DATE : 07/05/2017

Test Booklet Code

A

(APRA)

Aakash
Medical | IIT-JEE | Foundations
(Divisions of Aakash Educational Services Pvt. Ltd.)

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Time : 3 hrs.

Answers & Solutions

for

NEET (UG) - 2017

Max. Marks : 720

Important Instructions :

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue / black** ball point pen only.
2. The test is of **3 hours** duration and Test Booklet contains **180** questions. Each question carries **4** marks. For each correct response, the candidate will get **4 marks**. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **720**.
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses.
4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
5. **On completion of the test, the candidate must hand over the Answer Sheet to the invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.**
6. The CODE for this Booklet is **A**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet / Answer Sheet.
8. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
9. Each candidate must show on demand his / her Admit Card to the Invigilator.
10. No candidate, without special permission of the Superintendent or Invigilator, would leave his / her seat.
11. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. **Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case**.
12. Use of Electronic / Manual Calculator is prohibited.
13. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
14. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
15. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

1. A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F, because the method involves :

   (1) Cells

   (2) Potential gradients

   (3) A condition of no current flow through the galvanometer

   (4) A combination of cells, galvanometer and resistances

Answer (3)

Sol. Reading of potentiometer is accurate because during taking reading it does not draw any current from the circuit.

2. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is

   (1) 4 RT (2) 15 RT

   (3) 9 RT (4) 11 RT

Answer (4)

Sol. $U = n_1\frac{f_1}{2}RT + n_2\frac{f_2}{2}RT$

$= 2\times\frac{5}{2}RT + 4\times\frac{3}{2}RT$

$= 5\,RT + 6\,RT$

$U = 11\,RT$

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

   (1) $\frac{1}{\lambda}$ (2) $\frac{1}{7\lambda}$

   (3) $\frac{1}{8\lambda}$ (4) $\frac{1}{9\lambda}$

Answer (2)

Sol. No option is correct

If we take $\frac{N_A}{N_B} = \frac{1}{e}$

Then

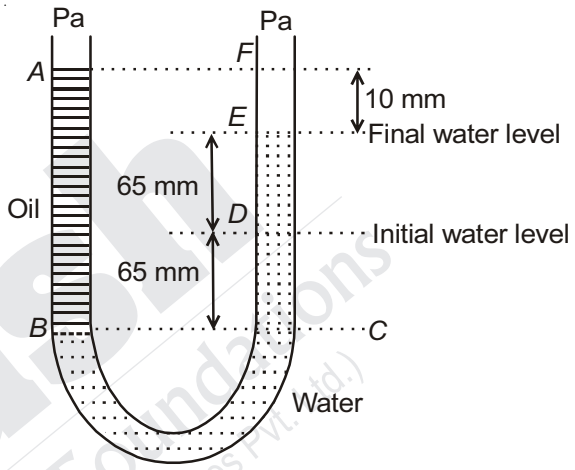
$\frac{N_A}{N_B} = \frac{e^{-8\lambda t}}{e^{-\lambda t}}$

$\frac{1}{e} = e^{-7\lambda t}$

$-1 = -7\lambda t$

$t = \frac{1}{7\lambda}$

4. A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is



   (1) 650 kg m^{-3}

   (2) 425 kg m^{-3}

   (3) 800 kg m^{-3}

   (4) 928 kg m^{-3}

Answer (4)

Sol. $h_{oil}\,\rho_{oil}\,g = h_{water}\,\rho_{water}\,g$

$140 \times \rho_{oil} = 130 \times \rho_{water}$

$\rho_{oil} = \frac{13}{14}\times 1000\ kg/m^3$

$\rho_{oil} = 928\ kg\ m^{-3}$

5. A 250-Turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 μA and subjected to a magnetic field of strength 0.85 T. Work done for rotating the coil by 180° against the torque is

   (1) 9.1 μJ (2) 4.55 μJ

   (3) 2.3 μJ (4) 1.15 μJ

Answer (1)

Sol. $W = MB\,(\cos\theta_1 - \cos\theta_2)$

When it is rotated by angle 180° then

$W = 2MB$

$W = 2(NIA)B$

$= 2 \times 250 \times 85 \times 10^{-6}[1.25 \times 2.1 \times 10^{-4}] \times 85 \times 10^{-2}$

$= 9.1\ \mu J$

6. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is

(1) $\frac{h}{\sqrt{mkT}}$ (2) $\frac{h}{\sqrt{3mkT}}$

(3) $\frac{2h}{\sqrt{3mkT}}$ (4) $\frac{2h}{\sqrt{mkT}}$

Answer (2)

Sol. de-Broglie wavelength

$$\lambda = \frac{h}{mv}$$

$$= \frac{h}{\sqrt{2m(KE)}}$$

$$= \frac{h}{\sqrt{2m(\frac{3}{2}kT)}}$$

$$\lambda = \frac{h}{\sqrt{3mkT}}$$

7. One end of string of length l is connected to a particle of mass 'm' and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed 'v', the net force on the particle (directed towards center) will be (T represents the tension in the string)

(1) T

(2) $T + \frac{mv^2}{l}$

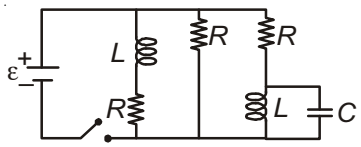
(3) $T - \frac{mv^2}{l}$

(4) Zero

Answer (1)

Sol. Centripetal force $\left(\frac{mv^2}{l}\right)$ is provided by tension so the net force will be equal to tension *i.e.*, T.

8. Figure shows a circuit contains three identical resistors with resistance $R = 9.0\ \Omega$ each, two identical inductors with inductance $L = 2.0$ mH each, and an ideal battery with emf $\varepsilon = 18$ V. The current 'i' through the battery just after the switch closed is



(1) 2 mA

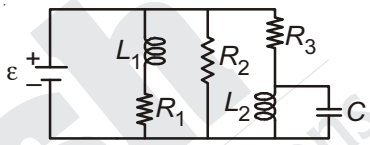
(2) 0.2 A

(3) 2 A

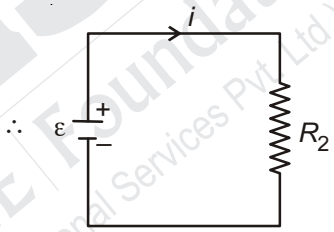
(4) 0 ampere

Answer (3*)

Sol



At $t = 0$, no current flows through R_1 and R_3



$$\therefore \quad i = \frac{\varepsilon}{R_2}$$

$$= \frac{18}{9}$$

$= 2$ A

Note : Not correctly framed but the best option out of given is (3).

9. The x and y coordinates of the particle at any time are $x = 5t - 2t^2$ and $y = 10t$ respectively, where x and y are in meters and t in seconds. The acceleration of the particle at $t = 2$ s is

(1) 0

(2) 5 m/s^2

(3) –4 m/s^2

(4) –8 m/s^2

Answer (3)

Sol. $x = 5t - 2t^2$ $y = 10t$

$\frac{dx}{dt} = 5 - 4t$ $\frac{dy}{dt} = 10$

$v_x = 5 - 4t$ $v_y = 10$

$\frac{dv}{dt}x = -4$ $\frac{dv}{dt}y = 10$

$a_x = -4$ $a_y = 0$

Acceleration of particle at $t = 2$ s is $= -4$ m/s^2

10. Suppose the charge of a proton and an electron differ slightly. One of them is $-e$, the other is $(e + \Delta e)$. If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27}$ kg]

(1) 10^{-20} C

(2) 10^{-23} C

(3) 10^{-37} C

(4) 10^{-47} C

Answer (3)

Sol. $F_e = F_g$

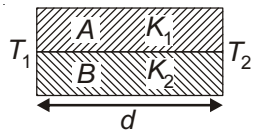
$$\frac{1}{4\pi\varepsilon_0}\frac{\Delta e^2}{d^2} = \frac{Gm^2}{d^2}$$

$$9 \times 10^9 (\Delta e^2) = 6.67 \times 10^{-11} \times 1.67 \times 10^{-27} \times 1.67 \times 10^{-27}$$

$$\Delta e^2 = \frac{6.67 \times 1.67 \times 1.67}{9} \times 10^{-74}$$

$$\Delta e \approx 10^{-37}$$

11. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are K_1 and K_2. The thermal conductivity of the composite rod will be



(1) $\frac{K_1 + K_2}{2}$ (2) $\frac{3(K_1 + K_2)}{2}$

(3) $K_1 + K_2$ (4) $2(K_1 + K_2)$

Answer (1)

Sol. Thermal current

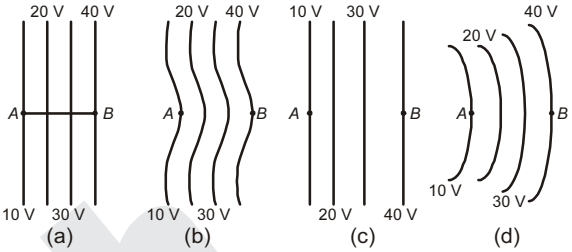
$$H = H_1 + H_2$$

$$= \frac{K_1 A(T_1 - T_2)}{d} + \frac{K_2 A(T_1 - T_2)}{d}$$

$$\frac{K_{EQ} 2A(T_1 - T_2)}{d} = \frac{A(T_1 - T_2)}{d}[K_1 + K_2]$$

$$K_{EQ} = \left[\frac{K_1 + K_2}{2}\right]$$

12. The diagrams below show regions of equipotentials.



A positive charge is moved from A to B in each diagram.

(1) Maximum work is required to move q in figure (c).

(2) In all the four cases the work done is the same.

(3) Minimum work is required to move q in figure (a).

(4) Maximum work is required to move q in figure (b).

Answer (2)

Sol. Work done $w = q\Delta V$

ΔV is same in all the cases so work is done will be same in all the cases.

13. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

(1) 2 (2) 1

(3) 4 (4) 0.5

Answer (3)

Sol. For last Balmer series

$$\frac{1}{\lambda_b} = R\left[\frac{1}{2^2} - \frac{1}{\infty^2}\right]$$

$$\lambda_b = \frac{4}{R}$$

For last Lyman series

$$\frac{1}{\lambda_l} = R\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

$$\lambda_l = \frac{1}{R}$$

$$\frac{\lambda_b}{\lambda_l} = \frac{\frac{4}{R}}{\frac{1}{R}}$$

$$\frac{\lambda_b}{\lambda_l} = 4$$

14. Young's double slit experiment is first performed in air and then in a medium other than air. It is found that 8th bright fringe in the medium lies where 5th dark fringe lies in air. The refractive index of the medium is nearly

(1) 1.25

(2) 1.59

(3) 1.69

(4) 1.78

Answer (4)

Sol. $X_1 = X_{5\text{th dark}} = (2 \times 5 - 1)\frac{\lambda D}{2d}$

$$X_2 = X_{8\text{th bright}} = 8\frac{\lambda D}{\mu d}$$

$$X_1 = X_2$$

$$\frac{9}{2}\frac{\lambda D}{d} = 8\frac{\lambda D}{\mu d}$$

$$\mu = \frac{16}{9} = 1.78$$

15. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in seconds is

(1) $\frac{\sqrt{5}}{\pi}$

(2) $\frac{\sqrt{5}}{2\pi}$

(3) $\frac{4\pi}{\sqrt{5}}$

(4) $\frac{2\pi}{\sqrt{3}}$

Answer (3)

Sol. $v = \omega\sqrt{A^2 - x^2}$

$$a = x\omega^2$$

$$v = a$$

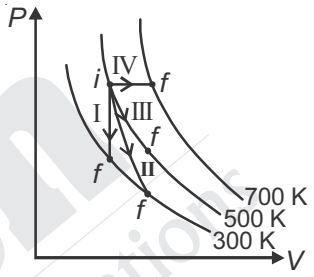
$$\omega\sqrt{A^2 - x^2} = x\omega^2$$

$$\sqrt{(3)^2 - (2)^2} = 2\left(\frac{2\pi}{T}\right)$$

$$\sqrt{5} = \frac{4\pi}{T}$$

$$T = \frac{4\pi}{\sqrt{5}}$$

16. Thermodynamic processes are indicated in the following diagram.



Match the following

	Column-1		Column-2
P.	Process I	a.	Adiabatic
Q.	Process II	b.	Isobaric
R.	Process III	c.	Isochoric
S.	Process IV	d.	Isothermal

(1) P → a, Q → c, R → d, S → b

(2) P → c, Q → a, R → d, S → b

(3) P → c, Q → d, R → b, S → a

(4) P → d, Q → b, R → a, S → c

Answer (2)

Sol. Process I = Isochoric

II = Adiabatic

III = Isothermal

IV = Isobaric

17. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system

(1) Increases by a factor of 4

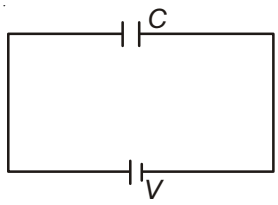
(2) Decreases by a factor of 2

(3) Remains the same

(4) Increases by a factor of 2

Answer (2)

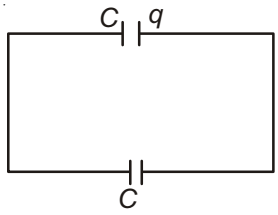
Sol.



Charge on capacitor

$q = CV$

when it is connected with another uncharged capacitor.



$$V_c = \frac{q_1 + q_2}{C_1 + C_2} = \frac{q + 0}{C + C}$$

$$V_c = \frac{V}{2}$$

Initial energy

$$U_i = \frac{1}{2}CV^2$$

Final energy

$$U_f = \frac{1}{2}C\left(\frac{V}{2}\right)^2 + \frac{1}{2}C\left(\frac{V}{2}\right)^2$$

$$= \frac{CV^2}{4}$$

Loss of energy = $U_i - U_f$

$$= \frac{CV^2}{4}$$

i.e. decreases by a factor (2)

18. The photoelectric threshold wavelength of silver is 3250×10^{-10} m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10} m is

(Given $h = 4.14 \times 10^{-15}$ eVs and $c = 3 \times 10^8$ ms^{-1})

(1) $\approx 6 \times 10^5$ ms^{-1}

(2) $\approx 0.6 \times 10^6$ ms^{-1}

(3) $\approx 61 \times 10^3$ ms^{-1}

(4) $\approx 0.3 \times 10^6$ ms^{-1}

Answer (1 & 2)* Both answers are correct.

Sol. $\lambda_0 = 3250 \times 10^{-10}$ m

$\lambda = 2536 \times 10^{-10}$ m

$$\phi = \frac{1242 \text{ eV-nm}}{325 \text{ nm}} = 3.82 \text{ eV}$$

$$h\nu = \frac{1242 \text{ eV-nm}}{253.6 \text{ nm}} = 4.89 \text{ eV}$$

$KE_{max} = (4.89 - 3.82)$ eV $= 1.077$ eV

$$\frac{1}{2}mv^2 = 1.077 \times 1.6 \times 10^{-19}$$

$$v = \sqrt{\frac{2 \times 1.077 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}}$$

$v = 0.6 \times 10^6$ m/s

19. A physical quantity of the dimensions of length that can be formed out of c, G and $\frac{e^2}{4\pi\varepsilon_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge]

(1) $\frac{1}{c^2}\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

(2) $c^2\left[G\frac{e^2}{4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

(3) $\frac{1}{c^2}\left[\frac{e^2}{G4\pi\varepsilon_0}\right]^{\frac{1}{2}}$

(4) $\frac{1}{c}G\frac{e^2}{4\pi\varepsilon_0}$

Answer (1)

Sol. Let $\frac{e^2}{4\pi\varepsilon_0} = A = ML^3T^{-2}$

$l = C^xG^y(A)^z$

$L = [LT^{-1}]^x [M^{-1}L^3T^{-2}]^y [ML^3T^{-2}]^z$

$-y + z = 0 \Rightarrow y = z$ ...(i)

$x + 3y + 3z = 1$ ...(ii)

$-x - 4z = 0$ ...(iii)

From (i), (ii) & (iii)

$$z = y = \frac{1}{2}, \quad x = -2$$

20. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s]

(1) 350 Hz (2) 361 Hz

(3) 411 Hz (4) 448 Hz

Answer (4)

Sol. $f_A = f\left[\frac{v+v_o}{v-v_s}\right]$

$= 400\left[\frac{340+16.5}{340-22}\right]$

f_A = 448 Hz

21. In a common emitter transistor amplifier the audio signal voltage across the collector is 3 V. The resistance of collector is 3 kΩ. If current gain is 100 and the base resistance is 2 kΩ, the voltage and power gain of the amplifier is

(1) 200 and 1000

(2) 15 and 200

(3) 150 and 15000

(4) 20 and 2000

Answer (3)

Sol. Current gain (β) = 100

Voltage gain (A_V) = $\beta\frac{R_c}{R_b}$

$= 100\left(\frac{3}{2}\right)$

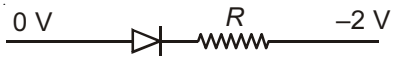
= 150

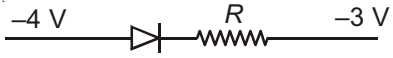
Power gain = A_V β

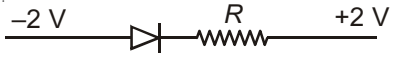
= 150 (100)

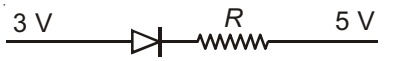
= 15000

22. Which one of the following represents forward bias diode?

(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. In forward bias, *p*-type semiconductor is at higher potential w.r.t. *n*-type semiconductor.

23. A spring of force constant *k* is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constant is *k'*. Then they are connected in parallel and force constant is *k''*. Then *k'* : *k''* is

(1) 1 : 6 (2) 1 : 9

(3) 1 : 11 (4) 1 : 14

Answer (3)

Sol. Spring constant $\propto \frac{1}{\text{length}}$

$k \propto \frac{1}{l}$

i.e, $k_1 = 6k$

$k_2 = 3k$

$k_3 = 2k$

In series

$\frac{1}{k'} = \frac{1}{6k} + \frac{1}{3k} + \frac{1}{2k}$

$\frac{1}{k'} = \frac{6}{6k}$

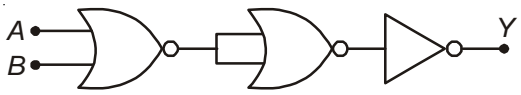
$k' = k$

$k'' = 6k + 3k + 2k$

$k'' = 11k$

$\frac{k'}{k''} = \frac{1}{11}$ i.e $k' : k'' = 1 : 11$

24. The given electrical network is equivalent to



(1) AND gate

(2) OR gate

(3) NOR gate

(4) NOT gate

Answer (3)

Sol. $Y = \overline{A+B}$

25. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth *d* below the surface of earth. Then

(1) $d = \frac{1}{2}$ km (2) d = 1 km

(3) $d = \frac{3}{2}$ km (4) d = 2 km

Answer (4)

Sol. Above earth surface

$g' = g\left(1 - \frac{2h}{R_e}\right)$

$\Delta g' = g\frac{2h}{R_e}$ ...(1)

Below earth surface

$g' = g\left(1 - \frac{d}{R_e}\right)$

$\Delta g = g\frac{d}{R_e}$ ...(2)

From (1) & (2)

$d = 2h$

$d = 2 \times 1$ km

26. Which of the following statements are correct?

(a) Centre of mass of a body always coincides with the centre of gravity of the body.

(b) Centre of mass of a body is the point at which the total gravitational torque on the body is zero

(c) A couple on a body produce both translational and rotational motion in a body.

(d) Mechanical advantage greater than one means that small effort can be used to lift a large load.

(1) (b) and (d) (2) (a) and (b)

(3) (b) and (c) (4) (c) and (d)

Answer (1)

Sol. Centre of mass may or may not coincide with centre of gravity.

27. A Carnot engine having an efficiency of $\frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

(1) 1 J (2) 90 J

(3) 99 J (4) 100 J

Answer (2)

Sol. $\beta = \frac{1-\eta}{\eta}$

$= \frac{1-\frac{1}{10}}{\frac{1}{10}} = \frac{\frac{9}{10}}{\frac{1}{10}}$

$\beta = 9$

$\beta = \frac{Q_2}{W}$

$Q_2 = 9 \times 10 = 90$ J

28. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by

(1) $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

(2) $\tan^2\theta = \tan^2\theta_1 + \tan^2\theta_2$

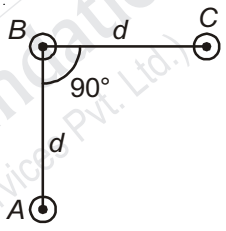
(3) $\cot^2\theta = \cot^2\theta_1 - \cot^2\theta_2$

(4) $\tan^2\theta = \tan^2\theta_1 - \tan^2\theta_2$

Answer (1)

Sol. $\cot^2\theta = \cot^2\theta_1 + \cot^2\theta_2$

29. An arrangement of three parallel straight wires placed perpendicular to plane of paper carrying same current '*I*' along the same direction is shown in Fig. Magnitude of force per unit length on the middle wire '*B*' is given by

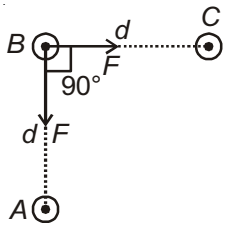


(1) $\frac{\mu_0 I^2}{2\pi d}$ (2) $\frac{2\mu_0 I^2}{\pi d}$

(3) $\frac{\sqrt{2}\mu_0 I^2}{\pi d}$ (4) $\frac{\mu_0 I^2}{\sqrt{2}\pi d}$

Answer (4)

Sol. Force between *BC* and *AB* will be same in magnitude.



$F_{BC} = F_{BA} = \frac{\mu_0 I^2}{2\pi d}$

$F = \sqrt{2}F_{BC}$

$= \sqrt{2}\frac{\mu_0}{2\pi}\frac{I^2}{d}$

$F = \frac{\mu_0 I^2}{\sqrt{2}\pi d}$

30. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will:

(1) Keep floating at the same distance between them

(2) Move towards each other

(3) Move away from each other

(4) Will become stationary

Answer (2)

Sol. Both the astronauts are in the condition of weightness. Gravitational force between them pulls towards each other.

31. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6 V/m. The peak value of the magnetic field is

(1) 1.41×10^{-8} T

(2) 2.83×10^{-8} T

(3) 0.70×10^{-8} T

(4) 4.23×10^{-8} T

Answer (2)

Sol. $\frac{E_{rms}}{B_{rms}} = c$

$B_{rms} = \frac{E_{rms}}{c}$

$= \frac{6}{3\times10^{8}}$

$B_{rms} = 2 \times 10^{-8}$

$B_{rms} = \frac{B_0}{\sqrt{2}}$

$B_0 = \sqrt{2}\times B_{rms}$

$= \sqrt{2}\times2\times10^{-8}$

$= 2.83 \times 10^{-8}$ T

32. The bulk modulus of a spherical object is '*B*'. If it is subjected to uniform pressure '*p*', the fractional decrease in radius is

(1) $\frac{p}{B}$ (2) $\frac{B}{3p}$

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

Answer (4)

Sol. $B = \frac{p}{\left(\frac{\Delta V}{V}\right)}$

$\frac{\Delta V}{V} = \frac{p}{B}$

$3\frac{\Delta r}{r} = \frac{p}{B}$

$\frac{\Delta r}{r} = \frac{p}{3B}$

33. The ratio of resolving powers of an optical microscope for two wavelengths λ_1 = 4000 Å and λ_2 = 6000 Å is

(1) 8 : 27

(2) 9 : 4

(3) 3 : 2

(4) 16 : 81

Answer (3)

Sol. Resolving power $\propto \frac{1}{\lambda}$

$\frac{R_1}{R_2} = \frac{\lambda_2}{\lambda_1}$

$= \frac{6000\ \text{Å}}{4000\ \text{Å}}$

$= \frac{3}{2}$

34. Consider a drop of rain water having mass 1 g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take *g* constant with a value 10 m/s^2. The work done by the (i) gravitational force and the (ii) resistive force of air is

(1) (i) – 10 J (ii) –8.25 J

(2) (i) 1.25 J (ii) –8.25 J

(3) (i) 100 J (ii) 8.75 J

(4) (i) 10 J (ii) –8.75 J

Answer (4)

Sol. $w_g + w_a = K_f - K_i$

$mgh + w_a = \frac{1}{2}mv^2 - 0$

$10^{-3} \times 10 \times 10^3 + w_a = \frac{1}{2}\times10^{-3}\times(50)^2$

w_a = –8.75 J i.e. work done due to air resistance and work done due to gravity = 10 J

35. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be

(1) 225 (2) 450

(3) 1000 (4) 1800

Answer (4)

Sol. Rate of power loss

$r \propto R^2T^4$

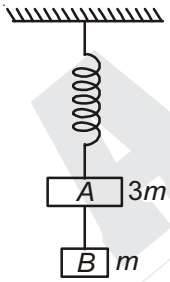
$\frac{r_1}{r_2} = \frac{R_1^2T_1^4}{R_2^2T_2^4}$

$= 4 \times \frac{1}{16}$

$\frac{450}{r_2} = \frac{1}{4}$

r_2 = 1800 watt

36. Two blocks A and B of masses $3m$ and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively



(1) $g, \frac{g}{3}$ (2) $\frac{g}{3}, g$

(3) g, g (4) $\frac{g}{3}, \frac{g}{3}$

Answer (2)

Sol.

Before the string is cut

$kx = T + 3mg$ ...(1)

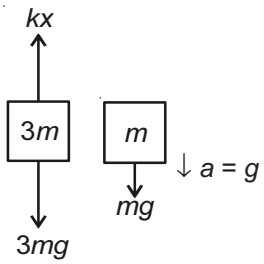
$T = mg$ ...(2)

$\Rightarrow kx = 4mg$

After the string is cut, $T = 0$

$a = \frac{kx - 3mg}{3m}$

$a = \frac{4mg - 3mg}{3m}$



$a = \frac{g}{3} \uparrow$

37. Two Polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45º with that of P_1. The intensity of transmitted light through P_2 is

(1) $\frac{I_0}{2}$

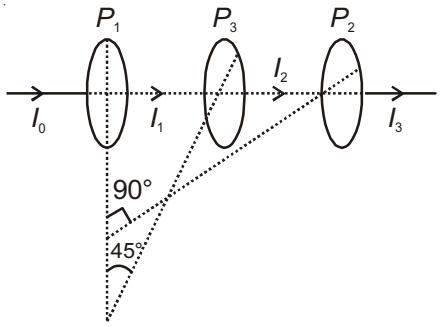
(2) $\frac{I_0}{4}$

(3) $\frac{I_0}{8}$

(4) $\frac{I_0}{16}$

Answer (3)

Sol.



$I_2 = \frac{I_0}{2}\cos^2 45°$

$= \frac{I_0}{2} \times \frac{1}{2}$

$= \frac{I_0}{4}$

$I_3 = \frac{I_0}{4}\cos^2 45°$

$I_3 = \frac{I_0}{8}$

38. A long solenoid of diameter 0.1 m has 2×10^4 turns per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0 A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^2\ \Omega$, the total charge flowing through the coil during this time is

(1) $32\pi\ \mu C$ (2) $16\ \mu C$

(3) $32\ \mu C$ (4) $16\pi\ \mu C$

Answer (3)

Sol. $\varepsilon = -N\frac{d\phi}{dt}$

$\left|\frac{\varepsilon}{R}\right| = \frac{N}{R}\frac{d\phi}{dt}$

$dq = \frac{N}{R}d\phi$

$\Delta Q = \frac{N(\Delta\phi)}{R}$

$\Delta Q = \frac{\Delta\phi_{total}}{R}$

$= \frac{(NBA)}{R}$

$= \frac{\mu_0 ni\pi r^2}{R}$

Putting values

$= \frac{4\pi\times10^{-7}\times100\times4\times\pi\times(0.01)^2}{10\pi^2}$

$\Delta Q = 32\ \mu C$

39. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought into contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is

(1) $\frac{1}{2}I(\omega_1+\omega_2)^2$ (2) $\frac{1}{4}I(\omega_1-\omega_2)^2$

(3) $I(\omega_1-\omega_2)^2$ (4) $\frac{I}{8}(\omega_1-\omega_2)^2$

Answer (2)

Sol. $\Delta KE = \frac{1}{2}\frac{I_1I_2}{I_1+I_2}(\omega_1-\omega_2)^2$

$= \frac{1}{2}\frac{I^2}{(2I)}(\omega_1-\omega_2)^2$

$= \frac{1}{4}I(\omega_1-\omega_2)^2$

40. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be

(1) $\frac{t_1+t_2}{2}$ (2) $\frac{t_1t_2}{t_2-t_1}$

(3) $\frac{t_1t_2}{t_2+t_1}$ (4) t_1-t_2

Answer (3)

Sol. Velocity of girl w.r.t. elevator $= \frac{d}{t_1} = v_{ge}$

Velocity of elevator w.r.t. ground $v_{eG} = \frac{d}{t_2}$ then velocity of girl w.r.t. ground

$\vec{v}_{gG} = \vec{v}_{ge} + \vec{v}_{eG}$

i.e, $v_{gG} = v_{ge} + v_{eG}$

$\frac{d}{t} = \frac{d}{t_1} + \frac{d}{t_2}$

$\frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2}$

$t = \frac{t_1t_2}{(t_1+t_2)}$

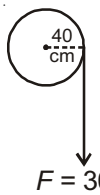
41. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30 N?

(1) $25\ m/s^2$ (2) $0.25\ rad/s^2$

(3) $25\ rad/s^2$ (4) $5\ m/s^2$

Answer (3)

Sol.



$F = 30$ N

$\tau = I\alpha$

$F \times R = MR^2\alpha$

$30 \times 0.4 = 3 \times (0.4)^2\ \alpha$

$12 = 3 \times 0.16\ \alpha$

$400 = 16\ \alpha$

$\alpha = 25$ rad/s^2

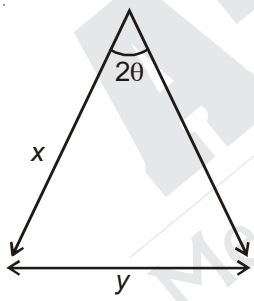
42. A beam of light from a source L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by

(1) $\frac{y}{2x}$ (2) $\frac{y}{x}$

(3) $\frac{x}{2y}$ (4) $\frac{x}{y}$

Answer (1)

Sol. When mirror is rotated by θ angle reflected ray will be rotated by 2θ.



$\frac{y}{x} = 2\theta$

$\theta = \frac{y}{2x}$

43. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(1) 10 Hz (2) 20 Hz

(3) 30 Hz (4) 40 Hz

Answer (2)

Sol. Two successive frequencies of closed pipe

$\frac{nv}{4l} = 220$ ...(i)

$\frac{(n+2)v}{4l} = 260$ ...(ii)

Dividing (ii) by (i), we get

$\frac{n+2}{n} = \frac{260}{220} = \frac{13}{11}$

$11n + 22 = 13n$

$n = 11$

So, $11\frac{v}{4l} = 220$

$\frac{v}{4l} = 20$

So fundamental frequency is 20 Hz.

44. A thin prism having refracting angle 10° is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be

(1) 4° (2) 6°

(3) 8° (4) 10°

Answer (2)

Sol. $(\mu - 1)A + (\mu' - 1)A' = 0$

$|(\mu - 1)A| = |(\mu' - 1)A'|$

$(1.42 - 1) \times 10° = (1.7 - 1)A'$

$4.2 = 0.7A'$

$A' = 6°$

45. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be

(1) nR (2) $\frac{R}{n}$

(3) n^2R (4) $\frac{R}{n^2}$

Answer (3)

Sol. $\frac{R_2}{R_1} = \frac{l_2^2}{l_1^2}$

$= \frac{n^2 l_1^2}{l_1^2}$

$\frac{R_2}{R_1} = n^2$

$R_2 = n^2 R_1$

46. With respect to the conformers of ethane, which of the following statements is true?

(1) Bond angle remains same but bond length changes

(2) Bond angle changes but bond length remains same

(3) Both bond angle and bond length change

(4) Both bond angles and bond length remains same

Answer (4)

Sol. There is no change in bond angles and bond lengths in the conformations of ethane. There is only change in dihedral angle.

47. Which of the following pairs of compounds is isoelectronic and isostructural?

(1) $BeCl_2$, XeF_2 (2) TeI_2, XeF_2

(3) IBr_2^-, XeF_2 (4) IF_3, XeF_2

Answer (3)

Sol. IBr_2^-, XeF_2

Total number of valence electrons are equal in both the species and both the species are linear also.

48. $HgCl_2$ and I_2 both when dissolved in water containing I^- ions the pair of species formed is

(1) HgI_2, I_3^- (2) HgI_2, I^-

(3) HgI_4^{2-}, I_3^- (4) Hg_2I_2, I^-

Answer (3)

Sol. In a solution containing $HgCl_2$, I_2 and I^-, both $HgCl_2$ and I_2 compete for I^-.

Since formation constant of $[HgI_4]^{2-}$ is 1.9×10^{30} which is very large as compared with I_3^- ($K_f = 700$)

$\therefore$ I^- will preferentially combine with $HgCl_2$.

$$HgCl_2 + 2I^- \rightarrow \underset{\text{Red ppt}}{HgI_2\downarrow} + 2Cl^-$$

$$HgI_2 + 2I^- \rightarrow \underset{\text{soluble}}{[HgI_4]^{2-}}$$

49. Mixture of chloroxylenol and terpineol acts as

(1) Analgesic (2) Antiseptic

(3) Antipyretic (4) Antibiotic

Answer (2)

Sol. Mixture of chloroxylenol and terpineol acts as antiseptic.

50. Which is the incorrect statement?

(1) $FeO_{0.98}$ has non stoichiometric metal deficiency defect

(2) Density decreases in case of crystals with Schottky's defect

(3) NaCl(s) is insulator, silicon is semiconductor, silver is conductor, quartz is piezo electric crystal

(4) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal

Answer (1 & 4)

Sol. Frenkel defect occurs in those ionic compounds in which size of cation and anion is largely different.

Non-stoichiometric ferrous oxide is $Fe_{0.93-0.96}O_{1.00}$ and it is due to metal deficiency defect.

51 Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}. Solubility product of $Ag_2C_2O_4$ is

(1) 2.42×10^{-8} (2) 2.66×10^{-12}

(3) 4.5×10^{-11} (4) 5.3×10^{-12}

Answer (4)

Sol. $Ag_2C_2O_4(s) \rightleftharpoons \underset{2s}{2Ag^+(aq)} + \underset{s}{C_2O_4^{2-}(aq)}$

$K_{SP} = [Ag^+]^2 [C_2O_4^{2-}]$

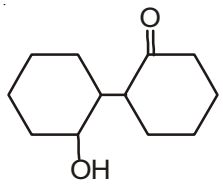
$[Ag^+] = 2.2 \times 10^{-4}$ M

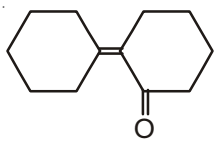
$$\therefore \quad [C_2O_4^{2-}] = \frac{2.2\times10^{-4}}{2}M = 1.1\times10^{-4}M$$

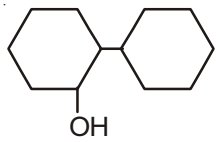
$\therefore$ $K_{SP} = (2.2 \times 10^{-4})^2 (1.1 \times 10^{-4})$

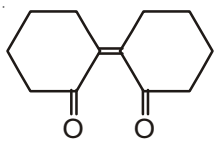
$= 5.324 \times 10^{-12}$

52. Of the following, which is the product formed when cyclohexanone undergoes aldol condensation followed by heating?

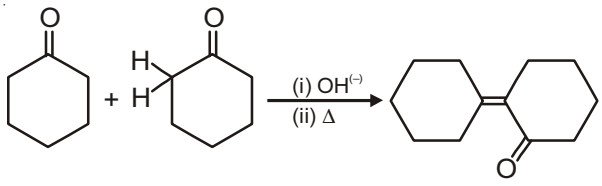
(1) 

(2) 

(3) 

(4) 

Answer (2)

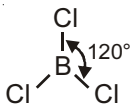
Sol. 

53. The species, having bond angles of 120° is

(1) PH_3 (2) ClF_3

(3) NCl_3 (4) BCl_3

Answer (4)

Sol. 

54. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be

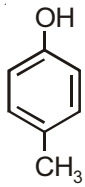
(1) Doubled (2) Halved

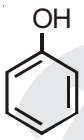
(3) Tripled (4) Unchanged

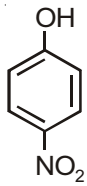
Answer (4)

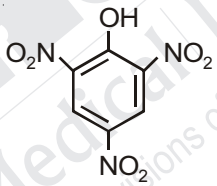
Sol. K_f (molal depression constant) is a characteristic of solvent and is independent of molality.

55. Which one is the most acidic compound?

(1) 

(2) 

(3) 

(4) 

Answer (4)

Sol. $-NO_2$ group has very strong –I & –R effects.

56. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that

(1) Sn^{2+} is reducing while Pb^{4+} is oxidising

(2) Sn^{2+} is oxidising while Pb^{4+} is reducing

(3) Sn^{2+} and Pb^{2+} are both oxidising and reducing

(4) Sn^{4+} is reducing while Pb^{4+} is oxidising

Answer (1)

Sol. Inability of *ns*^{2} electrons of the valence shell to participate in bonding on moving down the group in heavier p-block elements is called **inert pair effect**

As a result, Pb(II) is more stable than Pb(IV)

Sn(IV) is more stable than Sn(II)

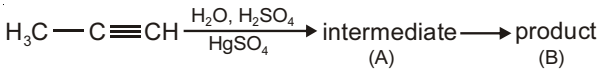
$\therefore$ Pb(IV) is easily reduced to Pb(II)

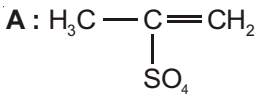
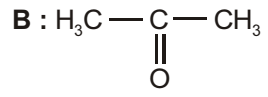
$\therefore$ Pb(IV) is oxidising agent

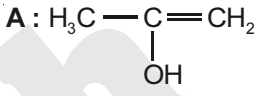
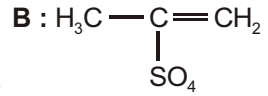
Sn(II) is easily oxidised to Sn(IV)

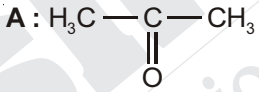
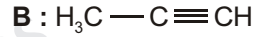
$\therefore$ Sn(II) is reducing agent

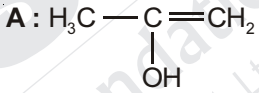
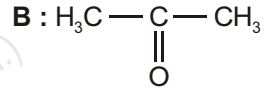
57. Predict the correct intermediate and product in the following reaction



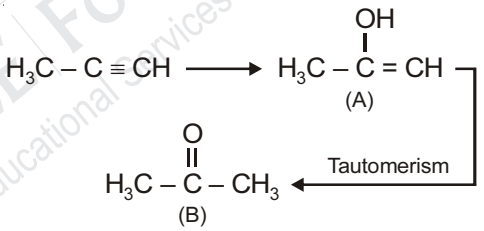
(1) **A :**  **B :** 

(2) **A :**  **B :** 

(3) **A :**  **B :** 

(4) **A :**  **B :** 

Answer (4)

Sol. 

58. Which one of the following statements is not correct?

(1) Catalyst does not initiate any reaction

(2) The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium

(3) Enzymes catalyse mainly bio-chemical reactions

(4) Coenzymes increase the catalytic activity of enzyme

Answer (2)

Sol. A catalyst decreases activation energies of both the forward and backward reaction by same amount, therefore, it speeds up both forward and backward reaction by same rate.

Equilibrium constant is therefore not affected by catalyst at a given temperature.

59. Which one is the wrong statement?

(1) de-Broglie's wavelength is given by $\lambda = \frac{h}{mv}$, where m = mass of the particle, v = group velocity of the particle

(2) The uncertainty principle is $\Delta E \times \Delta t \geq \frac{h}{4\pi}$

(3) Half-filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement

(4) The energy of 2*s* orbital is less than the energy of 2*p* orbital in case of Hydrogen like atoms

Answer (4)

Sol. Energy of 2*s*-orbital and 2*p*-orbital in case of hydrogen like atoms is equal.

60. A gas is allowed to expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be

(1) 1136.25 J

(2) –500 J

(3) –505 J

(4) +505 J

Answer (3)

Sol. $\Delta U = q + w$

For adiabatic process, q = 0

$\therefore \quad \Delta U = w$

$= -P \cdot \Delta V$

$= -2.5 \text{ atm} \times (4.5 - 2.5) \text{ L}$

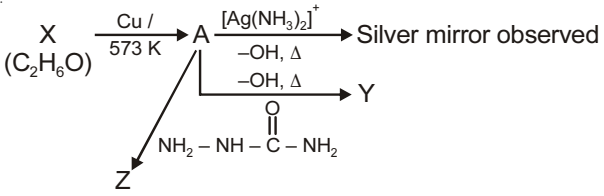
$= -2.5 \times 2 \text{ L-atm}$

$= -5 \times 101.3 \text{ J}$

$= -506.5 \text{ J}$

$\approx -505 \text{ J}$

61. Consider the reactions :



Identify A, X, Y and Z

(1) A-Methoxymethane, X-Ethanoic acid, Y-Acetate ion, Z-hydrazine

(2) A-Methoxymethane, X-Ethanol, Y-Ethanoic acid, Z-Semicarbazide

(3) A-Ethanal, X-Ethanol, Y-But-2-enal, Z-Semicarbazone

(4) A-Ethanol, X-Acetaldehyde, Y-Butanone, Z-Hydrazone

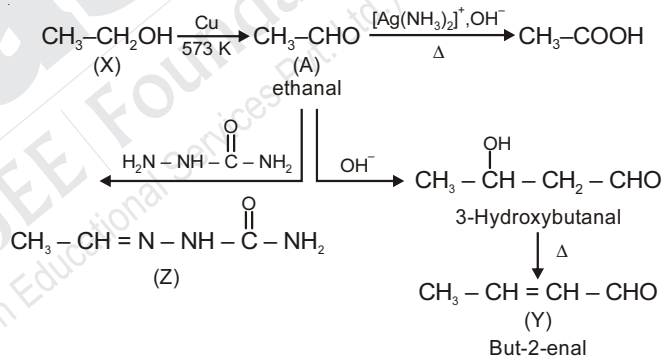
Answer (3)

Sol. Since 'A' gives positive silver mirror test therefore, it must be an aldehyde or α-Hydroxyketone.

Reaction with semicarbazide indicates that A can be an aldehyde or ketone.

Reaction with OH^- i.e., aldol condensation (by assuming alkali to be dilute) indicates that A is aldehyde as aldol reaction of ketones is reversible and carried out in special apparatus.

These indicates option (3).



62. Which one is the **correct** order of acidity?

(1) $CH_2 = CH_2 > CH_3 - CH = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$

(2) $CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$

(3) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH > CH_3 - CH_3$

(4) $CH_3 - CH_3 > CH_2 = CH_2 > CH_3 - C \equiv CH > CH \equiv CH$

Answer (2)

Sol. Correct order is

$$\underset{\text{(Two acidic hydrogens)}}{H-C\equiv C-H} > \underset{\text{(One acidic hydrogen)}}{H_3C-C\equiv C-H} > H_2C = CH_2 > CH_3 - CH_3$$