ANSWER KEY & SOLUTIONS
TO
MHT – CET MOCK
(Physics, Chemistry & Biology)

शिव सेना
उद्धव बाळासाहेब ठाकरे

ANSWER KEY & SOLUTIONS
TO
MHT - CET MOCK TEST - 2025

Subjects : Physics, Chemistry & Biology

1. Answer key is provided to all the questions.
2. Solutions are provided below the Answer Key, wherever needed.

1. (B)
According to Kirchhoff's law,
$I_{CD} = I_2 + I_3$

2. (A)
$F = W = 90\text{ N} = \frac{GMm}{R^2}$

$F' = \frac{GMm}{(r')^2}$

$r' = \frac{3R}{4} + R = \frac{7R}{4}$

$F' = \frac{GMm}{\left(\frac{7R}{4}\right)^2}$

$F' = \frac{16}{49} \times \frac{GMm}{R^2}$

$F' = \frac{16}{49} \times 90$

$F' \approx 29.4\text{N}$
Option with closest answer is (A).

3. (D)
Here, $A_1 = 27$, $r_1 = 3.6$ fermi, $A_2 = 125$
Since, $R = R_0 A^{1/3}$
∴ $R \propto A^{1/3}$

∴ $\frac{R_2}{R_1} = \left(\frac{A_2}{A_1}\right)^{1/3} = \left(\frac{125}{27}\right)^{1/3} = \frac{5}{3}$

$R_2 = \frac{5}{3} R_1 = \frac{5}{3} \times 3.6 = 6.0$ fermi

4. (B)
The induced current in a solenoid is governed by Lenz's Law. Lenz's Law states that the induced current will flow in a direction that opposes the change in magnetic flux that caused it. When the current through the solenoid increases, the magnetic field inside the solenoid also increases. This increasing magnetic field is the change in magnetic flux that Lenz's Law responds to. To oppose this increase in magnetic field, the induced current will create a magnetic field in the opposite direction. This means the induced current will flow opposite to the direction of the inducing current. Therefore, the correct answer is: is constant and is opposite to the direction of the inducing current.

5. (D)
$v_x = v_0 \cos\theta$ (remains constant)

$v_y = v_0 \sin\theta - g\,t$

At the instant when the velocity makes an angle of 30°,

$\tan(30°) = \frac{v_y}{v_x}$

∴ $v_y = \frac{v_x}{\sqrt{3}}$

$v^2 = v_x^2 + v_y^2 = \left(\frac{v_0}{2}\right)^2$

Since $v_y = \frac{v_x}{\sqrt{3}}$

$\frac{4}{3}v_x^2 = \frac{v_0^2}{4}$

$(v_0 \cos\theta)^2 = \frac{3v_0^2}{16}$ ...(Since $v_x = v_0 \cos\theta$)

$\cos\theta = \frac{\sqrt{3}}{4}$

6. (C)

Using, $\frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^\gamma \Rightarrow \frac{P'}{P} = (8)^{5/2}$

∴ $P' = P \times (2)^{15/2}$

7. (C)

Here, $\omega_1 = 2\pi n_1 = 480\ \pi$, $n_1 = 240$ Hz

∴ $\omega_2 = 2\pi n_2 = 490\ \pi$, $n_2 = 245$ Hz

No. of beats / s = $n_2 - n_1 = 245 - 240 = 5$ Hz

No. of beats / minute = $5 \times 60 = 300$

8. (D)

Number of revolutions completed by the electron in one second, $n = \frac{v}{2\pi r}$

Also, current, $I = nq = \frac{v}{2\pi r} q$

Now, magnetic field,

$B = \frac{\mu_0 I}{2r} = \frac{\mu_0}{2r} \times \frac{v}{2\pi r} q = \frac{\mu_0 vq}{4\pi r^2} = \frac{4\pi \times 10^{-7} \times 1.2 \times 10^6 \times 1.6 \times 10^{-19}}{4\pi\left(4 \times 10^{-11}\right)^2} = 12\ T$

9. (A)

Solar cells work on the principle of the photovoltaic effect. This effect involves the creation of electron-hole pairs when light falls on a semiconductor material. When photons of light strike the material, they excite electrons, causing them to jump to a higher energy level, leaving behind a hole in their previous position. This separation of charges creates an electric current.

10. (C)

$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto g^{1/2}$

∴ $dt \propto -\frac{1}{2}g^{-1/2}$

∴ $\frac{dT}{T} = -\frac{1}{2}\frac{dg}{g} = -\frac{1}{2} \times (4\%) = -2\%$

∴ As acceleration due to gravity decreases, the time period decreases.

11. (C)

According to Bernoulli's principle,

$P = \frac{F}{A} = \frac{1}{2}\rho v^2$

$\Rightarrow F = \frac{1}{2}\rho v^2 A = \frac{1}{2} \times 1.2 \times (30)^2 \times 500 = 2.7 \times 10^5$ N

Also, net force acting on the roof is upward.

12. (C)
Comparing the given equation with standard equation $y = A \sin(\omega t - kx)$ we get,

$$\frac{2\pi}{\lambda} = 0.01\,\pi \Rightarrow \lambda = 200 \text{ m}$$

$$\text{Phase difference} = \frac{2\pi}{\lambda} \times (\text{Path difference})$$

$$= \frac{2\pi}{200} \times 50 = \frac{\pi}{2}$$

If the wave enters a new medium where its speed increases by 50%, and the frequency remains constant, the new wavelength is:
$\lambda' = 1.5 \text{ x } \lambda = 1.5 \text{ x } 200 = 300$ m
The new phase difference is:
$\Delta\varphi' = (2\pi / \lambda') \text{ x } \Delta x = (2\pi / 300) \text{ x } 50 = \pi/3$
Comparing the phase differences:
$\Delta\varphi' / \Delta\varphi = (\pi/3) / (\pi/2) = 2/3$
Thus, the phase difference decreases by 33.3%.

13. (D)
Using the principle of conservation of energy:
The potential energy stored in the compressed spring is given by: $PE_{spring} = \frac{1}{2}ks^2$
When the ball reaches height h, all the spring's potential energy is converted into kinetic energy,

$$K.E. = \frac{1}{2}mv^2$$

By energy conservation:

$$\frac{1}{2}ks^2 = \frac{1}{2}mv^2$$

$$s^2 = \frac{mv^2}{k}$$

$$s = v\sqrt{\frac{m}{k}}$$

14. (D)
Orbital speed (v) $\propto \frac{1}{\sqrt{r}}$
Angular Momentum (L) $\propto$ vr
∴ $L \propto \sqrt{r}$
Orbital periods (T) $\propto r^{\frac{3}{2}}$
Gravitational Force (F) $\propto \frac{1}{r^2}$
Hence, the correct option will be (D) The ratio of their gravitational forces will be 9 : 1

15. (D)

$$e = \frac{MdI}{dt}$$

$$e = M\frac{d}{dt}(I_m \sin \omega t)$$

Now, $\frac{d}{dt}(I_m \sin \omega t) = I_m\omega \cos \omega t$

For maximum value of emf, $\frac{dI}{dt}$ is maximum

$\Rightarrow \cos \omega t = 1$

$\therefore \quad \frac{dI}{dt} = I_m\omega$

$\therefore \quad e = 0.005 \times 10 \times 100\,\pi = 5\pi$

16. (B)
As diamagnetic material repels the external magnetic field, the level of liquid in that arm will fall.

17. (A)
$F = T \times (2\pi r_1 + 2\pi r_2)$
$= T \times 2\pi \times (1.75 + 2.25) \times 10^{-2}$
$= 0.074 \times 2 \times 3.14 \times 4 \times 10^{-2}$
$= 1.86 \times 10^{-2}$ N

18. (D)
The given circuit is a balanced Wheatstone's bridge circuit. Hence potential difference between A and B is zero.

19. (C)
$\phi = nAB \cos \theta$
Now, $\vec{B}$ is perpendicular to coil $\Rightarrow \theta = 0°$

$\therefore \quad \phi = nAB$

$\therefore \quad e = \frac{d\phi}{dt} = nA\frac{dB}{dt}$
$= 20 \times 25 \times 10^{-4} \times 1000$
$= 50$ V

Current in the coil is,

$I = \frac{e}{R} = \frac{50}{100} = 0.5$ A

20. (D)
Work done = Energy stored in condenser

$\therefore \quad mgh = \frac{1}{2}CV^2$

$\therefore \quad h = \frac{CV^2}{2mg} = \frac{10\times10^{-6}\times(6\times10^3)^2}{2\times10\times10^{-3}\times10} = 1800$ m

21. (B)

22. (D)
The ratio of specific heats for an ideal gas is given by: $\gamma = \frac{C_P}{C_v}$ Where: C_p is the specific heat capacity at constant pressure C_v is the specific heat capacity at constant volume For an ideal gas, the relationship between specific heat capacities and degrees of freedom (n) is: $C_P = C_v + R$ $C_v = \frac{nR}{2}$ Substituting these values into the formula for γ, we get: $\gamma = \frac{C_v + R}{C_v} = 1 + \frac{R}{C_v}\gamma = 1 + \frac{R}{\frac{nR}{2}}\gamma = 1 + \frac{2}{n}$ Therefore, the ratio of specific heats for a gas with n degrees of freedom is 1 + 2/n.

23. (A)
The quality factor of series resonant circuit is also defined as the ratio of voltage drop across capacitor or inductor to the voltage drop across the resistor.

i.e., $Q = \frac{\omega_r L}{R}$ where, ω_r = resonant frequency.

$$\omega_r = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{9\times100\times10^{-6}}} = \frac{100}{3}\text{ rad/s}$$

∴ $Q = \frac{100}{3}\times\frac{9}{10} = 30$

24. (C)
In single slit diffraction, for small angle,
$d\theta = 2n\frac{\lambda}{2}$ is the condition for minimum.

$$d = \frac{n\lambda}{\theta} = \frac{1\times698\times10^{-9}}{\left(2^{\circ}\times\frac{\pi}{180}\right)^{c}}$$

∴ $d = 2\times10^{-5}$ m
∴ $d = 0.02$ mm

25. (B)
Acceleration, $a = \omega^2 x$

$\omega = \sqrt{\frac{a}{x}} = \sqrt{\frac{20}{5}}$ ….($\because$ a = 20 m/s^2, x = 5 m)

$\omega = 2$ rad/s

Period, $T = \frac{2\pi}{\omega} = \pi$ s

26. (C)
From Wien's displacement law-
$\lambda_{max}T$ = constant
If T is also same, λ_{max} = constant
Hence, $\lambda'_{max} = \lambda''_{max}$

27. (C)
The work done in breaking a big drop of liquid of radius R into small n droplets of equal radius r is $W = 4\pi R^2 T(n^{1/3} - 1)$

28. (D)
Given AB = AC = 2a
$V_D = V_E$ ….($\because$ D and E are mid-points)
∴ The work done in taking a charge q from D to E is
$W = q\Delta V = q(V_D - V_E)$
∴ $W = 0$ ….(Equipotential surfaces)

29. (D)
Using Einstein photoelectric equation,
$E = \phi_0 + K.E_{max}$

$hf_1 = \phi_0 + \frac{1}{2}mv_1^2$ ….(i)

$hf_2 = \phi_0 + \frac{1}{2}mv_2^2$ ….(ii)

$hf_3 = \phi_0 + \frac{1}{2}mv_3^2$ ….(iii)

Subtracting equation (ii) from equation (i) we get,

$h(f_1 - f_2) = \frac{1}{2}m\left(v_1^2 - v_2^2\right)$

$\therefore \quad \left(v_1^2 - v_2^2\right) = \frac{2h}{m}(f_1 - f_2)$

Also,
Subtracting equation (iii) from equation (i) we get,

$h(f_1 - f_3) = \frac{1}{2}m\left(v_1^2 - v_3^2\right)$

$\therefore \quad \left(v_1^2 - v_3^2\right) = \frac{2h}{m}(f_1 - f_3)$

30. (D)

31. (D)

Let I_0 be the intensity of unpolarised light. The intensity transmitted by the first sheet is $\frac{I_0}{2}$.

$\Rightarrow$ Transmitted intensity $= \left(I_0 - \frac{I_0}{2}\right) = \frac{I_0}{2}$.

This will be the intensity of incident light on the second polaroid. The intensity transmitted by the second polaroid will be $\left(\frac{I_0}{2}\right)\cos^2\theta$

where θ is the angle between their axes

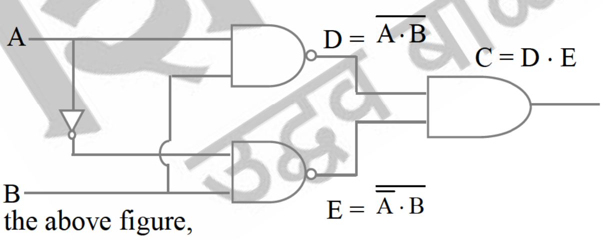
$\sin\theta = \frac{9}{15}$

$\therefore \quad \cos\theta = \frac{12}{15}$ ....[$\because 1 - \sin^2\theta = \cos^2\theta$]

$\therefore \quad \left(\frac{I_0}{2}\right)\cos^2\theta = \left(\frac{I_0}{2}\right)\left(\frac{12}{15}\right)^2 = \frac{8}{25}I_0$

Ratio of intensity of emergent light to that of unpolarised light $= \frac{8}{25}$

32. (A)



From the above figure,

$C = D\cdot E = \left(\overline{A\cdot B}\right)\cdot\left(\overline{\overline{A}\cdot B}\right)$

$\therefore$ Truth table can be given as,

A	$\overline{A}$	B	$D = \left(\overline{A\cdot B}\right)$	$E = \left(\overline{\overline{A}\cdot B}\right)$	$C = D\cdot E$
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	0	1	0

33. (C)

For an isothermal process,

dU = 0 and work done = dW = P $(V_2 - V_1)$

As volume decreases, the work done by the gas is negative.

34. (A)

$$\frac{t_f - 32}{180} = \frac{t_k - 273.15}{100}$$

Since $t_f = t_k$

$$\frac{t_f - 32}{18} = \frac{t_f - 273.15}{10}$$

$10t_f - 320 = 18t_f - 4916.7$

$t_f = 4596.7$

$\therefore$ $t_f = 574.58$ °F

35. (D)

For any charged particle, de-Broglie wavelength is,

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$\therefore \quad \lambda_2 = \frac{h}{\sqrt{2(2m)(2E)}}$$

$$\therefore \quad \lambda_2 = \frac{h}{2\times\sqrt{2mE}} = \frac{\lambda}{2}$$

36. (D)

According to Kepler's law $T^2 \propto R^3$

If n is the frequency of revolution then

$n^2 \propto (R)^{-3}$

$$\therefore \quad \frac{n_2}{n_1} = \left(\frac{R_2}{R_1}\right)^{-3/2} \Rightarrow \frac{R_1}{R_2} = \left(\frac{n_2}{n_1}\right)^{2/3}$$

37. (D)

Axis of I_1 and I_2 and that of I_3 and I_4 are perpendicular to each other.

By theorem of perpendicular axis,

$I = I_1 + I_2$ or $I = I_3 + I_4$ …(i)

As it is a square,

$I_1 = I_2$ and $I_3 = I_4$

From (i),

$$I_1 = I_2 = \frac{I}{2}$$

$$I_3 = I_4 = \frac{I}{2}$$

$\therefore$ $I_3 = I_1$

$\therefore$ Moment of inertia of the plate $= I = I_1 + I_3$

38. (A)

As the current i leads the voltage by $\frac{\pi}{4}$, it is an RC circuit $\Rightarrow \tan\phi = \frac{X_C}{R}$

$$\therefore \quad \tan\frac{\pi}{4} = \frac{1}{\omega CR}$$

$\therefore$ $\omega CR = 1$

Given that, $\omega = 100$ rad/s

$$\therefore \quad CR = \frac{1}{100}\ s^{-1}$$

$\therefore$ From all the given options, only option (A) is correct.

39. (C)

The equation of state is, PV = nRT

Initial conditions: P_0, V_0, T_0, and n moles of gas

New conditions: $2P_0$, $4V_0$, T′, and 4n moles of gas

$(2P_0)(4V_0) = (4n)\, R\, T'$

$2P_0 V_0 = n R T'$

We know, $P_0 V_0 = n R T_0$

∴ $2P_0 V_0 = (P_0 V_0 / T_0)\, T'$

Thus, $T' = 2T_0$

40. (C)

Reading of ammeter shows the current in the circuit.

Current is given by, I = V/R

$I = \dfrac{V - V_{diode}}{R}$

For silicon diode, $V_{diode} = 0.7$ V

∴ $I = \dfrac{5 - 0.7}{200} = \dfrac{4.3}{200} = 21.5$ mA

41. (C)

Since both waves have same intensity I_0,

∴ $I_1 = I_2 = I_0$

$I_{max} = \left(\sqrt{I_0} + \sqrt{I_0}\right)^2 = \left(2\sqrt{I_0}\right)^2 = 4\, I_0$

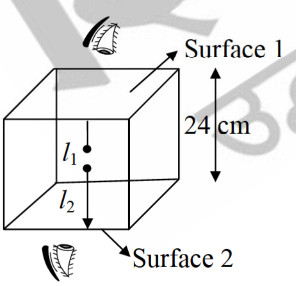
$I_{min} = \left(\sqrt{I_0} - \sqrt{I_0}\right)^2 = 0$

∴ $I_{avg} = \dfrac{I_{max} + I_{min}}{2} = \dfrac{4I_0 + 0}{2}$

∴ $I_{avg} = 2I_0$

42. (A)

Given: Length of cube = 12 cm



$\mu = \dfrac{\text{Real depth}}{\text{Apparent depth}} = \dfrac{l_1}{h_1} = \dfrac{24 - l_1}{h_2}$

putting $h_1 = 10$ cm and $h_2 = 6$ cm into (i), we get

$\dfrac{l_1}{10} = \dfrac{24 - l_1}{6}$

$6l_1 = 240 - 10l_1$

$16l_1 = 240$

∴ $l_1 = 15$ cm

43. (C)

$$P = \frac{V_{rms}^2}{Z}\cos\phi = \frac{V_{rms}^2}{Z}\left(\frac{R}{Z}\right)$$

$$P = \frac{V_0^2}{2}\frac{R}{Z^2} \quad \text{....(i)}$$

Given $V_0 = 10$ V; $\omega = 340$ rad/s; L = 20 mH; C = 50 μF; R = 40 Ω

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$\therefore \quad P = \frac{(10)^2}{2} \times (40) \times \frac{1}{\left[(40)^2 + \left(340 \times 20 \times 10^{-3} - \frac{1}{340 \times 50 \times 10^{-6}}\right)^2\right]}$$

$$= \frac{2000}{1600 + [6.8 - 58.8]^2} = \frac{2000}{1600 + [2704]}$$

$$= \frac{2000}{4304} \approx 0.46 \text{ W} = 0.51 \text{ W}$$

44. (D)

When multiple lenses are kept in contact, the total magnification is the product of individual magnifications. Therefore, the correct formula is: $m = m_1 \times m_2 \times m_3$ ...

45. (C)

Moment of inertia of complete disc about O is $I = \frac{1}{2}MR^2$.

Mass of the cut - out part is $m = \left(\frac{M}{4}\right)$.

The moment of inertia of the cut-out portion about its own centre,

$$I_0 = \frac{1}{2}mr^2 = \frac{1}{2}\left(\frac{M}{4}\right)\left(\frac{R}{2}\right)^2 = \frac{1}{32}MR^2$$

because r = R/2.

From the parallel axes theorem, the moment of inertia of the cut out portion about O is

$$I_c = I_0 + mr^2 = \frac{1}{32}MR^2 + \left(\frac{M}{4}\right)\left(\frac{R}{2}\right)^2 = \frac{3}{32}MR^2$$

∴ Moment of inertia of the shaded portion about O is

$$I_s = I - I_c$$

$$= \frac{1}{2}MR^2 - \frac{3}{32}MR^2 = \frac{13}{32}MR^2$$

46. (D)

If the energy radiated in the transition be E,
then we have,

$$E_{R\to G} > E_{Q\to S} > E_{R\to S} > E_{Q\to R} > E_{P\to Q}$$

For getting blue line, the energy radiated should be maximum $\left(\because E \propto \frac{1}{\lambda}\right)$

47. (D)

Initial energy of the system,

$$U_i = \frac{1}{2}CV_1^2 + \frac{1}{2}CV_2^2 = \frac{1}{2}C\left(V_1^2 + V_2^2\right)$$

When the capacitors are joined, common potential, $V = \frac{CV_1 + CV_2}{2C} = \frac{V_1 + V_2}{2}$

∴ Final energy of the system,

$$U_f = \frac{1}{2}(2C)V^2 = \frac{1}{2}2C\left(\frac{V_1+V_2}{2}\right)^2$$

$$= \frac{1}{4}C(V_1 + V_2)^2$$

∴ Decrease in energy = $U_i - U_f$

$$= \frac{1}{4}C(V_1 - V_2)^2$$

48. (C)

$P_1V_1 = P_2V_2$

$$\Rightarrow (P_0 + h\rho g) \times \frac{4}{3}\pi r^3 = P_0 \times \frac{4}{3}\pi(2r)^3$$

Where, h = depth of lake

$$\Rightarrow h\rho g = 7P_0 \Rightarrow h = 7 \times \frac{H\rho g}{\rho g} = 7H$$

49. (D)

Time period of a simple pendulum

$$T = 2\pi\sqrt{\frac{L}{g}} \quad \ldots(i)$$

For simple pendulum of length L_1, $T_1 = 2\pi\sqrt{\frac{L_1}{g}}$

Similarly For simple pendulum of length L_2,

$$T_2 = 2\pi\sqrt{\frac{L_2}{g}}$$

Solving for L_1 and L_2, we get

$$L_1 = \frac{T_1^2 . g}{4\pi^2} \text{ and } L_2 = \frac{T_2^2 . g}{4\pi^2}$$

∴ $L_1 - L_2 = \left(T_1^2 - T_2^2\right)\frac{g}{4\pi^2}$

∴ $\sqrt{L_1 - L_2} = \sqrt{T_1^2 - T_2^2}\,\frac{\sqrt{g}}{2\pi}$

∴ $\sqrt{T_1^2 - T_2^2} = \frac{2\pi\sqrt{L_1 - L_2}}{\sqrt{g}}$

Comparing the above equation with equation (i),

We get $T = \sqrt{T_1^2 - T_2^2}$

50. (D)

Suppose n_p = frequency of piano

n_f = Frequency of tuning fork = 256 Hz

x = Beat frequency = 5 b.p.s., which is decreasing after changing the tension of piano wire.

Now, $n_p \propto \sqrt{T}$

Also, tension of piano wire is increasing so n_p increases.

Hence, if $n_p > n_f$ then beat frequency increases with increase in tension, which contradicts the given data.

∴ $n_f > n_{ps}$

$\Rightarrow n_P = n_f - x = 256 - 5$ Hz.

51. (B)

$$t_{1/2} = \frac{[A]_0}{2k}$$

$$= \frac{0.74\ M}{2 \times 3.7 \times 10^{-4}\ M\ s^{-1}} = \frac{0.37}{3.7 \times 10^{-4}\ s^{-1}}$$

$= 0.1 \times 10^4$ s

= 1000 seconds = 16.67 min

52. (A)

53. (A)

$$\Delta T_f = \frac{1000\ K_f W_2}{M_2 W_1}$$

$$= \frac{1000\ g\ kg^{-1} \times 5.12\ K\ kg\ mol^{-1} \times 5\ g}{50\ g\ mol^{-1} \times 250\ g} = 2.048\ K$$

$\Delta T_f = T_f^0 - T_f$

∴ $T_f = T_f^0 - \Delta T_f$

T_f = 278.4 K – 2.048 K = 276.352 K

54. (B)

The ionization of NH_4OH can be suppressed by NH_4Cl which contains a common NH_4^+ ion.

55. (C)

56. (C)

$CH_3CH_2\overset{\alpha}{C}H(CH_3) - CHO$

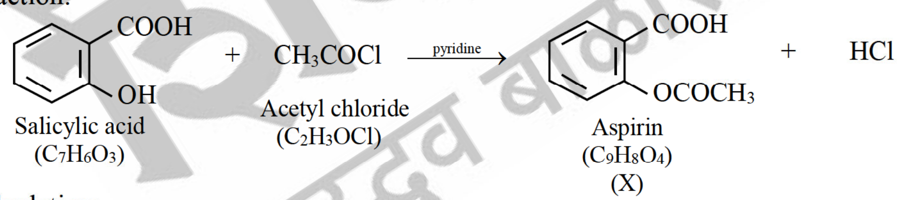
2-Methylbutanal

or

α-Methylbutyraldehyde

57. (C)

Reaction:



Calculation:

% atom economy

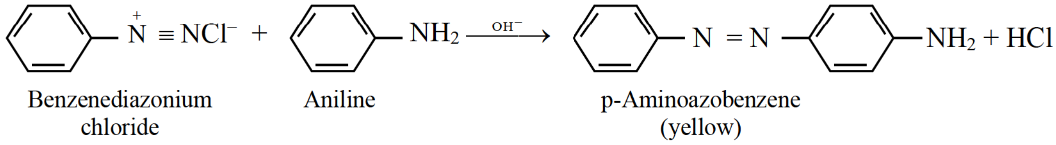
$$= \frac{\text{Formula weight of the desired product}}{\text{Sum of formula weight of all the reactants used in the reaction}} \times 100$$

% atom economy

$$= \frac{\text{mass of } (9C + 8H + 4O) \text{ atoms}}{\text{mass of } (7C + 6H + 3O) + (2C + 3H + 1O + 1Cl) \text{ atoms}} \times 100$$

$$= \frac{180}{216.5} \times 100$$

58. (D)

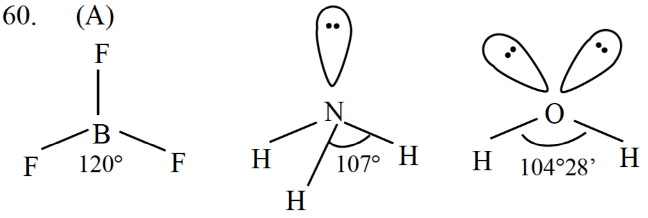


59. (D)

For Group 16 elements:

Acidic character: increases down the group as the bond dissociation enthalpy decreases.
Thermal stability: decreases down the group as the bond strength decreases.
Boiling point: increases down the group as the molecular size and van der Waals forces increase.
Reducing property: increases down the group as the bond dissociation enthalpy decreases, making it easier to lose electrons.

60. (A)



BF_3 NH_3 H_2O

61. (C)

62. (D)

63. (A)

Ratio of rates is equal to the ratio of rate constants.

$$\therefore \quad \frac{\text{Rate}_2 \text{ at } 500\,\text{K}}{\text{Rate}_1 \text{ at } 300\,\text{K}} = \frac{k_2}{k_1} = 10^5$$

$$\therefore \quad \log_{10}\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$$

$$\therefore \quad \log_{10}10^5 = \frac{E_a}{2.303 \times R}\left[\frac{500-300}{300 \times 500}\right]$$

$$\therefore \quad \log_{10}10^5 = \frac{E_a}{2.303 \times R} \times \left(\frac{200}{150000}\right)$$

$$\therefore \quad 5 = \frac{E_a}{2.303R} \times \left(\frac{2}{1500}\right)$$

$$\therefore \quad E_a = 2.303\ R \times 5 \times 1500 \times \frac{1}{2} = 8636 \times 8.314\ \text{J mol}^{-1}$$

64. (A)

Cu^{2+} : $3d^9$ (1 unpaired electron)
V^{2+} : $3d^3$ (3 unpaired electrons)
Cr^{2+} : $3d^4$ (4 unpaired electrons)
Mn^{2+} : $3d^5$ (5 unpaired electrons)
As the number of unpaired electrons increases, the paramagnetic property also increases.

65. (A)

In cold, a mixed ether (except the one having a tertiary alkyl group) gives higher alcohol and lower alkyl iodide.

$$(CH_3)_2CH - O - CH_3 \xrightarrow{\text{Cold HI}} \underset{\substack{\text{Propan-2-ol} \\ \text{(X)}}}{(CH_3)_2CHOH} + \underset{\substack{\text{Iodomethane} \\ \text{(Y)}}}{CH_3I}$$

$$(CH_3)_2CHOH \xrightarrow[\text{dil. } H_2SO_4]{K_2Cr_2O_7} \underset{\substack{\text{Propanone} \\ \text{(Z)}}}{CH_3COCH_3}$$

$$CH_3I + \underset{\text{(aq.)}}{NaOH} \xrightarrow{\Delta} \underset{\text{Methanol}}{CH_3OH} + NaI$$

66. (C)
Oxidation state of Co is +3 and ligands donate 12 electrons.
Z = 27, X = 3, Y = 12
EAN of Co^{3+} = Z – X + Y
= 27 – 3 + 12
= 36

67. (B)

68. (B)
PV = nRT

$$PV = \frac{m}{M}RT$$

$$\therefore \quad M = \frac{mRT}{PV}$$

$$\therefore \quad M = \frac{dRT}{P} \qquad \left(\because d = \frac{m}{V}\right)$$

$$\therefore \quad M = \frac{2.86 \times 0.0821 \times 273}{1} \approx 64 \text{ g mol}^{-1}$$

69. (B)

70. (A)
Teflon – fluoropolymer
Bakelite – Phenol-formaldehyde polymer
Terylene – Polyesters

71. (C)

72. (A)

Amount	No. of moles	No. of molecules
32 g of CH_4	32/16 = 2 moles	$2 \times N_A$
36 g of H_2O	36/18 = 2 moles	$2 \times N_A$
8 g of O_2	8/32 = 0.25 moles	$0.25 \times N_A$
22 g of CO_2	22/44 = 0.5 moles	$0.5 \times N_A$
32 g of O_2	32/32 = 1 moles	$1 \times N_A$
32 g of N_2	32/28 = 1.14 moles	$1.14 \times N_A$
18 g of H_2O	18/18 = 1 moles	$1 \times N_A$
4 g of H_2	4/2 = 2 moles	$2 \times N_A$

∴ Equal numbers of molecules are present in 32 g of CH_4 and 36 g of H_2O.

73. (A)
The adsorption of a gas is directly proportional to the surface area of the adsorbent. Powdered charcoal has the largest surface area due to its fine particles, allowing it to adsorb the most gas.

74. (C)
Na_3PO_4 gives a maximum of four ions, thus, it will show highest van't Hoff factor.

75. (D)

76. (A)
Non-biodegradable polymers are those polymers which are not degraded by microorganisms. PHBV and nylon 2-nylon 6 are biodegradable polymers.

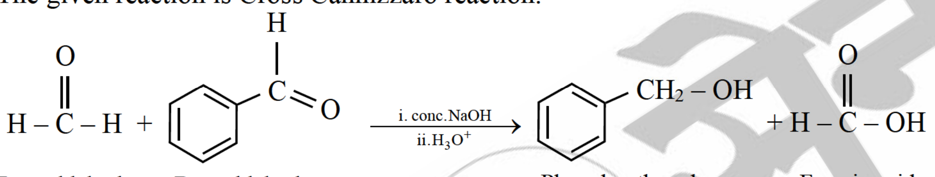
77. (B)

$$\Delta S_{surr} = -\frac{\Delta H^\circ}{T} = -\frac{(+8\text{ kJ})}{500\text{ K}}$$
$$= -0.016\text{ kJ K}^{-1} = -16\text{ J K}^{-1}$$

78. (B)
The catalyst reacts with the reactants to form intermediate of low activation energy. The intermediate then decomposes to form the product along with the regeneration of catalyst. Thus, it reduces energy of activation and provides alternate path for the reaction.

79. (C)
For 3f orbital: $n = 3$, $l = 3$;
This is not possible as the maximum possible value of l is $(n-1)$ i.e., for n = 3, the permissible values of l are 0, 1 and 2. Hence, 3f orbital does not exist.

80. (B)
The given reaction is Cross Cannizzaro reaction.



Formaldehyde   Benzaldehyde   Phenylmethanol   Formic acid

81. (C)

82. (D)

83. (B)
$3MnO_2 + 6KOH + KClO_3 \xrightarrow{\Delta} 3K_2MnO_4 + KCl + 3H_2O$
During the reaction, $KClO_3$ decomposes to release oxygen, which is used to oxidize MnO_2 to form $KMnO_4$.

84. (A)

85. (B)
$Zn_{(s)} + 2Ag^{+}(1\text{ M}) \longrightarrow Zn^{2+}(1\text{ M}) + 2Ag_{(s)}$
The two half cell reactions are:
$Zn_{(s)} \longrightarrow Zn^{2+}(1\text{ M}) + 2e^{-}$
$[Ag^{+}(1\text{ M}) + e^{-} \longrightarrow Ag_{(s)}] \times 2$
Therefore, Zn is oxidised and acts as negative electrode (anode) whereas, Ag^{+} ions are reduced and acts as positive electrode (cathode).
Hence the cell representation is:
$Zn_{(s)} \mid Zn^{2+}(1\text{ M}) \parallel Ag^{+}(1\text{ M}) \mid Ag_{(s)}$

86. (D)
15.6 g C_6H_6 gives 70 kJ heat
78 g C_6H_6 (1 mol) gives $\frac{70 \times 78}{15.6} = 350$ kJ heat
Thus, $\Delta U = -350\text{ kJ mol}^{-1}$ at 300 K for
$C_6H_{6(l)} + \frac{15}{2} O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$
Now, $\Delta n_g = 6 - \frac{15}{2} = -\frac{3}{2}$
$\Delta H = \Delta U + \Delta n_g RT$
$= -350 - \left[\frac{3}{2} \times \frac{8.314 \times 300}{10^3}\right]\text{ kJ mol}^{-1}$
$\Delta H = -353.74\text{ kJ mol}^{-1}$

87. (A)

$C_2H_5-NO_2 \xrightarrow{LiAlH_4} C_2H_5-NH_2 \xrightarrow{C_2H_5Br} (C_2H_5)_2NH \xrightarrow{C_2H_5Br} (C_2H_5)_3N$

Nitroethane → Ethylamine (A) → Diethylamine (B) → Triethylamine (C)

88. (D)

89. (A)

Number of unit cells in volume (V) of metal $= \dfrac{V}{a^3}$

∴ Number of unit cells in 1.00 cm^3 of Al

$= \dfrac{1.00}{(3.536 \times 10^{-8})^3} = 2.26 \times 10^{22}$

90. (D)

Benzylic halides (1°, 2°, 3°) prefer to undergo S_N1 mechanism. Option (D) is 3° benzylic halide which is highly stabilised resonance structure. Thus, amongst given compound, $PhC(CH_3)(Ph)Cl$ is most reactive towards S_N1 reaction.

$C_6H_5-C(CH_3)(C_6H_5)-Cl$

91. (C)

$\overset{+1}{K_4}\overset{x}{P_2}\overset{-2}{O_7}$

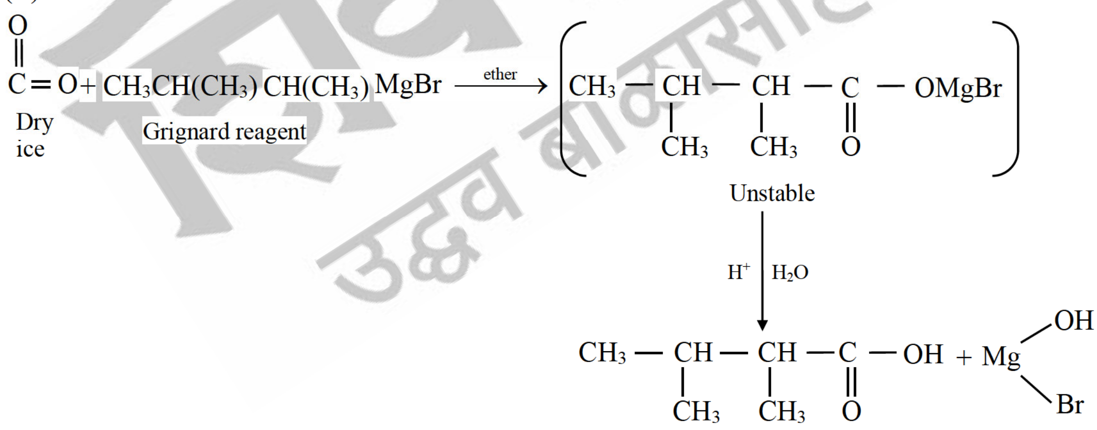
$4(+1) + 2x + 7(-2) = 0$

$2x - 10 = 0$

$2x = +10$

∴ $x = +5$

92. (B)



2,3-Dimethylbutanoic acid

93. (B)

$HCHO \xrightarrow[\text{ii. } H^+/H_2O]{\text{i. } C_3H_7MgI} CH_3CH_2CH_2CH_2OH$

94. (C)

When molten metal chloride undergoes electrolysis, at cathode, X^{3+} ions from MF_3 get reduced as follows:

$X^{3+} + 3e^- \longrightarrow X$

Hence, Mole ratio $= \dfrac{1 \text{ mol}}{3 \text{ mol } e^-}$

Mass of X formed,

$$W = \frac{I(A) \times t(s)}{96500\ (C / mol\ e^-)} \times \text{mole ratio} \times \text{molar mass of X}$$

$$0.25 = \frac{3.9 \times 9.65 \times 60}{96500} \times \frac{1}{3} \times \text{Molar mass of X}$$

$$\text{Molar mass of X} = \frac{0.25 \times 96500 \times 3}{3.9 \times 9.65 \times 60}$$

$$= 32.05\ g\ mol^{-1}$$

95. (C)

$c = 2 \times 10^{-3}$ M

For a monoacidic weak base,

$[OH^-] = c \times \alpha$

$[OH^-] = 2 \times 10^{-3} \times \frac{5}{100}$

$[OH^-] = 1 \times 10^{-4}$ M

$pOH = -\log_{10}[OH^-] = -\log_{10}(1 \times 10^{-4})$

$pOH = 4.00$

$pH + pOH = 14$

∴ $pH = 14 - pOH = 14 - 4.00$

$pH = 10.00$

96. (C)

Using Dalton's law of partial pressure,

∴ $P_{solution} = P_A + P_B$

∴ $P_{solution} = x_A P_A^0 + x_B P_B^0$

∴ $P_{solution} = 0.5 \times 160 + 0.5 \times 60 = 110$ mm Hg

97. (C)

Ozonolysis of alkenes is primarily used to cleave the double bonds of alkenes to form carbonyl compounds (aldehydes or ketones), not to prepare alkanes.

98. (B)

Number of atoms in 0.5 mol = $0.5 \times N_A$

$= 0.5 \times 6.022 \times 10^{23}$

$= 3.011 \times 10^{23}$

Number of tetrahedral voids

$= 2 \times$ Number of atoms

$= 2 \times 3.011 \times 10^{23}$

$= 6.022 \times 10^{23}$

Number of octahedral voids = Number of atoms

$= 3.011 \times 10^{23}$

Total $= 6.022 \times 10^{23} + 3.011 \times 10^{23}$

$= 9.033 \times 10^{23}$

99. (C)

Enantiomers have identical physical properties like melting point, boiling points, densities, refractive index except the sign of optical rotation (specific rotation). The magnitude of their optical rotation is equal.

100. (B)

101. (C)

102. (A)

103. (D)

104. (B)

105. (A)

106. (A)

107. (B)
Oral vaccines offer significant advantages, including ease of administration, lower cost, and simple storage. Usually, a vaccine consists of a biological agent that represents the disease-causing microorganism. It is often made from a weakened or killed form of the microorganism, its toxins or one of its surface protein antigens.

108. (A)
The haploid generative cell of a microspore or pollen grain undergoes mitotic division to form two haploid male gametes.

109. (A)

110. (B)

111. (D)
Alzheimer's disease cannot be cured but treatment slows down the progression of the disease.

112. (A)

113. (A)

114. (A)

115. (A)

116. (C)

117. (A)

118. (A)

119. (B)

120. (D)
Pollen grains are haploid, while endosperm has triploid chromosome number and integument is diploid in nature.

121. (B)

122. (A)
Saccharum barberi is a native variety of sugarcane of North India

123. (B)

124. (C)
Glucose is reabsorbed in the proximal convoluted tubule.

125. (A)

126. (C)

127. (B)

128. (B)

129. (C)

130. (C)

131. (D)

132. (C)

133. (C)
Water's high specific heat, high heat of vaporization, and high heat of fusion are due to hydrogen bonds between molecules. Heat absorbed by water first breaks these bonds rather than raising its temperature, allowing it to absorb large amounts of heat and act as an effective thermal buffer.

134. (C)
Mucosa of small intestine forms finger like foldings called villi.

135. (C)
i. High CO_2, high temperature, and low pH shift the oxygen dissociation curve to the right, reducing hemoglobin's oxygen affinity (Bohr effect).
ii. Low CO_2, low temperature, and high pH increase affinity (left shift), making oxygen binding stronger.

136. (D)

137. (D)

138. (B)

139. (B)
Tapetum is the inner most nutritive layer of anther wall. It immediately encloses the sporogenous tissue.

140. (B)

141. (A)

142. (B)
Inspiration is an active process.

143. (D)

144. (C)
Polycythemia is the condition in which there is an increase in the number of RBCs.
Diapedesis is the process by which WBCs can move out of the capillary walls with their amoeboid movements.
Electrocardiograph is the instrument used to record heart function, while the graphical record is called electrocardiogram (ECG).

145. (D)

146. (A)

147. (B)
Eutrophication is due to overgrowth of algae at the instance of high phosphorus dissolved in water. The overgrowth of algae kills or harms the aquatic life.

148. (D)
X chromosome is metacentric, while Y chromosome is acrocentric.
Y chromosome has small amount of euchromatin and large amount of heterochromatin.

149. (B)

150. (B)

151. (C)

152. (A)

153. (D)

154. (C)

155. (C)

156. (C)
After ovulation, the corpus luteum secretes progesterone, which maintains the endometrium for possible pregnancy.

157. (B)
i. Ventricular systole refers to ventricle contraction.
ii. AV valves close to prevent backflow into the atria.
iii. Semilunar valves open to eject blood into arteries.

158. (B)
Inhibin stops secretion of FSH.
Corpus luteum of the ovary secrets hormone relaxin at the end of gestation period. It relaxes the cervix of the pregnant female and ligaments of pelvic girdle for easy birth of young one.

159. (B)

160. (D)

161. (C)
Biopiracy refers to the unauthorized use or exploitation of indigenous knowledge, traditional resources, or genetic material by individuals or organizations without proper compensation or consent.

162. (A)

163. (B)
Formation of seedless fruits is parthenocarpy

164. (B)
A. The lac operon is inducible, only active when lactose is present.
C. It produces enzymes to metabolize lactose.
D. It's repressed without lactose but can be induced to produce enzymes when lactose is available.

165. (C)
The variation due to space results in spatial pattern. There are two types of spatial patterns. viz. Stratification and Zonation. Stratification is vertical whereas Zonation is horizontal distribution of plants and animals on land or in water.

166. (A)

167. (D)

168. (C)

169. (A)

170. (D)

171. (D)
Competition is the type of interaction where both the species are at loss.
In parasitism only one species is benefited and the interaction is detrimental to the other species.

172. (C)
iii. Mule is an example of inter-specific hybridization.
iv. Hissardale is an example of cross breeding.

173. (D)

174. (C)

175. (B)
Niche supports a single species at a time.

176. (D)

177. (C)

178. (A)
The frequency of recessive homozygotes is q2
i.e. q2 = 0.01
Thus, q = 0.1
Since p + q = 1
Thus, p = 1 – q
p = 1 – 0.1 = 0.9
The frequency of dominant homozygotes in the population is represented as p2 i.e. 0.81 or 81%.

179. (B)

180. (C)

181. (A)

182. (A)

183. (C)

184. (D)

185. (B)

186. (B)

187. (C)

188. (C)

189. (A)

190. (D)

191. (D)
When the anther (male part) and stigma (female part) of a flower mature at different times, it prevents self-pollination and encourages cross-pollination. This condition is known as dichogamy.
(A) Autogamy: Self-pollination within the same flower. This wouldn't occur if anther and stigma mature at different times.
(B) Geitonogamy: Pollination between different flowers on the same plant. While possible, it's still a form of self-pollination and less likely under strict dichogamy.
(C) Cleistogamy: Pollination in closed flowers that self-pollinate.

192. (B)

193. (C)

A. Spermatogonia first divide by mitosis to produce primary spermatocytes.

B. Secondary spermatocytes undergo meiosis II to form spermatids.

D. Sertoli cells provide physical and nutritional support to developing sperm cells.

194. (C)

Parent : Round green × Wrinkled yellow

RRyy × rrYY

Gametes : (Ry) (rY)

F1 generation : RrYy

Round yellow

195. (A)

196. (A)

197. (D)

198. (D)

Parkinsons disease is a neurological disorder.

199. (B)

D.P.D. = O.P. – TP

Cell A: D.P.D. = 12 – 10 = 2 atm

Cell B: D.P.D. = 10 – 10 = 0 atm

Movement of water will be from low D.P.D. to high D.P.D., i.e., from B to A.

200. (B)