}$$

$$\therefore \frac{\Delta U}{\Delta Q} = \frac{5}{7}$$

52. The ratio of the kinetic energy values of 4 g of hydrogen ( $H_2$ ) to 7g of nitrogen ( $N_2$ ) at room temperature is

- (A) 4: 1
- (B) 1: 4
- (C) 4: 7
- (D) 7: 4
- (E) 1: 1

Ans: No option

No option is correct.

For one mole of diatomic gas,  $K = \frac{5}{2}RT$

$$\frac{K_1}{K_2} = \frac{n_1}{n_2} = \frac{4/2}{7/28} = 8: 1$$

53. A planet with radius  $R$  and acceleration due to gravity  $g$ , will have atmosphere only if r.m.s. speed of air molecules is less than

- (A)  $1.414\sqrt{gR}$
- (B)  $1.732\sqrt{gR}$
- (C)  $2\sqrt{gR}$
- (D)  $3.14\sqrt{gR}$
- (E)  $2.75\sqrt{gR}$

Ans: (A)

$$V_{rms} < V_e$$

$$V_{rms} < \sqrt{\frac{2Gm}{R}}$$

$$[GM = gR^2]$$

$$V_{rms} < 1.414\sqrt{gR}$$

54. If the ratio of the acceleration due to gravity on the surface of earth to that on the surface of the moon is 6: 1, then the ratio of the periods of a simple pendulum on their surfaces is

- (A) 1: 1

- (B) 1:6  
 (C) 1:3  
 (D)  $1:\sqrt{6}$   
 (E)  $1:\sqrt{3}$

Ans: (D)

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$\frac{T_e}{T_m} = \sqrt{\frac{1}{6}} \Rightarrow 1:\sqrt{6}$$

55. The velocity of a transverse wave propagating on a stretched string represented by the equation,  $y = 0.5\sin\left(\frac{\pi}{2}t + \frac{\pi}{3}x\right)$  is (where  $x$  and  $y$  are in metres and  $t$  in seconds)
- (A)  $0.5 \text{ ms}^{-1}$   
 (B)  $1.0 \text{ ms}^{-1}$   
 (C)  $2 \text{ ms}^{-1}$   
 (D)  $3 \text{ ms}^{-1}$   
 (E)  $1.5 \text{ ms}^{-1}$

Ans: (E)

$$V = \frac{\omega}{k} = \pi/2 \times 3/\pi = 3/2 = 1.5 \text{ m/s}$$

56. The kinetic energy of a particle of mass  $m$  executing linear simple harmonic motion with angular velocity  $\omega$  and amplitude  $a$  is  $\frac{1}{4}m\omega^2 a^2$  at a distance of \_\_\_\_\_ from the mean position.
- (A)  $\frac{a}{\sqrt{2}}$   
 (B)  $\frac{a}{2}$   
 (C)  $\frac{a}{4}$   
 (D)  $a$   
 (E)  $\frac{a}{8}$

Ans: (A)

$$K \cdot E = \frac{1}{2}m\omega^2(a^2 - x^2)$$

$$\frac{1}{4}m\omega^2 a^2 = \frac{1}{2}m\omega^2(a^2 - x^2)$$

$$x = \pm \frac{a}{\sqrt{2}}$$

57. When two sound waves of slightly different frequencies  $f_1$  and  $f_2$  are sounded together, then the time interval between successive maxima is

(A)  $\frac{1}{f_1 + f_2}$

(B)  $\frac{1}{f_1} + \frac{1}{f_2}$

(C)  $\frac{1}{f_1 - f_2}$

(D)  $\frac{1}{f_1 f_2}$

(E)  $\frac{1}{f_1} - \frac{1}{f_2}$

Ans: (C)

58. The electric potential at a point at a distance  $r$  due to an electric dipole is proportional to

(A)  $r^2$

(B)  $r$

(C)  $r^{-1}$

(D)  $r^{-2}$

(E)  $r^{-3}$

Ans: (D)

$$V = \frac{P \cos \theta}{4\pi\epsilon_0 r^2} \Rightarrow V \propto r^{-2}$$

59. An air capacitor and identical capacitor filled with dielectric medium of dielectric constant 5 are connected in series to a voltage source of 12 V. The fall of potential across  $C_1$  and  $C_2$  are respectively

(A) 2 V and 10 V

(B) 10 V and 2 V

(C) 6 V and 6 V

(D) 4 V and 8 V

(E) 8 V and 4 V

Ans: (B)

$$V = \frac{q}{c}$$

$$V_1 : V_2 = C_2 : C_1$$

$$V_1 : V_2 = 5 : 1$$

$$V_1 = \frac{12}{6} \times 5 = 10$$

$$V_2 = \frac{12}{6} \times 1 = 2V$$

60. The ratio of the magnitudes of electrostatic force between two protons at a distance  $r$  apart to that between two electrons at the same distance of separation is
- (A) 1: 1
  - (B) 2: 1
  - (C) 1: 2
  - (D) 4: 1
  - (E) 1: 4

Ans: (A)

Force between two protons = Force between 2 electrons.

61. When two charges are kept in air medium, at certain distance  $d$  apart, the force between them is  $F$ . When they are kept in a dielectric medium at the same distance of separation, the force between them becomes  $F/2$ . Then the dielectric constant of the medium is
- (A) 5
  - (B) 2
  - (C) 4
  - (D) 3
  - (E) 8

Ans: (B)

$$F_{med} = \frac{F_{air}}{k} \Rightarrow k = 2$$

62. The magnitude of the drift velocity per unit electric field is defined as
- (A) Mobility
  - (B) Resistivity
  - (C) Conductivity
  - (D) current density
  - (E) impedance

Ans: (A)

Mobility.

63. A Wheatstone network is balanced with respective resistors  $5\Omega$ ,  $10\Omega$ ,  $20\Omega$  and  $40\Omega$  in the  $P$ ,  $Q$ ,  $R$  and  $S$  arms. If a  $40\Omega$  resistor is connected across  $S$  arm, then the bridge is again balanced by connecting
- (A)  $10\Omega$  across  $R$
  - (B)  $10\Omega$  across  $P$
  - (C)  $20\Omega$  across  $Q$
  - (D)  $20\Omega$  across  $P$

(E)  $10\Omega$  across  $Q$

Ans: (E)

64. If one cell is connected wrongly in a series combination of four cells each of e.m.f.  $1.5\text{ V}$  and internal resistance of  $0.5\Omega$ , then the equivalent internal resistance of the combination is

(A)  $0.5\Omega$

(B)  $1\Omega$

(C)  $1.5\Omega$

(D)  $2\Omega$

(E)  $2.5\Omega$

Ans: (D)

$$r_{eq} = 4r = 4 \times 0.5 = 2$$

65. A carbon resistor is marked with the rings coloured blue, black, red and silver. Its resistance in ohm is

(A)  $60 \times 10^2 \pm 10\%$

(B)  $1 \times 10^5 \pm 10\%$

(C)  $1 \times 10^6 \pm 5\%$

(D)  $3.2 \times 10^4 \pm 5\%$

(E)  $45 \times 10^2 \pm 5\%$

Ans: (A)

Blue  $\Rightarrow 6$

Black  $\Rightarrow 0$

Red  $\Rightarrow 10^2$

Silver  $\Rightarrow \pm 10\%$

$$R = 60 \times 10^2 \pm 10\%$$

66. A conductor of length  $20\text{ cm}$  carrying a current of  $5\text{ A}$  is placed at an angle of  $30^\circ$  to the external magnetic field of  $0.5\text{ T}$ . The force acting on it is

(A)  $0.5\text{ N}$

(B)  $5\text{ N}$

(C)  $0.25\text{ N}$

(D)  $2.5\text{ N}$

(E)  $0.125\text{ N}$

Ans: (C)

$$\begin{aligned}
 F &= IlB \sin \theta \\
 &= 5 \times 20 \times 10^{-2} \times 1/2 \times \sin 30^\circ \\
 &= 50 \times 1/2 \times 10^{-2} \\
 &= 25 \times 10^{-2} = 0.25 \text{ N}
 \end{aligned}$$

67. A current carrying coil placed in a magnetic field  $B$  experiences a torque  $\tau$ . If  $\theta$  is the angle between the normal to the plane of the coil and field  $B$  and  $\phi$  is the flux linked with the coil, then

- (A)  $\tau$  is minimum for  $\theta = 90^\circ$
- (B)  $\tau$  and  $\phi$  are maximum for  $\theta = 0^\circ$
- (C)  $\phi$  is maximum for  $\theta = 90^\circ$
- (D)  $\tau$  and  $\phi$  are zero for  $\theta = 90^\circ$
- (E)  $\tau$  is zero and  $\phi$  is maximum for  $\theta = 0^\circ$

Ans: (E)

$$\tau = mB \sin \theta$$

$$\text{when, } \theta = 90^\circ \Rightarrow \tau = 0$$

$$\phi = NBA \cos \theta$$

$$\text{when, } \theta = 0^\circ \Rightarrow \phi = NBA \Rightarrow \text{maximum}$$

68. In Cyclotron, the frequency of revolution of the charged particle in a magnetic field is independent of

- (A) its mass
- (B) its energy
- (C) oscillatory frequency
- (D) magnetic field
- (E) its charge

Ans: (B)

$$f = \frac{qB}{2\pi m}; \quad f \propto v^0$$

Frequency is independent of kinetic energy.

69. The hard ferromagnetic material among the following is

- (A) Gadolinium
- (B) Iron
- (C) Cobalt
- (D) Alnico
- (E) nickel

Ans: (D)

Alnico

70. If  $B_c$  is the magnetic induction at the centre of a circular coil carrying current, then the magnetic induction at a point on the axis of the coil at a distance equal to the radius of the coil is

(A)  $\frac{B_c}{2\sqrt{2}}$

(B)  $\frac{B_c}{2}$

(C)  $\frac{B_c}{4}$

(D)  $\frac{B_c}{\sqrt{2}}$

(E)  $\frac{B_c}{8}$

Ans: (A)

$$\left. \begin{array}{l} B_c = \frac{\mu_0 I}{2R} \\ B_{ax} = \frac{\mu_0 I R^2}{2(R^2 + R^2)^{3/2}} \end{array} \right\} B_{ax} = \frac{B_c}{2\sqrt{2}}$$

71. If air core is replaced by an iron core in an inductor, its self-inductance is increased from 0.02mH to 40mH. The relative permeability of iron is

(A) 5000

(B) 2000

(C) 200

(D) 500

(E) 400

Ans: (B)

$$\mu_r = \frac{L}{L_0} = \frac{40}{0.02} = 2000$$

72. Among various circuits constructed with resistor  $R$ , inductor  $L$  and capacitor  $C$ , the circuit that gives maximum power dissipation is

(A) purely inductive circuit

(B) purely capacitive circuit

(C) purely resistive circuit

(D)  $L - C$  series circuit

(E)  $C - R$  series circuit

Ans: (C)

$$\langle P \rangle = \frac{V_0 I_0}{2} \cos \phi$$

$\cos \phi = I \text{ max for } R \text{ only circuit}$

73. The increasing order of acid strength of the following carboxylic acids is
- (A)  $\text{ClCH}_2 - \text{CH}_2 - \text{COOH} < \text{ClCH}_2\text{COOH} < \text{NC} - \text{CH}_2\text{COOH} < \text{CHCl}_2\text{COOH}$
- (B)  $\text{ClCH}_2 - \text{COOH} < \text{NC} - \text{CH}_2\text{COOH} < \text{ClCH}_2\text{CH}_2\text{COOH} < \text{CHCl}_2\text{COOH}$
- (C)  $\text{ClCH}_2 - \text{CH}_2 - \text{COOH} < \text{CHCl}_2 - \text{COOH} < \text{ClCH}_2 - \text{COOH} < \text{NC} - \text{CH}_2 - \text{COOH}$
- (D)  $\text{NC} - \text{CH}_2 - \text{COOH} < \text{Cl} - \text{CH}_2\text{COOH} < \text{CH} - \text{Cl}_2\text{COOH} < \text{Cl} - \text{CH}_2\text{CH}_2\text{COOH}$
- (E)  $\text{ClCH}_2\text{CH}_2 - \text{COOH} < \text{CHCl}_2\text{COOH} < \text{ClCH}_2\text{COOH} < \text{NC} - \text{CH}_2\text{COOH}$

Ans: (A)

$:\text{CHCl}_2\text{COOH} > \text{NO}_2\text{CH}_2\text{COOH} > \text{NCCH}_2\text{COOH}$   
 $\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH}$   
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74. Which one of the following is not correct with respect to properties of amines?
- (A)  $\text{pK}_b$  of aniline is more than that of methylamine.
- (B) Ethylamine is soluble in water whereas aniline is not.
- (C) Ethanamide on reaction with  $\text{Br}_2$  and  $\text{NaOH}$  gives ethylamine.
- (D) Ethylamine reacts with nitrous acid to give ethanol.
- (E) Aniline does not undergo Friedel-Crafts reaction.

Ans: (C)

Ethanamide on Bromamide reaction produce methyl amine.

75. The increasing order of extent of H-bonding of the alkyl ammonium ions,  $\text{RNH}_3^+$ ,  $\text{R}_2\text{NH}_2^+$ ,  $\text{R}_3\text{NH}^+$  in water is
- (A)  $\text{R}_3\text{NH}^+ < \text{R}_2\text{NH}_2^+ < \text{RNH}_3^+$
- (B)  $\text{R}_3\text{NH}^+ < \text{RNH}_3^+ < \text{R}_2\text{NH}_2^+$
- (C)  $\text{R}_2\text{NH}_2^+ < \text{RNH}_3^+ < \text{R}_3\text{NH}^+$
- (D)  $\text{RNH}_3^+ < \text{R}_2\text{NH}_2^+ < \text{R}_3\text{NH}^+$
- (E)  $\text{RNH}_3^+ < \text{R}_3\text{NH}^+ < \text{R}_2\text{NH}_2^+$

Ans: (A)

$\text{R}_3\text{NH} < \text{R}_2\text{N} | \text{H}_2 < \text{RNH}_3$

76. The conversion of benzene diazonium chloride to bromobenzene by treating with  $\text{HBr}$  in the presence of copper powder is called
- (A) Sandmeyer reaction
- (B) Gattermann reaction



- (C) Wurtz reaction
- (D) Hoffmann reaction
- (E) Gabriel synthesis

Ans: (B)  
Gattermann reaction

77. Which one of the following statements is TRUE with regard to glucose?

- (A) It gives Schiff's test
- (B) It forms addition product with  $\text{NaHSO}_3$
- (C) Its pentaacetate does not react with  $\text{NH}_2\text{OH}$
- (D) It does not undergo mutarotation
- (E)  $\beta$  - form of glucose is obtained by crystallisation from conc. solution of glucose at 303 K

Ans: (C)  
Pentaacetate of glucose will react with hydroxylamine

78. Fibrous protein present in muscles is

- (A) keratin
- (B) albumin
- (C) insulin
- (D) myosin
- (E) histidine

Ans: (D)  
Myosin is fibrous protein present in muscles. Keratine is fibrous protein present in hair, nail, etc...

79. The drug used to inhibit the enzymes which catalyse the degradation of noradrenaline is

- (A) phenelzine
- (B) prontosil
- (C) cimetidine
- (D) terfenadine
- (E) chloramphenicol

Ans: (A)  
phenalazine and iproniazid are antidepressant

80. The gas which is the major contributor to global warming is

- (A)  $\text{NO}_2$
- (B)  $\text{CO}_2$

- (C) SO<sub>2</sub>
- (D) O<sub>2</sub>
- (E) N<sub>2</sub>O

Ans: (B)

CO<sub>2</sub> is the major contributor of global warming

81. A cooking gas contains carbon and hydrogen only. A volume of 11.2 L of this gas is found to weigh 22 g at STP. Then the molecular formula of the gas is

- (A) C<sub>3</sub>H<sub>8</sub>
- (B) C<sub>2</sub>H<sub>2</sub>
- (C) C<sub>2</sub>H<sub>4</sub>
- (D) C<sub>2</sub>H<sub>6</sub>
- (E) C<sub>3</sub>H<sub>4</sub>

Ans: (A)

22.4 L weighs 44g C<sub>3</sub>H<sub>8</sub> has molar mass 44

82. The number of electrons in an atom that may have the quantum numbers  $n = 3$  and  $m_s = +1/2$  is

- (A) 32
- (B) 9
- (C) 18
- (D) 16
- (E) 8

Ans: (B)

$n = 3$ ;  $n^2 = 9$

83. "No two electrons in an atom can have the same set of four quantum numbers." This is known as

- (A) Hund's rule
- (B) Pauli's exclusion principle
- (C) Aufbau principle
- (D) Heisenberg's principle
- (E) Fajan's rule

Ans: (B)

statement of Pauli's exclusion principle

84. The first ionisation enthalpy is the least in

- (A) Germanium

- (B) Antimony
- (C) Tellurium
- (D) Arsenic
- (E) Bismuth

Ans: (E)  
Bismuth is most metallic among them

85. Predict in which of the following, entropy decreases:

- (A) A liquid crystallizes into a solid.
- (B) Temperature of a crystalline solid is raised from 0 K to 115 K.
- (C)  $2\text{NaHCO}_3(s) \rightarrow \text{Na}_2\text{CO}_3(s) + \text{CO}_2(g) + \text{H}_2\text{O}(g)$
- (D)  $\text{H}_2(g) \rightarrow 2\text{H}(g)$
- (E)  $2\text{SO}_3(g) \rightarrow 2\text{SO}_2(g) + \text{O}_2(g)$

Ans: (A)  
liquid to solid Randomness decreases

86. In which one of the following,  $sp^2$  hybridisation is involved in the central atom?

- (A)  $\text{NH}_3$
- (B)  $\text{BCl}_3$
- (C)  $\text{ClF}_3$
- (D)  $\text{PCl}_3$
- (E)  $\text{PH}_3$

Ans: (B)  
 $\text{BCl}_3$   $sp^2$  hybridized

87. In which one of the following molecules, the central atom has expanded octet?

- (A) Sulphur dichloride
- (B) Boron trichloride
- (C) Nitrogen dioxide
- (D) Ozone
- (E) Sulphuric acid

Ans: (E)  
In sulphuric acid valence shell of Sulphur has 12 electrons

88. A cycle tube will burst if the volume of air inside exceeds 1 L at the room temperature. If at 1 bar pressure the air occupies 500 mL, then up to what pressure can the tube be expanded at the same temperature?

- (A) 2 bar

- (B) 1.5bar
- (C) 0.5 bar
- (D) 0.002 bar
- (E) 1.2bar

Ans: (C)

$$P_1V_1 = P_2V_2;$$

$$1 \times 500 = P_2 \times 1000$$

$$P_2 = 0.5 \text{ bar}$$

89. The ratio of the actual molar volume of a gas to the ideal molar volume is the gas.

- (A) co-volume
- (B) van der Waals factor ' a '
- (C) critical volume
- (D) molar gas constant
- (E) compressibility factor

Ans: (E)

$$\frac{V_{\text{real}}}{V_{\text{ideal}}} = \text{compressibility factor (z)}$$

90. Enthalpy change is always negative for which one of the following processes?

- (A) Enthalpy of ionisation
- (B) Enthalpy of sublimation
- (C) Enthalpy of vapourisation
- (D) Enthalpy of fusion
- (E) Enthalpy of combustion

Ans: (E)

Enthalpy of combustion is exothermic

91. The enthalpy change for the evaporation of a liquid at its boiling point 127°C is +40.32kJmol<sup>-1</sup>. What is the value of internal energy change for the above process at 127°C? (R = 8.3JK<sup>-1</sup> mol<sup>-1</sup>)

- (A) -37.0kJmol<sup>-1</sup>
- (B) +43.0kJmol<sup>-1</sup>
- (C) +37.0kJmol<sup>-1</sup>
- (D) -43.0kJmol<sup>-1</sup>
- (E) +43.64kJmol<sup>-1</sup>

Ans: (C)

$$\Delta H = \Delta U + \Delta n_g RT$$

$$40.32 \times 10^3 = \Delta U + 1 \times 8.3 \times 400$$

$$\Delta U = 37 \text{ kJ}$$

92. In which one of the following equilibria  $\Delta n_g$  value is zero?

- (A)  $2\text{NOCl}(\text{g}) \rightleftharpoons 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$
- (B)  $\text{Ni}(\text{s}) + 4\text{CO}(\text{g}) \rightleftharpoons \text{Ni}(\text{CO})_4(\text{g})$
- (C)  $\text{CO}_2(\text{g}) + \text{C}(\text{s}) \rightleftharpoons 2\text{CO}(\text{g})$
- (D)  $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightleftharpoons 2\text{HBr}(\text{g})$
- (E)  $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$

Ans: (D)

$$\Delta n_g = 0$$

93. The following concentrations were obtained for the formation of  $\text{NH}_3(\text{g})$  from  $\text{N}_2(\text{g})$  and  $\text{H}_2(\text{g})$  at equilibrium and at 500 K:  $[\text{N}_2] = 1 \times 10^{-2}\text{M}$ ,  $[\text{H}_2] = 2 \times 10^{-2}\text{M}$  and  $[\text{NH}_3] = 2 \times 10^{-2}\text{M}$ . The equilibrium constant,  $K_c$ , for the reaction  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$  at 500 K is

- (A)  $5 \times 10^3 \text{ mol}^{-2}\text{dm}^6$
- (B)  $1 \times 10^3 \text{ mol}^{-2}\text{dm}^6$
- (C)  $5 \times 10^{-3} \text{ mol}^{-2}\text{dm}^6$
- (D)  $2 \times 10^3 \text{ mol}^{-2}\text{dm}^6$
- (E)  $2 \times 10^{-3} \text{ mol}^{-2}\text{dm}^6$

Ans: (A)

$$\begin{aligned} K_c &= \frac{(2 \times 10^{-2})^2}{10^2 \times (2 \times 10^{-2})^3} = \frac{4 \times 10^{-4}}{8 \times 10^{-8}} \\ &= \frac{10 \times 10^3}{2} = 5 \times 10^3 \end{aligned}$$

94. The SI unit of molar conductivity is

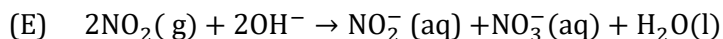
- (A)  $\text{Sm}^3 \text{ mol}^{-1}$
- (B)  $\text{Smmol}^{-1}$
- (C)  $\text{Smmol}^{-2}$
- (D)  $\text{Sm}^2 \text{ mol}^{-1}$
- (E)  $\text{Sm}^2 \text{ mol}^{-2}$

Ans: (D)

$\text{Sm}^2 \text{ mol}^{-1}$  is the SI unit of molar conductivity.

95. Which of the following is an example of disproportionation redox reaction?

- (A)  $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$
- (B)  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$
- (C)  $2\text{Pb}(\text{NO}_3)_2(\text{s}) \rightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
- (D)  $\text{NaH}(\text{s}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{NaOH}(\text{aq}) + \text{H}_2(\text{g})$



Ans: (E)

*N* undergo oxidation and reduction

96. A scientist wants to perform an experiment in aqueous solution in a hill station where the boiling point of water is  $98.98^\circ\text{C}$ . How much urea (mol.wt  $60 \text{ g mol}^{-1}$ ) is to be added by him to 2 kg of water to get the boiling point  $100^\circ\text{C}$  at the same place? ( $K_b$  of water =  $0.51 \text{ K kg mol}^{-1}$ )

- (A) 60 g  
 (B) 120 g  
 (C) 180 g  
 (D) 240 g  
 (E) 1.02 g

Ans: (D)

$$\Delta T_b = K_b m$$

$$1.02 = 0.51 \times \frac{W_B}{60} \times \frac{1000}{2000}$$

$$W_B = \frac{1.02 \times 60 \times 2}{0.51} = 2 \times 60 \times 2 = 240$$

97. The vapour pressure of pure benzene at a certain temperature is 0.850 bar. A nonvolatile, non-electrolyte solid weighing 1.0 g when added to 39.0 g of benzene (molar mass  $78 \text{ g mol}^{-1}$ ), vapour pressure of the solution is reduced to 0.845 bar. What is the molar mass of the solid substance?

- (A)  $340 \text{ g mol}^{-1}$   
 (B)  $170 \text{ g mol}^{-1}$   
 (C)  $240 \text{ g mol}^{-1}$   
 (D)  $270 \text{ g mol}^{-1}$   
 (E)  $370 \text{ g mol}^{-1}$

Ans: (A)

$$\frac{p^0 - P}{p^0} = \chi_B \approx \frac{n_B}{n_A}$$

$$\frac{0.85 - 0.845}{0.85} = \frac{1/M_B}{\frac{39}{78}}$$

$$\frac{0.005}{0.85} = \frac{1}{M_B} \times \frac{78}{39}$$

$$M_B = \frac{78 \times 0.85}{39 \times 0.005}$$

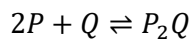
$$= 340 \text{ g mol}^{-1}$$

98. For the reaction  $2\text{P} + \text{Q} \rightleftharpoons \text{P}_2\text{Q}$ , the rate of formation of  $\text{P}_2\text{Q}$  is  $0.24 \text{ moldm}^{-3} \text{ s}^{-1}$ . Then the rates of disappearance of P and Q respectively are

- (A)  $-0.48 \text{ moldm}^{-3} \text{ s}^{-1}$  and  $-0.48 \text{ moldm}^{-3} \text{ s}^{-1}$

- (B)  $-0.24 \text{ moldm}^{-3} \text{ s}^{-1}$  and  $-0.48 \text{ moldm}^{-3} \text{ s}^{-1}$   
 (C)  $-0.48 \text{ moldm}^{-3} \text{ s}^{-1}$  and  $-0.24 \text{ moldm}^{-3} \text{ s}^{-1}$   
 (D)  $-0.12 \text{ moldm}^{-3} \text{ s}^{-1}$  and  $-0.24 \text{ moldm}^{-3} \text{ s}^{-1}$   
 (E)  $-0.24 \text{ moldm}^{-3} \text{ s}^{-1}$  and  $-0.12 \text{ moldm}^{-3} \text{ s}^{-1}$

Ans: (C)



$$\frac{-d[P]}{dt} = 2 \frac{d[P_2Q]}{dt} = 2 \times 0.24 = 0.48$$

99. Choose the correct set of reactions which follow first order kinetics:

- (i) Thermal decomposition of HI on gold surface:  
 (ii) Thermal decomposition of  $\text{N}_2\text{O}_5(\text{g})$  at constant volume.  
 (iii) Hydrogenation of ethene.  
 (iv) Decomposition of  $\text{NH}_3$  on a hot Pt surface.  
 (v) Thermal decomposition of  $\text{SO}_2\text{Cl}_2(\text{g})$  at constant volume.

- (A) i, ii, iii  
 (B) i, iii, iv  
 (C) i, iv, v  
 (D) ii, iv, v  
 (E) ii, iii, v

Ans: (E)

(ii), (iii) and (v) are first order reaction.

100. Which one of the following is true?

- (A) Chemisorption is not specific in nature  
 (B) Physisorption is irreversible  
 (C) Both physisorption and chemisorption depend on the nature of the gas  
 (D) Enthalpy of adsorption is high in physisorption  
 (E) Chemisorption increases with surface area of adsorbent while in physisorption it is not

Ans: (C)

Adsorption depends on the nature of the gas.

101. When zinc metal is reacted with aqueous sodium hydroxide, the products formed are

- (A) zinc hydroxide and oxygen only  
 (B) sodium zincate and oxygen only  
 (C) sodium zincate, hydrogen and oxygen  
 (D) sodium zincate and hydrogen only  
 (E) sodium zincate and hydrogen oxide only

Ans: (D)

Sodium zincate and  $H_2$  only

102. 'Syngas' produced from sewage is a gaseous mixture of

- (A)  $CH_4$  and  $C_2H_6$
- (B) CO and  $H_2$
- (C) CO and  $CH_4$
- (D)  $CS_2$  and CO
- (E)  $CS_2$  and  $CH_4$

Ans: (B)  
CO &  $H_2$  syngas.

103. Choose the correct choice containing true statements regarding  $PCl_5$ .

- (i)  $PCl_5$  is prepared by the reaction of white phosphorus with excess of dry chlorine.
- (ii) The complete hydrolysis of  $PCl_5$  gives phosphoric acid.
- (iii)  $PCl_5$  has square pyramidal structure in gaseous phase.
- (iv) All the five bonds in  $PCl_5$  molecule are equivalent.

- (A) ii and iii
- (B) i and iii
- (C) iii and iv
- (D) ii and iv
- (E) i and ii

Ans: (E)  
 $PCl_5$  is trigonal bipyramid.  
It's axial length is longer than equatorial.

104. Match the substances and their uses.

- |                 |                                            |
|-----------------|--------------------------------------------|
| a) Silicones    | (i) Cracking of hydrocarbons               |
| b) Zeolites     | (ii) Light composite material for aircraft |
| c) Quartz       | (iii) Flux for soldering metals            |
| d) Borax        | (iv) Waterproofing of fabrics              |
| e) Boron fibres | (v) Piezoelectric material                 |

- (A) a)-(iv); b)-(ii); c)-(i); d)-(v); e)-(iii)
- (B) a)-(i); b)-(ii); c)-(iv); d)-(iii); e)-(v)
- (C) a)-(iv); b)-(i); c)-(iii); d)-(ii); e)-(v)
- (D) a)-(iii); b)-(ii); c)-(i); d)-(iv); e)-(v)
- (E) a)-(iv); b)-(i); c)-(v); d)-(iii); e)-(ii)

Ans: (E)

105. Choose the wrong statement in the following with regard to orthoboric acid:

- (A) It can be prepared by the hydrolysis of boron trihalide



- (B) It is not a protonic acid but acts as a Lewis acid
- (C) It has a layer structure
- (D) It is freely soluble in cold water
- (E) On heating above 370 K it forms first metaboric acid which on further heating yields  $B_2O_3$

Ans: (D)  
Orthoboric acid is sparingly soluble in cold water.

106. The magnetic moment of a trivalent ion of a metal with  $Z = 24$  in aqueous solution is

- (A) 3.87BM
- (B) 2.84BM
- (C) 1.73BM
- (D) 4.90BM
- (E) 5.92BM

Ans: (A)  
There is 3 unpaired electron.

107. In the first row transition metals, the element that exhibits only +3 oxidation state is

- (A) Zinc
- (B) Scandium
- (C) Nickel
- (D) Titanium
- (E) iron

Ans: (B)  
Scandium shows +3 only.

108. The metal that has the highest melting point in the first series of transition elements is

- (A) Titanium
- (B) Vanadium
- (C) Chromium
- (D) Iron
- (E) Manganese

Ans: (B)  
Vanadium 1915 K  
Chromium 1903 K

In NCERT text book, graph shows Cr has higher melting point than V. Actually V has higher melting point than Cr.

109. In which one of the following complexes, the conductivity corresponds to 1: 2 electrolyte in aqueous solution?

- (A) Hexaamminecobalt(III) chloride
- (B) Tetraamminedichlorocobalt(III) chloride
- (C) Pentaamminechlorocobalt(III) chloride
- (D) Triamminetriaquachromium(III) chloride
- (E) Diamminesilver(I) dicyanoargentate(I)

Ans: (C)

$[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ ; 1: 2 electrolyte

110. The complex ion formed when the film developed in black and white photography is washed with hypo solution is

- (A)  $[\text{Ag}_2(\text{S}_2\text{O}_3)_2]^{3-}$
- (B)  $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$
- (C)  $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3+}$
- (D)  $[\text{Ag}_2(\text{S}_2\text{O}_3)_2]^{3+}$
- (E)  $[\text{Ag}(\text{S}_2\text{O}_3)_3]^{3-}$

Ans: (B)

$[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$

111. Which one of the following is an ore of aluminium?

- (A) Kaolinite
- (B) Siderite
- (C) Malachite
- (D) Calamine
- (E) Haematite

Ans: (A)

Kaolinite  $[\text{Al}_2(\text{OH})_4\text{Si}_2\text{O}_5]$

112. In the estimation of nitrogen present in an organic compound, Kjeldahl's method cannot be applied to

- (A) Aniline
- (B) Toluidine
- (C) Urea
- (D) Pyridine
- (E) Benzylamine

Ans: (D)

Heterocyclic nitrogen compound will not give Kjeldahl's method of estimation

113. Among the following, the alkene that exhibits optical isomerism is

- (A) 3-methyl-2-pentene
- (B) 4-methyl-1-pentene
- (C) 3-methyl-1-pentene
- (D) 2-methyl-2-pentene
- (E) 2,3 -dimethyl-2-butene

Ans: (C)

3-methyl-1-pentene has asymmetric carbon

114. The reagent that is used to convert but-2-yne to trans-but-2-ene is

- (A)  $H_2/Pd/C$
- (B)  $NaBH_4$
- (C)  $Sn/HCl$
- (D)  $Na/liquid\ NH_3$
- (E)  $Zn - Hg/HCl$

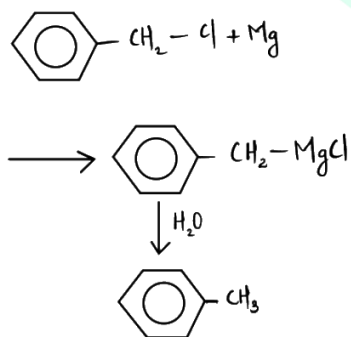
Ans: (D)

Na in liquid ammonia produces trans - alkene

115. Compound 'A' is obtained by the reaction of benzyl chloride with magnesium metal in dry ether followed by treatment with water. What is the compound 'A'?

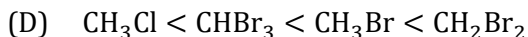
- (A) Toluene
- (B) Benzyl alcohol
- (C) Phenol
- (D) Benzene
- (E) Benzaldehyde

Ans: (A)



116. The correct increasing order of boiling points of the following compounds is

- (A)  $CH_2Br_2 < CH_3Br < CHBr_3 < CH_3Cl$
- (B)  $CH_2Br_2 < CHBr_3 < CH_3Br < CH_3Cl$
- (C)  $CH_3Cl < CH_3Br < CH_2Br_2 < CHBr_3$



Ans: (C)

Greater the molar mass greater the boiling point.

117. Compounds 'A', 'B' and 'C' have the same molecular formula  $\text{C}_7\text{H}_8\text{O}$ . Compound 'A', and 'B' liberate hydrogen gas with sodium metal. When treated with sodium hydroxide, compound 'B' alone dissolves. Compound 'C' is inert towards both sodium metal and sodium hydroxide. Compounds 'A', 'B' and 'C' are respectively

(A) Cresol, benzyl alcohol and anisole

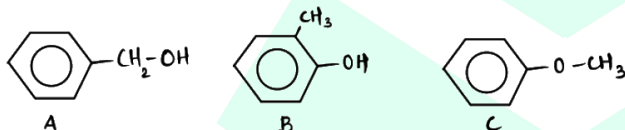
(B) Benzyl alcohol, cresol and anisole

(C) Benzyl alcohol, anisole and cresol

(D) Cresol, anisole and benzyl alcohol

(E) Anisole, cresol and benzyl alcohol

Ans: (B)

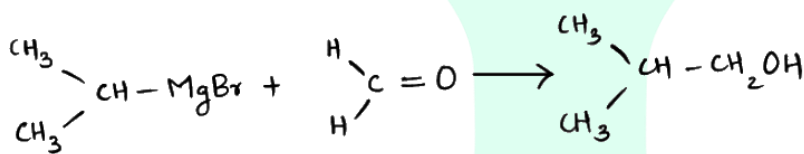


A & B has acidic hydrogen.  
B reacts with NaOH.

118. The suitable Grignard reagent used for the preparation of 2-methylpropan-1-ol using methanal is

(A)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2\text{MgBr}$ (B)  $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2\text{MgBr}$ (C)  $\text{CH}_3 - \text{CH}(\text{CH}_3) - \text{CH}_2\text{MgBr}$ (D)  $(\text{CH}_3)_3\text{C} - \text{MgBr}$ (E)  $\text{CH}_2 = \text{CH}(\text{CH}_3) - \text{MgBr}$ 

Ans: (E)



119. Isopropylbenzene (cumene) is oxidized in the presence of air to give compound 'X' which on hydrolysis in the presence of acids gives compounds 'Y' and 'Z'. Compounds 'X', 'Y' and 'Z' are respectively

(A) benzyl alcohol, benzaldehyde, ethanol

(B) cumene hydroperoxide, phenol, acetaldehyde

(C) cumene hydroperoxide, benzaldehyde, acetone

(D) cumene hydroperoxide, phenol, acetone

(E) cumene hydroperoxide, benzaldehyde, acetaldehyde

Ans: (D)

Large scale preparation of phenol.

120. A research scholar returned to the laboratory after the lock down due to Covid-19. He kept acetone, benzaldehyde, acetaldehyde and diethyl ketone in four different bottles. The bottles contained only the label as *P*, *Q*, *R* and *S*. He forgot which bottle contained which compound. Compounds *P* and *R* only underwent iodoform test. Compound *R* alone gave reddish brown precipitate with Fehling's reagent. Compounds *Q* and *R* alone underwent Tollen's test. Compound *S* did not answer any of the above tests. Identify the compounds *P*, *Q*, *R* and *S*.

(A) *P* -diethyl ketone; *Q* -benzaldehyde; *R* -acetaldehyde; *S* -acetone

(B) *P* -acetone; *Q* -benzaldehyde; *R* -acetaldehyde; *S* -diethyl ketone

(C) *P* -acetone; *Q* -acetaldehyde; *R* -benzaldehyde; *S* -diethyl ketone

(D) *P* -acetaldehyde; *Q* -acetone; *R* -diethyl ketone; *S* -benzaldehyde

(E) *P* -benzaldehyde; *Q* -diethyl ketone; *R* -acetone; *S* -acetaldehyde

Ans: (B)

*P*, *R* = Iodoform test

*R* = Fehling's test

*Q*, *R* = Tollen's test

*P* = Acetone;                      *Q* = Benzaldehyde

*R* = Fehling's test;              *S* = Diethyl ketone

