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Test Booklet Series

D

TEST BOOKLET
PHYSICAL SCIENCES

Time Allowed : Two Hours **PAPER-II** **Maximum Marks : 200**

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. **Please note that it is the candidate's responsibility to encode and fill in the Roll number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR answer sheet. Any omission/discrepancy will render the answer sheet liable for rejection.**

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. DO NOT write *anything else* on the Test Booklet.

4. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.

5. You have to mark all your responses ONLY on the separate Answer Sheet provided. See directions in the Answer Sheet.

6. All items carry equal marks.

7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet.* You are permitted to take away with you the Test Booklet.

9. Sheet for rough work are appended in the Test Booklet at the end.

10. **Penalty for wrong answers :**

THERE WILL BE PENALTY FOR WRONG ANSWER MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.

(ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answer happens to be correct and there will be same penalty as above to that question.

(iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that questions.

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1. Which of the following are correct ?
A static fluid implies that
1. there will not be any shear force acting in a fluid element
2. the individual molecules of a fluid element are not in motion
3. the fluid can be assumed to be a rigid body

Select the correct answer using the code given below
(a) 1,2, and 3 (b) 1 and 2 only (c) 2 and 3 only (d) 1 and 3 only

Sol. **(a)**
Assuming ideal fluid we can say that all the statements are correct.

2. A planet with mass equal to eight times the mass of the Earth, has the same average density as the Earth. With g being the gravitational acceleration on the surface of the Earth, the gravitational acceleration on the surface of the planet is :
(a) 8g (b) 4g (c) $\sqrt{8}$ g (d) 2g

Sol. **(d)**

$$\frac{M}{\frac{4}{3}\pi R_E^3} = \frac{8M}{\frac{4}{3}\pi R^3} \qquad R = 2R_E\,, \qquad g' = \frac{G(8M)}{(2R_E)^2} = 2g$$

3. The pitch of a screw gauge is 0.5 mm. Its head scale contains 50 divisions. The least count of the screw gauge is :
(a) 0.0001 cm (b) 0.0025 cm (c) 0.01 cm (d) 0.00 1 cm

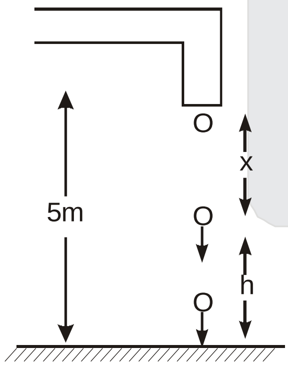
Sol. **(d)**

$$\text{Least count} = \frac{0.5\text{mm}}{50} = 0.001 \text{ cm}$$

4. Water drops fall at regular intervals from a tap which is 5 m above the ground. The third drop leaves the tap at the instant the first drop touches the ground. How far above the ground is the, second drop at that instant?
(a) 2.5 m (b) 3.75 m (c) 4.0 m (d) 1.25 m

Sol. **(b)** Time of flight for each drop $t = \sqrt{\frac{2h}{g}} = 1\text{sec}$

time interval between two drops = 0.5 sec



$$x = \frac{1}{2} \times 10 \times (0.5)^2 = \frac{10}{8}$$

$$h = 5 - x = 5 - 1.25 = 3.75 \text{ m}$$

5. A body is acted upon by a force proportional to square of distance covered. If the distance covered is denoted by x, then work done by the force will be proportional to :
(a) x (b) x^2 (c) x^3 (d) x^{-2}

Sol. **(c)**

$F = Kx^2$ K = constant

$W = \int F dx = \int Kx^2 dx$

$W \propto x^3$

6. If the internal energy of an ideal gas decreases by the same amount as the work done by the system, then which of the following is/are correct ?
1. The process must be adiabatic
2. The process must be must decrease
3. The temperature of the gas must decrease

Select the correct answer using the code given below :
(a) 1 only (b) 1 and 3 (c) 2 (d) 3 only

Sol. **(b)** $-\Delta U = W_g$

$\Delta Q = \Delta U + W_g = 0$

Process must be adiabatic

$\Delta U < 0$ $\quad \Delta T < 0$

7. Which one of the following quantities is zero on an average for the molecules of an ideal gas in equilibrium ?
(a) kinetic energy (b) density (c) speed (d) None of the above

Sol. **(d)** All positive

8. A sample of gas with $\gamma = 1.5$ is taken through an adiabatic process in which the volume is compressed from 1600 cm^3 to 400 cm^3. If the initial pressure is 150 kPa, then the work done in the process is :
(a) –120 J (b) +120 J (c) –480 J (d) +480 J

Sol. **(c)**

$P_iV_i^{\gamma} = P_fV_f^{\gamma}$

$P_f = 1200$ KPa

$$W = \frac{P_iV_i - P_fV_f}{\gamma - 1} = -480J$$

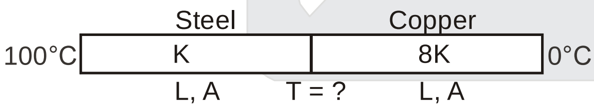
9. The root–mean–square speed and average kinetic energy of the molecules of an ideal gas at absolute temperature T are respectively proportional to :
(a) T and T^{-1} (b) $\sqrt{T}$ and T (c) T and T^2 (d) T^{-1} and T

Sol. **(b)**

$V_{rms} = \sqrt{\frac{3RT}{M}}$ $\qquad$ K.E. $= \frac{f}{2}KT$

10. A copper rod is joined to a steel rod in series. The rods have equal length and equal cross–sectional area. The free end of copper rod is kept at 0ºC and that of steel rod is kept at 100ºC. If the thermal conductivity of copper is eight times that of steel, what is the temperature (approximate) at the junction of the rods ?
(a) 50ºC (b) 26ºC (c) 21ºC (d) 11ºC

Sol. **(d)**



$$\frac{KA}{L}(100 - T) = \frac{8KA}{L}(T - 0)$$

$100 - T = 8T$

$$T = \frac{100}{9} \approx 11°C$$

11. A beam of light travelling with speed c in vacuum encounters a glass medium at an angle of incidence 60º. If the speed of light in the medium is $\frac{c}{\sqrt{3}}$, then the angle between the reflected and the refracted beams is :

(a) 30º (b) 60º (c) 90º (d) 120º

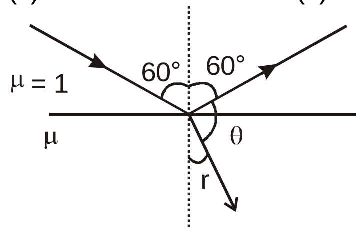
Sol. **(c)**

$\mu = \sqrt{3}$

(1) sin 60° = $\sqrt{3}$ sin r

r = 30°

θ = 90°



12. An object is placed 10 cm from a lens. The size of the image is same as the size of the object. The power of the lens should be :

(a) + 20 D (b) –20 D (c) +10 D (d) – 10 D

Sol. **(a)**

2f = 10 cm f = 5 cm

$P = \frac{1}{f} = 20$ D

13. If the eye sees two objects located at different distances, then which one of the following does not change ?

(a) the radius of curvature of the eye lens (b) the object distance from the eye lens

(c) the image distance from the eye lens (d) the focal length of the eye lens

Sol. **(c)**

Image forms on retina which is at a constant distance 2.5 cm (for normal eye) from eye lens.

14. A monochromatic beam of light of wavelength λ and frequency v goes from vacuum to a medium of refractive index n. How do the wavelength and frequency of light change ?

(a) wavelength becomes $\frac{\lambda}{n}$ and frequency nv (b) wavelength becomes nλ and frequency becomes $\frac{v}{n}$

(c) wavelength and frequency do not change (d) wavelength becomes $\frac{\lambda}{n}$ and frequency does not change

Sol. **(d)**

Frequency does not change

$n = \frac{\lambda}{\lambda_m}$

15. A concave mirror of focal length f produces a real image n times the size of the object. The distance of the object from the mirror is :

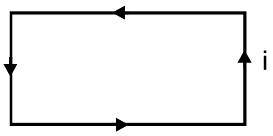
(a) (n – 1)f (b) (n + 1)f (c) (n + 1)f / n (d) (n – 1) f / n

Sol. **(c)**

$-n = \frac{-f}{-f-u}$ (u $\rightarrow$ coordinate)

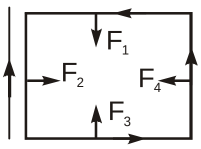
$|u| = \frac{(n+1)f}{n}$

16. A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current I is established in the wire as shown in the figure above, then the loop will :



(a) rotate about an axis parallel to the wire (b) move away from the wire
(c) move towards the wire (d) remain stationary

Sol. **(b)**



$F_1 = F_3$
$F_2 > F_4$
$\sum \tau_{net} = 0$

$\sum F_{net} = F_2 - F_4$ (towards right)

17. Current flows through a thick long straight wire such that the current density is uniform over the cross–section of the wire. The magnetic induction B inside the wire at a distance r from the axis is :
(a) proportional to r (b) inversely proportional to r
(c) inversely proportional to r^2 (d) uniform throughout the cross–section of the wire

Sol. **(a)** $B_{in} = \frac{\mu_0 Jr}{2}$ $B_{in} \propto r$

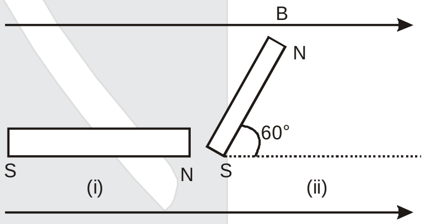
18. A magnetic needle lying parallel to the magnetic field requires W units of work to turn through 60º. The torque required to maintain the needle in this position is :

(a) $\sqrt{3}W$ (b) W/2 (c) $\sqrt{3}W/2$ (d) None of the above

Sol. **(a)** W = (–MB cos 60°) – (–MB cos 0°)

$W = \frac{MB}{2}$

$\tau = MB \sin 60° = \sqrt{3}W$



19. What is the work done in carrying a charge q around a complete circle of radius r with charge Q at the centre

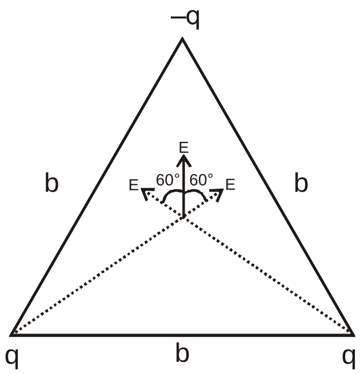
(a) $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{2\pi r}\right)$ (b) $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{\pi r}\right)$ (c) $\frac{qQ}{4\pi\varepsilon_0}$ (d) 0

Sol. **(d)** $W_{ext} = \Delta U = U_f - U_i = 0$

20. Consider three charges q,–q, q (in SI units) at the vertices of an equilateral triangle with side length b. The magnitude of electric field at the centroid of the triangle is :

(a) $\frac{3q}{2\pi\varepsilon_0 b^2}$ (b) $\frac{3q}{4\pi\varepsilon_0 b^2}$ (c) $\frac{q}{2\pi\varepsilon_0 b^2}$ (d) 0

Sol. **(a)**



$E = \frac{Kq}{\left(\frac{b}{\sqrt{3}}\right)^2} = \frac{3Kq}{b^2}$

$E_{net} = 2E$

$= \frac{6Kq}{b^2} = \frac{3q}{2\pi\varepsilon_0 b^2}$

21. A 400 turns primary coil of an ideal transformer is connected to an alternating current power line of120 V. A secondary coil of 100 turns is connected to a light bulb of 60 Ω resistance. The maximum current in the secondary would be :

(a) 2A (b) 1A (c) 0.5 A (d) 0.25 A

Sol. **(c)**

$\frac{V_2}{V_1} = \frac{N_2}{N_1}$ $\frac{i \times 60}{120} = \frac{100}{400}$, i = 0.5A

22. Two long wires each parallel to the z–axis and each carrying current I, are at (0,0,0) and (a,b,0). What is the force per unit length of each wire ?

(a) $\frac{\mu_0 I^2}{2\pi(a^2+b^2)}$ (b) $\frac{\mu_0 I^2}{2\pi(a^2+b^2)^{3/2}}$ (c) $\frac{\mu_0 I^2(a+b)}{2\pi(a^2+b^2)}$ (d) None of the above

Sol. **(d)**

$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r} = \frac{\mu_0 I^2}{2\pi\sqrt{a^2+b^2}}$

23. A heating coil transforms 100 J of electric energy into heat energy per second. The coil is cut into two halves and the two halves are joined in parallel to the same source. Now the energy transformed per second will be

(a) 25 J (b) 50 J (c) 100 J (d) 400 J

Sol. **(d)**

$P_1 = \frac{V^2}{R} = 100$ J/S

$P_2 = \frac{V^2}{R/4} = \frac{4V^2}{R} = 400$ J/S

24. In resistance box, the wire is doubled before winding to :

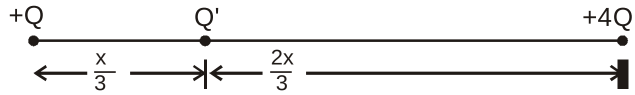
(a) save space (b) avoid induction (c) avoid heating (d) decrease the cost

Sol. (b) In resistance box the wire is doubled before winding to avoid induction (eddy currents).

25. The free charges +Q and +4W are placed at a distance x apart. The magnitude of third charge which makes the system in equilibrium is :

(a) 9Q/4 (b) 9Q (c) 4Q/9 (d) 4Q

Sol. **(c)**



$U_{sys} = 0$

$\Rightarrow \quad [\,4Q + 3Q' + 6Q'\,] = 0$

$Q' = -\dfrac{4Q}{9}$

26. A free neutron decays to a proton but a free proton does not decay to a neutron. This is because :
(a) neutron is a composite particle made of proton and electron whereas proton is a fundamental particle
(b) neutron is an uncharged particle whereas proton is a charged particle
(c) neutron has large rest mass than proton
(d) None of the above

Sol. **(c)**
Because neutron has larger rest mass than proton.

27. The K_α and K_β X–rays of molybdenum have wavelengths 0.71 Å and 0.63 Å respectively. Then the wavelength of L_α of molybdenum will be :

(a) 0.66 Å (b) 0.55 Å (c) 5.59 Å (d) 10.55 Å

Sol.
27. **(c)**

$\Delta E_{L\alpha} = \Delta E_{K\beta} - \Delta E_{K\alpha}$

$\dfrac{1}{\lambda} = \dfrac{1}{\lambda_1} - \dfrac{1}{\lambda_2} \quad \Rightarrow \quad \lambda = \dfrac{\lambda_1\lambda_2}{\lambda_2 - \lambda_1}$

$\Rightarrow \quad \lambda = \dfrac{0.71 \times 0.63}{0.08} \quad\quad \lambda = 5.59\ \overset{0}{A}$

28. In a laboratory on emission from atomic hydrogen in a discharge tube, only a small number of lines are observed whereas a large number of lines are present in the spectrum of a star. This is because in a laboratory.
(a) The amount of hydrogen taken is much smaller than that present in the star
(b) The temperature of hydrogen is much smaller than that of star
(c) The pressure of hydrogen is much smaller than that of star
(d) The gravitational pull is much smaller than that in the star

Sol. **(b)**

Temperature of hydrogen is much smaller.

29. The cutoff wavelength of X-rays coming from an X-ray tube depends on the
(a) filament material
(b) acceleration voltage
(c) target material
(d) temperature of the filament

Sol. **(b)** $\lambda_m = \left(\dfrac{hC}{eV_0}\right)$

i.e. cut off wave length of X–rays depends only on accelerating voltage (V_0).

30. Consider the alpha decay of $^{212}Bi \rightarrow {}^{208}Tl + {}^{4}He$. Taking the binding energy per nucleon to be approximately 8.00 MeV per nucleon for Bi, 8.05 MeV per nucleon for Tl and 7.1 MeV per nucleon for He, the energy released in the decay of one nucleus is approximately.

(a) 6.8 MeV (b) 3.6 MeV (c) 10.4 MeV (d) 14.0 MeV

Sol. **(a)**

$$^{212}Bi \longrightarrow {}^{208}Tl + {}^{4}He$$

$$\Delta Q = 208 \times 8.05 + 4 \times 7.1 - 212 \times 8$$
$$= 6.8 \text{ MeV}$$

31. The mass of a metal cube is 5.74 g and its volume is 1.2 cm^3. Then its density expressed up to appropriate significant figures will be

(a) 4.8 g cm^{-3} (b) 4.78 g cm^{-3} (c) 4.783 g cm^{-3} (d) 5.0 g cm^{-3}

Sol. **(a)**

$$d = \frac{m}{V} = \frac{5.74}{1.2} = 4.783 \text{ g/cm}^3$$
$$= 4.8 \text{ g/cm}^{-3} \text{ (in significant figures)}$$

32. The displacement of a particle in simple harmonic motion in one time period is

(a) A (b) 2A (c) 4A (d) 0

where A is the amplitude.

Sol. **(d)**

33. How will coefficient of friction change if the normal reaction is halved?

(a) Doubled (b) Halved (c) Unchanged (d) Cannot be predicted

Sol. **(c)**

Coefficient of friction depends only on nature of contact surface.

34. A car accelerates from rest to a speed of 10 m/s. Let the energy spent be E. If we accelerate the speed of the car from 10 m/s to 20 m/s, the energy spent will be

(a) E (b) 2E (c) 3E (d) 4E

Sol. **(c)**

$$\Delta K = \tfrac{1}{2} m (100 - 0) = E$$

$$\Delta K' = \tfrac{1}{2} m (400 - 100) = 3E$$

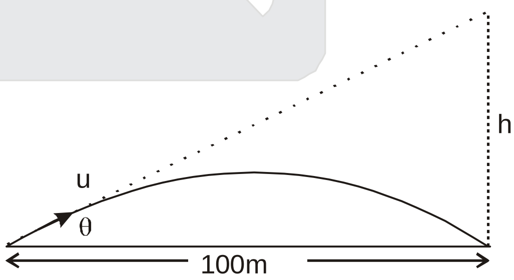
35. A boy desires to hit a bird on the ground from a point at a horizontal distance of 100 m. If the gun can impart a velocity of 500 m/s to the bullet, at what height above the bird must he aim his gun in order to hit it (g = 10 m/s^2)

(a) 10 cm (b) 20 cm (c) 50 cm (d) 100 cm

Sol. **(b)** $\frac{u^2 \sin 2\theta}{g} = 100$

$$\Rightarrow \frac{(500)^2 \sin 2\theta}{g} = 100$$

$$\Rightarrow \sin 2\theta = \frac{1}{250}$$



$$2\theta = \frac{1}{250}$$

$$2\left(\frac{h}{100}\right) = \frac{1}{250}$$

$$\Rightarrow h = \frac{1}{5} \text{ m} = 20 \text{ cm}$$

36. A car accelerates at 5 ms^{-2} and then retards to rest at 3 ms^{-2}. The maximum velocity of the car is 30 m/s. The distance covered by the car is

(a) 150 m (b) 240 m (c) 300 m (d) 260 m

Sol. **(b)**

$$S = S_1 + S_2 = \frac{V_m^2}{2|a_1|} + \frac{V_m^2}{2|a_2|} = \frac{(30)^2}{2}\left(\frac{1}{5} + \frac{1}{3}\right) = 240 \text{ m}$$

37. A bullet after firing from a gun goes through a plank of thickness h and changes its velocity from u to ν. The force of resistance is proportional to square of velocity. The time of motion of the bullet in the plank is proportional to

(a) $(u - \nu)\, u^{-2}$ (b) $(u - \nu)\, \nu^{-2}$ (c) $(u - \nu)\,(u\nu)^{-1}$ (d) $(u^2 - \nu^2)\,(u\nu)^{-2}$

Sol. **(c)**

$$a = \frac{dv}{dt} = -kv^2 \qquad \Rightarrow = \int_u^v \frac{dv}{v^2} = -k\int dt \qquad \Rightarrow \qquad t = \frac{1}{k}(u - v)\ (uv)^{-1}$$

38. A satellite is shot vertically upward from the surface of the Earth of radius R. If ν is the escape velocity from the surface of the Earth, then at what distance from the centre of the Earth will its speed be $\nu/3$?

(a) 3R (b) $\sqrt{3R}$ (c) $\frac{2R}{3}$ (d) 9R

Sol. **(d)**

E = 0

$$\Rightarrow \frac{-GMm}{r} + \frac{1}{2}m\left(\frac{v}{3}\right)^2 = 0 \qquad \Rightarrow \frac{GM}{r} = \frac{1}{2}\frac{2GM}{9R} \qquad \Rightarrow r = 9R$$

39. A simple pendulum is taken at a place where its separation from the Earth's surface is equal to the radius of the Earth. Then the time period of small oscillations of the pendulum (with string length of 1.0 m) is given by

(a) 1 s (b) 2 s (c) 4 s (d) 0.5 s

(Take $g = \pi^2$ m/s^2)

Sol. **(c)**

$$T = 2\pi\sqrt{\frac{l}{g/4}} = 4 \text{ Sec.}$$

40. A particle of mass m is at x = 0 with velocity ν = u in the x-direction at t = 0. It is subjected to a friction force $-b\nu$, where b is a positive constant. The position of the particle at $t \to \infty$ is

(a) mu/b (b) u/mb (c) 2mu/b (d) mu/2b

Sol. **(a)**

F = – bv

$$\frac{vdv}{ds} = -\frac{b}{m}v \qquad \Rightarrow \int_u^0 dv = -\frac{b}{m}\int_0^s ds$$

$$s = \frac{mu}{b}$$

41. A piece of ice of volume Vm^3 and density 900 kg/m^3 is dropped into water. What is the force (in newton) with which the ice should be pushed down so that it is totally under water (g = 10 m s^{-2})?

(a) 900 V (b) 100 V (c) 1900 V (d) 1000 V

Sol. **(d)**

mg + F = V (1000)g

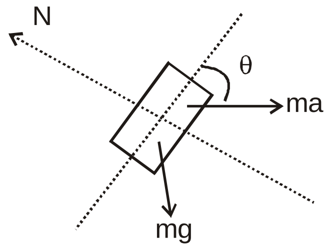
V (900) g + F = V (1000)g

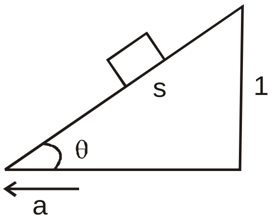
F = 1000V

42. A body kept on a smooth inclined plane having inclination 1 in s will remain stationary relative to inclined plane if the body is given a horizontal acceleration equal to

(a) $\frac{g}{\sqrt{s^2-1}}$ (b) $\frac{gs}{\sqrt{s^2-1}}$ (c) $\frac{g\sqrt{s^2-1}}{s}$ (d) $g\sqrt{s^2-1}$

Sol. **(a)**





$\sin\theta = \frac{1}{s}$

$$ma\cos\theta = mg\sin\theta$$

$$a = g\tan\theta = g\frac{1}{\sqrt{S^2-1}}$$

43. A body of mass m slides down a rough plane of inclination α. If μ is the coefficient of friction, then the acceleration of the body will be

(a) $g\sin\alpha$ (b) $\mu\cos\alpha$ (c) $g(\sin\alpha - \mu\cos\alpha)$ (d) $g(\cos\alpha - \mu\sin\alpha)$

Sol. **(c)**

$$mg\sin\alpha - \mu\, mg\cos\alpha = ma$$

$$a = g(\sin\alpha - \mu\cos\alpha)$$

44. A body floats with one-third volume outside when put in water and three-fourth of its volume outside when put in another liquid. The density of the liquid is

(a) 9/4 g cm^{-3} (b) 8/3 g cm^{-3} (c) 3/8 g cm^{-3} (d) 4/9 g cm^{-3}

Sol. **(b)**

$$\frac{\sigma}{\rho_1} = \frac{2}{3} \qquad \rho_1 = \frac{3}{2}\sigma$$

$$\frac{\sigma}{\rho_2} = \frac{1}{4} \qquad \rho_2 = 4\sigma$$

$$\frac{\rho_1}{\rho_2} = \frac{3}{8} \qquad \rho_2 = \frac{8}{3}\rho_1 = 8/3 \ \text{g/cm}^3$$

45. Radius of the Earth is twice that of the Mars and its weight is ten times the weight of the Mars. An object weighing 100 kg on the Earth will weigh how much on the Mars ?

(a) 50 kg (b) 40 kg (c) 30 kg (d) 20 kg

Sol. **(b)**

$$g_{mars} = G\frac{\frac{M}{10}}{(R/2)^2} = \frac{GM}{R^2}\cdot\frac{2}{5}$$

So weight on Mars is = $\frac{2}{5} \times 100 = 40$ kg

46. The optical power of a lens is 2.5 D. For a certain position of an object relative to the lens, a real doubly magnified image is formed on a screen. The object is now moved 0.1 m closer to the lens. What will be the magnification?

(a) 8 (b) 4 (c) 2 (d) 1

Sol. **(b)**

$f = \frac{1}{2.5}$ m = 40cm

In Ist case

$\frac{1}{2u} + \frac{1}{u} = \frac{1}{40}, \quad \frac{3}{2u} = \frac{1}{40}, \quad u = 60\text{cm}.$

In IInd case

$\frac{1}{v} + \frac{1}{50} = \frac{1}{40}, \quad \frac{1}{v} = \frac{1}{200}, \quad m = \left(\frac{v}{u}\right) = -4$

47. A glass tube 1.0 m length is filled with water. The water can be drained out slowly at the bottom of the tube. If a vibrating tuning fork of frequency 500 Hz is brought at the upper end of the tube, then what is the total number of resonances obtained? (Velocity of sound is 300 m s^{-1})

(a) 1 (b) 2 (c) 3 (d) 4

Sol. **(c)**

$\frac{(2n+1)v}{4L} = 500, \quad L = \frac{(2n+1)3}{4 \times 5} \le 1$

possible n = 0, 1 and 2

48. A sample of oxygen at NTP has a volume V and a sample of hydrogen at NTP has a volume 4V. Both the gases are mixed and the mixture is maintained at NTP. If the velocity of sound in hydrogen at NTP is 1270 m/s, then the velocity of sound in the mixture will be

(a) 317.5 m/s (b) 635 m/s (c) 830 m/s (d) 950 m/s

Sol. **(b)**

$v = \sqrt{\frac{\gamma RT}{M}}$

$\gamma_{mix} = \gamma_{H_2} \qquad M_{mix} = \frac{n_1M_1 + n_2M_2}{n_1 + n_2} = \frac{4x.2 + x.32}{5x} = 8$

$\frac{v_{mix}}{v_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{mix}}} = \frac{1}{2}, \quad v_{mix} = 635$ m/s

49. An observer standing on the seacoast finds that 48 ripples reach the surface per minute. If the wavelength of the ripples is 8 m, then the wave velocity is

(a) 4.8 m/s (b) 6.4 m/s (c) 8.4 m/s (d) 12.4 m/s

Sol. **(b)**

$V_{wave} = \frac{48 \times 8}{60} = 6.4$ m/s

50. A light ray is incident on a surface with angle of incidence 60º. The angle between the incident ray and the refracted ray is 15º. What is the refractive index (approximate) of the medium?

(a) 1.225 (b) 1.33 (c) 1.5 (d) 1.732

Sol. **(a)**

$\mu \sin 45° = 1 \sin 60°$

$\mu = 1.225$

51. A cell of steady e.m.f. 2.5 V and internal resistance of 0.5 Ω delivers a current of 1.0 A to an external circuit. The useful work done per second is

(a) 2.5 J (b) 2.0 J (c) 3.0 J (d) 0.5 J

Sol. (b)

$\Delta V = E - Ir$

$= 2.5 - 1 \times 0.5 = 2$

useful work = $\Delta V \times I$ = 2 J/s

52. A free proton and a free electron are placed in a uniform electric field. Which of the following statements are correct ?

1. The magnitudes of electric forces acting on them will be equal.
2. Their accelerations will be different.
3. They will move in the same direction.

Select the correct answer using the code given below.

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 2

Sol. (a)

force on both will be equal and opposite

53. When the separation between the charges is increased, the electric potential energy of the charges

(a) increases (b) decreases
(c) remains the same (d) may increase or decrease

Sol. (d)

$$U = \pm \frac{K|q_1||q_2|}{r}$$

54. The number of electrons to be removed from a metal surface to make it positive having positive charge 1.0 × 10^{-7} C will be

(a) 625 × 10^9 (b) 625 × 10^{10} (c) 625 × 10^{11} (d) 625 × 10^{12}

Sol. (a)

$$n = \frac{1.0 \times 10^{-7}}{e} = 0.625 \times 10^{12}$$

55. A uniform electric field 10 N C^{-1} exists in the vertically downward direction. What is the increase in the electric potential as one goes up through a height of 50 cm?

(a) 50 V (b) 10 V (c) 5 V (d) 1 V

Sol. (c) $\Delta V = -\vec{E}.\vec{l}$ = 10 × 0.5 = 5V

56. Consider the following statements :

If a charged particle at rest experiences no electromagnetic force, then

1. the electric field must be zero
2. the magnetic field must be zero
3. the electric field may or may not be zero
4. the magnetic field may or may not be zero

Select the correct answer using the code given below,

(a) 1 and 4 (b) 1 only (c) 1 and 2 (d) 2 and 3

Sol. (a)

because particle at rest so force due to $\vec{B}$ is zero

57. A metal wire loop is in a uniform magnetic field and the plane of the loop is perpendicular to the magnetic field. An e.m.f. will be induced in the loop if

(a) it moves in its plane (b) it is rotated about its axis
(c) it is rotated about its diameter (d) it moves along the direction of the field

Sol. **(c)**

because flux changes.

58. A copper rod of length 20 cm and cross-sectional area 2 mm^2 is joined with a similar aluminium rod in series. What is the total resistance of the combination between the ends? (Resistivity of copper is $1.7 \times 10^{-6}\ \Omega$ cm and that of aluminium is $2.6 \times 10^{-6}\ \Omega$ cm)

(a) $4.3 \times 10^{-3}\ \Omega$ (b) $3.3 \times 10^{-3}\ \Omega$ (c) $2.1 \times 10^{-3}\ \Omega$ (d) $1.3 \times 10^{-3}\ \Omega$

Sol. **(a)**

$$R = \rho_1 \frac{l}{A} + \rho_2 \frac{l}{A} = 4.3 \times 10^{-3}\ \Omega$$

59. A steady d.c. current is flowing through a cylindrical conductor. Which of the following statements is/are correct?

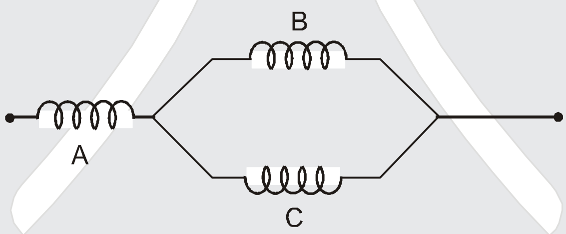
1. The electric field at the axis of the conductor is zero.
2. The magnetic field at the axis of the conductor is zero.

Select the correct answer using the code given below.

(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2

Sol. **(c)**

60. Three identical long solenoids A, B and C are connected as shown in the figure above. The magnetic field due to current flow is 2.0 T at the centre of solenoid A. What is the magnetic field at the centre of solenoid C?



(a) 2.0 T (b) 1.0 T (c) 0.5 T (d) 4.0 T

Sol. **(b)** B (at centre of solenoid) = $\mu_0 nI$

$B \propto I$, Current in C is half of current in A.

61. Consider the following ions :
1. NH_2^-
2. Cl^-
3. ClO_4^-
4. CH_3COO^-

What is the correct order of basic strength of the above ions ?
(a) 4 > 1 > 2 > 3 (b) 4 > 3 > 1 > 2 (c) 1 > 4 > 2 > 3 (d) 1 > 4 > 3 > 2

Sol. **(c)**
Acid strength order
$HClO_4 > HCl > CH_3COOH > NH_3$
Conjugate base strength order
$ClO_4^- < Cl^- < CH_3COO^- < NH_2^-$

62. Consider the following statements in respect of first-order chemical reactions :
1. Half-life period for a first-order reaction is independent of initial concentration.
2. The unit of rate constant of a first-order reaction is sec^{-1}.
3. The value of rate constant can be changed by changing the concentration unit.
4. The concentration of the reactants of a first-order reaction decreases linearly with time.

Which of the above statements are correct?
(a) 2 and 3 (b) 3 and 4 (c) 1 and 4 (d) 1 and 2

Sol. **(d)**
For first order

$$t_{1/2} = \frac{0.693}{K}$$

rate of unit constant $time^{-1}$

63. When sodium is dissolved in liquid ammonia, a solution of deep blue colour is obtained. The colour of the solution is due to :
(a) sodium ion (b) ammoniated electron (c) sodium amide (d) ammoniated sodium ion

Sol. **(b)**
$Na + (x + y)NH_3(\ell) \longrightarrow Na^+ (NH_3)_x + e^-(NH_3)_y$ colour due to ammoiniated electron.

64. The ionization constant of acetic acid is $K_a = 10^{-5}$ at standard ambient temperature. The pH of a solution of 0.01 M acetic acid and 0.1 M sodium acetate is :
(a) 4 (b) 5 (c) 6 (d) 7

Sol. **(c)**

$$pH = pK_a + \log \frac{[CH_3COONa]}{[CH_3COOH]}$$

$$= 5 + \log\frac{0.1}{0.01} = 6$$

65. A reaction obeys first-order kinetics. It takes 1 hour for the reactant to decay to one-eighth of its starting concentration. To decay to one-fourth of its starting concentration, it takes
(a) 10 minutes (b) 20 minutes (c) 30 minutes (d) 40 minutes

Sol. **(d)**

$$K = \frac{2.303}{1}\log\frac{a}{\frac{a}{8}}$$

or K = 2.303 log 8 = $\frac{2.303}{t}\log\frac{a}{\frac{a}{4}}$

or log 8 = $\frac{1}{t}\log 4$

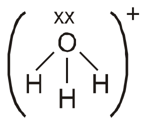
or t = $\frac{\log 4}{\log 8} = \frac{2\log 2}{3\log 2} = \frac{2}{3}$hr = 40 min.

Or

$3 \times t_{1/2} = 60$ min or $t_{1/2} = 20$ min.
$t_{3/4} = 2 \times t_{1/2}$
$= 2 \times 20 = 40$ min.

66. Which one among the following is the correct structure of H_3O^+ ?
(a) T-shaped (b) Bent shape (c) Trigonal planar (d) Trigonal pyramidal

Sol. **(d)**



SN $\rightarrow$ 4 (3 BP + 1 LP) trigonal pyramidal

67. A sample of water contains 12 mg of $MgSO_4$ (molecular weight = 120) per kg of water. The degree of hardness for this sample is :
(a) 1.0 ppm (b) 5.0 ppm (c) 10.0 ppm (d) 100.0 ppm

Sol. **(c)**

Moles of $MgSO_4 \equiv$ moles of $CaCO_3$

$\frac{12 \times 10^{-3}}{120} \equiv$ moles of $CaCO_3$

mass of $CaCO_3 = 10^{-4} \times 100$ g

Degree of hardness = $\frac{10^{-4} \times 100}{1000} \times 10^6$

$= \frac{10^{-4} \times 10^8}{10^3} = 10$ ppm

68. Consider the following statements for heavy water :
1. Pure heavy water is radioactive.
2. It is used as neutron moderator in nuclear fission reaction.
3. It is used as solvent in NMR spectroscopy.
4. Density of heavy water is less than that of ordinary water.
Which of the statement given above are correct?
(a)1 and 2 only (b) 1, 2, 3 and 4 (c) 1, 3 and 4 only (d) 2 and 3 only

Sol. **(d)**

Heavy water is used as neutron moderator in nuclear fission reaction. It is not radioactive. It is used as solvent in NMR spectroscopy.

69. Milk of magnesia contains

(a) $MgCO_3$ (b) $MgSO_4.7H_2O$ (c) $MgCl_2.6H_2O$ (d) $Mg(OH)_2$

Sol. **(d)**

Milk of magnesia is $Mg(OH)_2$

70. Which one of the following compounds is having 2-electror 3-centered bond?

(a) NH_3 (b) B_2H_6 (c) BH_4^- (d) H_3O^+

Sol. **(b)**

B_2H_6 has hybridisation of B as sp^3. It has two, three centre two e^- bonds.

71. What will be the pH range of are aqueous solution of borax ?

(a) pH > 7 (b) pH < 7 (c) pH = 7 (d) pH $\leq$ 7

Sol. **(a)**

$Na_2B_4O_7$. 10 H_2O is boron. It is SBWA types salt.

72. Consider the following statements :

1. Talc is magnesium silicate.
2. Lead shows allotropy
3. Producer gas is a mixture of CO and O_2.

Which of the statements given above is/are correct?

(a) I, 2 and 3 (b) 1 and 3 only (c) 1 only (d) 2 and 3 only

Sol. **(c)**

Talc is magnesium silicate. Lead does not shows allotropy. Producer gas is CO + N_2.

73. Consider the following statements :

Statement-1 : The dipole moment of NH_3 is greater than NF_3.

Statement-2 : The electronegativity difference between nitrogen and fluorine is almost same as that between nitrogen and hydrogen.

Which one of the following in respect of the above statements is correct ?

(a) Both the statements are correct and Statement-2 is the correct explanation for Statement-1.

(b) Both the statements are correct but Statement-2 is not the correct explanation for Statement-1.

(c) Statement-1 is correct but Statement-2 is incorrect.

(d) Statement-1 is incorrect but Statement-2 is correct.

Sol. **(b)**

$\mu_{NH_3} > \mu_{NF_3}$

EN difference N & H = 3.0 – 2.1 = 0.9

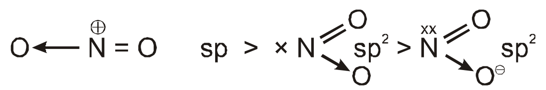
EN difference N & F = 4.0 – 3.0 = 1.0

74. What is the correct order of O–N–O bond angles in the compounds NO_2^-, NO_2^+, NO_2 ?

(a) $NO_2^- > NO_2^+ > NO_2$ (b) $NO_2 > NO_2^- > NO_2^+$ (c) $NO_2^+ > NO_2 > NO_2^-$ (d) $NO_2^+ > NO_2^- > NO_2$

Sol. **(c)**

Bond angle order :



75. In Ostwald's process of manufacturing of HNO_3, what are the two major nitrogen oxides formed in intermediate steps?

(a) NO_2, N_2O (b) NO, N_2O_3 (c) NO, NO_2 (d) NO, N_2O_5

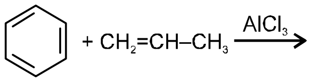
Sol. **(c)**

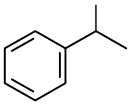
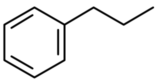
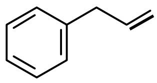
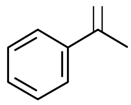
$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(\ell)$

$2NO_2(g) + O_2(g) \longrightarrow 2NO_2(g)$

$3NO_2(g) + H_2O(\ell) \longrightarrow 2HNO_3(aq.) + NO(g)$

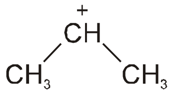
76. The major product of the following reaction :


is :

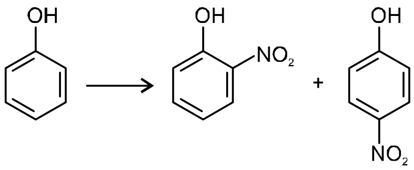
(a)  (b)  (c)  (d) 

Sol. **(a)**

It is example of Freidel Craft alkylation which proceed via more stable isopropyl cation.



77. Consider the following reaction :



For carrying out the above reaction, which condition should be used?

(a) Conc. HNO_3 + conc. H_2SO_4 + heat

(b) Conc. HNO_3 + conc. H_2SO_4

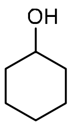
(c) Dilute HNO_3

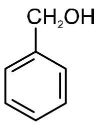
(d) Conc. HNO_3 only

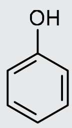
Sol. **(c)**

Mononitration on phenol takes place in dil. HNO_3 as phenol has activated aromatic ring.

78. Consider the following compounds :


(I)


(II)

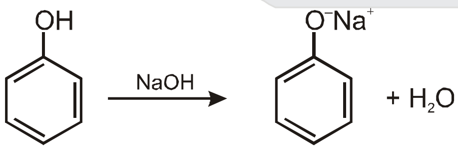

(III)

Which of the above compound will react with sodium hydroxide solution at room temperature?

(a) I, II and III (b) II and III only (c) III only (d) I and III only

Sol. **(c)**

Alcohol i.e. I and II are less acidic than H_2O, therefore is unreactive to NaOH but phenol is reactive and form phenoxide ion



79. Consider the following statements in respect of the reaction

$Br^- + R–CH_2–\overset{+}{O}H_2 \longrightarrow Br – CH_2–R + H_2O$

1. Br^- is a nucleophile and protonated alcohol is an electrophile.
2. It is nucleophilic displacement of water from protonated alcohol by Br^- nucleophile.

Which of the statements given above is /are correct?

(a) 1 only (b) 2 only (c) Both 1 and 2 (d) Neither 1 nor 2

Sol. **(b)**

Here Br^- is incoming nucleophile and $–OH_2^+$ is leaving nucleophilic group.

80. Consider the following statements in respect of the reaction

$(CH_3)_3CBr + \overset{-}{O}H \xrightarrow{\text{Alcohol}} (CH_3)_3COH + Br^-$

1. It is a nucleophilic substitution.
2. It is a two-step reaction.
3. The rate of the reaction depends only on the concentration of the alkyl halide.
4. It is an S_N2 reaction.
5. Carbocation intermediate is formed in this reaction.

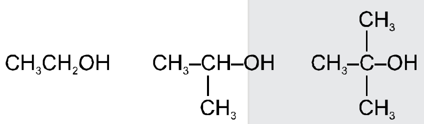
Which of the above statements are correct ?

(a) 1, 2, 3 and 5 (b) 1, 2 and 5 only (c) 3 and 4 only (d) 2, 3 and 4

Sol. **(a)**

The given reaction can takes place only by S_N1 hence statement 1, 2, 3 and 5 are correct.

81. Consider the following alcohols :



(I) **(II)** **(III)**

On treating these with concentrated sulphuric acid at 413 K, which of the above will give the corresponding ether ?

(a) I, II and III (b) I and II only (c) I only (d) II and III only

Sol. **(c)**

Isopropyl alcohol and tertbutyl alcohol gives alkene under the given conditions.

82. Consider the following reaction

$CH_2=CH_2 \xrightarrow[H_2O, O_2]{PdCl_2, CuCl_2} [Y]$

What is the major product [Y] in the above reaction?

(a) CH_3CHO (b) CH_3CO_2H (c) $HC{\equiv}CH$ (d) CH_3CH_2OH

Sol. **(a)**

The given reaction is example of formylation via Pd assisted catalytic oxidation.

83. Benzoyl chloride can be converted to benzaldehyde by treatment with :

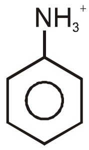
(a) H_2/Pd-$BaSO_4$ (b) Zn(Hg)/HCl (c) DIBAL–H (d) Na/liq. NH_3

Sol. **(a)**

The given reaction is classical application of Resenmund Catalyst. (H_2/Pd-$BaSO_4$).

84. Direct nitration of aniline by using HNO_3 / H_2SO_4 at 288 K gives :
(a) a mixture of ortho-, meta- and para-nitroaniline
(b) a mixture of ortho- and para-nitroaniline only
(c) a mixture of meta- and para-nitroaniline only
(d) a mixture of meta- and ortho-nitroaniline only

Sol. **(a)**

In acidic medium aniline also exist as anilinium 

ion, which is deactivating and meta directing.

Therefore a mixture of ortho, meta and para nitroaniline is obtained.

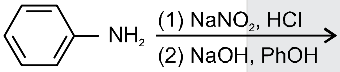
85. Which one of the following is a polyamide?
(a) Teflon (b) Polyester (c) Polythene (d) Nylon

Sol. **(d)**
Nylon is an example of polyamide.

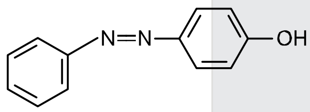
86. Which one of the following is water soluble ?
(a) Cellulose (b) Cholesterol (c) Vitamin D (d) Insulin

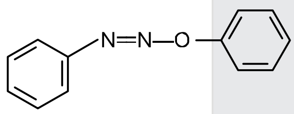
Sol. **(d)**
Insuline is a globular protein and it is water soluble.

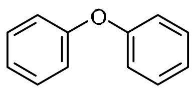
87. The major product of the following reaction :

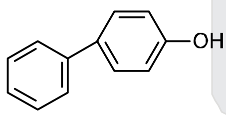


is :

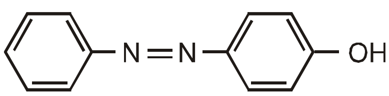
(a) 

(b) 

(c) 

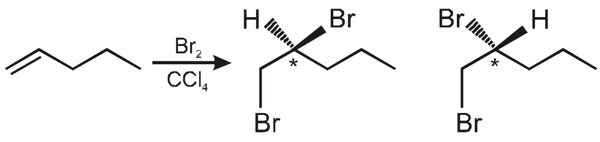
(d) 

Sol. **(a)**
Aniline first gives benzene diazonium chloride which with phenol in NaOH gives azo dye.



88. Addition of Br_2 to 1-pentene would produce 1, 2-dibromopentane which is :
(a) meso (c) achiral (c) optically active (d) racemic

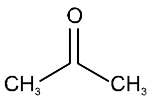
Sol. **(d)**



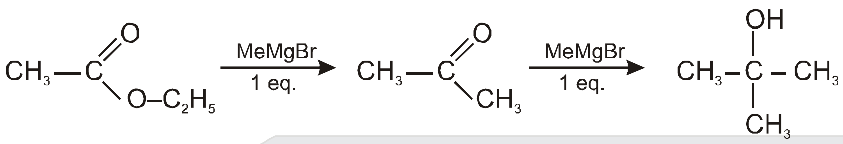
Racemic mixture

89. The major product of the following reaction

$$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-OC_2H_5 \xrightarrow[(2)\text{Dil. HCl}]{(1)\text{ Excess MeMgBr}} \text{ is :}$$

(a) $CH_3-\underset{\underset{\displaystyle CH_3}{|}}{\overset{\overset{\displaystyle OH}{|}}{C}}-CH_3$ (b)  (c) $CH_3-\underset{\underset{\displaystyle H}{|}}{\overset{\overset{\displaystyle OH}{|}}{C}}-CH_3$ (d) None of the above

Sol. **(a)**



90. Which one of the following has peptide linkage ?

(a) $HOOC-\underset{\underset{\displaystyle NH_2}{|}}{CH}-CH_2-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-NH_2$

(b) $HOOC-\underset{\underset{\displaystyle NH_2}{|}}{CH}-(CH_2)_3-NH-\underset{\underset{\displaystyle NH_2}{|}}{C}=NH$

(c) $H_2N-CH_2-CONH-\underset{\underset{\displaystyle CH_3}{|}}{CH}-COOH$

(d) $HOOC-\underset{\underset{\displaystyle NH_2}{|}}{CH}-CH_2CONH_2$

Sol. **(c)**
Peptide linkage is present in (c) only

$$H_2N-CH_2-\overset{\overset{\displaystyle O}{||}}{C}-\underset{\underset{\displaystyle H}{|}}{N}-\underset{\underset{\displaystyle CH_3}{|}}{CH}-COOH$$

91. The kinetic energy of an electron emitted when green light of wave-length 500 nm shines on sodium metal (work function = 2.3 eV) is : [Planck's constant = 6.6×10^{-34} J s]
(a) 0.0175 eV (b) 0.175 eV (c) 1.75 eV (d) 17.5 eV

Sol. **(b)**

$h\nu = h\nu_0 + KE$

$\left[\frac{h\nu}{\lambda}\right] = 2.3 + KE$

$\frac{6.6 \times 10^{-34} \times 3 \times 10^{8}}{5 \times 10^{-7} \times 1.6 \times 10^{-19}} = 2.3 + K.E.$

2.475 = 2.3 + K.E.

K.E. = 0.175 eV

92. The transition from $n_i = 6$ to $n_f = 2$ state in a hydrogen atom shows an emission in the region of the electromagnetic spectrum known as

(a) microwave (b) infrared (c) visible (d) ultraviolet

Sol. **(c)**

From n = 6 to n = 2 transition, spectrum region is visible.

93. The correct order for the number of radial nodes is :

(a) 4s > 5d > 3p > 3d (b) 3p > 3d > 4s > 5d (c) 5d > 4s > 3d > 3p (d) 4s > 3p> 3d > 5d

Sol. **(a)**

Number of radial node = $n - \ell - 1$

4s	=	4 – 1	=	3
3p	=	3 – 1 – 1	=	1
3d	=	3 – 2 – 1	=	0
5d	=	5 – 2 – 1	=	2

94. The correct order of ionization enthalpies is :

(a) O < N < B < Be < Li (b) Li < Be < B < N < O (c) Li < B < Be < O < N (d) Li < B < Be < N < O

Sol. **(c)**

Order of I.E. is $\Rightarrow$ Li < B < Be < O < N.

95. In the nuclear reaction

${}^{238}_{92}U \rightarrow {}^{206}_{82}U$

the number of α and β particles

(a) $8\alpha, 8\beta$ (b) $6\alpha, 4\beta$ (c) $4\alpha, 3\beta$ (d) $8\alpha, 6\beta$

Sol. **(d)**

${}^{238}_{92}U \longrightarrow {}^{206}_{82}Pb + X\left({}^{4}_{2}He\right) + Y\left({}^{0}_{-1}e\right)$

238 = 206 + 4x or X = 8

on balancing for charge Y = 6

96. Consider the following statements in respect of internal energy (U), pressure (P) and temperature (T) :

1. U, P, T are intensive variables.
2. U, P, T are state functions.
3. U, P, T do not change during a reversible isothermal expansion of an ideal gas.
4. U, P, T do not change during a reversible isothermal expansion of a real gas.

How many statements are correct ?

(a) Only one (b) Only two (c) Only three (d) All

Sol. **(a)**

U, P, T are state function.

97. Which one of the following is not correct regarding isothermal expansion of an ideal gas?
(a) The work done reversibly is maximum.
(b) The heat exchanged reversibly is maximum.
(c) The work done is equal to the heat exchanged for a reversible process.
(d) The work done is not equal to the heat exchanged for a irreversible process.

Sol. **(d)**
$\Delta E = q + W$ as $\Delta E = 0$
or $q = -W$

98. What is the equilibrium expression for the reaction
$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$?

(a) $K_c = \dfrac{[P_4O_{10}]}{[P_4][O_2]^5}$

(b) $K_c = \dfrac{[P_4O_{10}]}{5[P_4][O_2]}$

(c) $K_c = [O_2]^5$

(d) $K_c = \dfrac{1}{[O_2]^5}$

Sol. **(d)**

$$K_C = \frac{1}{[O_2]^5}$$

Active mass of solid is equal to 1.

99. Consider the reaction
$Zn^{2+}(aq) + H_2S(g) \rightleftharpoons ZnS(s) + 2H^+(aq)$
Which one of the following does not shift the equilibrium to the right ?
(a) Increasing the pH
(b) Removal of H^+ ions
(c) Increasing the pressure
(d) Removal of ZnS(s)

Sol. **(d)**
Change in amount of pure liquid and solid does not affect equilibrium.

100. Which concentration(s) can be calculated if the mole fraction, density of an aqueous solutiot HCl are known?
1. Molality
2. Molarity
3. Percent by mass
Select the correct answer using code given below.
(a) 1 only (b) 3 only (c) 1 and 2 only (d) 1,2 and 3

Sol. **(d)**

$$\text{Molality} = \frac{1000 \times X_B}{\text{Molecular weight}_A \times X_A}$$

$A \rightarrow$ solvent $B \rightarrow$ solute

$$d = M\left[\frac{1}{m} + \frac{\text{molecular weight solute}}{1000}\right]$$

101. The temperature in cold countries can go down to –10°C. Ethylene glycol is usually added to water as antifreeze agent. The amount of $HOCH_2CH_2OH$ that must be added so that the water in the car radiator (1.86 kg) does not freeze is (cryoscopic constant of water K_f = 1.86 K kg mol^{-1})

(a) 6.2 g (b) 62 g (c) 620 g (d) 6200 g

Sol. **(c)**

$\Delta T_f = K_f \times m$

or $10 = 1.86 \times \left[\dfrac{n}{1.86}\right]$

n = 10

W_{Glycol} = 10 × 62 = 620 gm.

102. The enthalpies of formation of ethylene and ethane are 52.3 kJ mol^{-1} and –84.6 kJ mol^{-1} respectively. The $\Delta H°$ for the reaction :

$C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$ in kJ mol^{-1} is :

(a) –32.3 (b) –136.9 (c) 32.3 (d) 136.9

Sol. **(b)**

$\Delta H_{reaction} = \Delta H_F (C_2H_6) - \Delta H_F (C_2H_4) - \Delta H_F (H_2)$

= – 84.6 – 52.3

= – 136.9

103. In which pair does the named substance have the same oxidation number?

(a) Sulphur in $H_2S_2O_7$ and H_2SO_4

(b) Mercury in Hg^{2+} and Hg_2^{2+}

(c) Oxygen in Na_2O_2 and H_2O

(d) Cobalt in $Co(NH_3)_6^{3+}$ and $Co(NO_3)_2$

Sol. **(a)**

$H_2S_2O_7$ ⇒ O.N. of S = + 6

H_2SO_4 ⇒ O.N. of S = + 6

104. The half-life of ^{14}C is 5570 years. How many years (approximate) will it take for 90% of a sample to decompose? ($\log_{10} 2 = 0.3$)

(a) 5570 years (b) 11140 years (c) 18600 years (d) 50100 years

Sol. **(c)**

$t = \dfrac{2.303 \times 5570}{0.693} \log \dfrac{100}{10}$

= 18600 year.

105. Consider the following statements in respect of covalent compounds :

1. They are bad conductors of electricity
2. They are all liquids at room temperature.
3. They do not show isomerism.

Which of the statements given above is/are correct?

(a) 1 only (b) 1 and 2 (c) 1 and 3 (d) 2 only

Sol. **(a)**

They are bad conductor of electricity.

106. Consider the following statements :
Statement-1 : The S-O bond distance in SO_2 is intermediate between a single bond and a double bond.
Statement-2 : The actual structure of SO_2 is a resonance hybrid of multiple canonical forms.
Which one of the following in respect of the above statements is correct?
(a) Both the statements are correct and Statement-2 is the correct explanation for Statement-1.
(b) Both the statements are correct but Statement-2 is not the correct explanation for Statement-1.
(c) Statement-1 is correct but Statement-2 is incorrect
(d) Statement-1 is incorrect but Statement-2 is correct

Sol. **(a)**
Both the statement are correct and statement II is the correct explanation for statement 1.

107. A compound contains 28% of nitrogen and 72% of a metal. Three atoms of the metal combine with two atoms of nitrogen. The approximate atomic weight of the metal is :
(a) 12 (b) 24 (c) 36 (d) 48

Sol. **(b)**
28% 72%
N metal
M_3N_2

$$\frac{3\times m}{3\times m+28}\times 100 = 72$$

$$\frac{3m}{3m+28}\times 50 = 36$$

or $75\text{ m} = 54\text{ m} + 504$
or $21\text{ m} = 504$ or $\text{m} = 24$

108. In the cyanide process of extraction of silver, the ore gives the extract containing :
(a) silver hydroxide (b) diamine silver(I) chloride
(c) silver cyanide (d) None of the above

Sol. **(d)**
In leaching plrocess in the metallurgy of Ag, $Na[Ag(CN)_2]$ is formed.

109. Which one of the following metals is extracted through electrolysis?
(a) Silver (b) Iron (c) Zinc (d) Aluminium

Sol. **(d)**
Al is extracted through electrolysis of Al_2O_3 by Hall Heroult process.

110. The metal ion present in vitamin B_{12} is :
(a) Cu (b) Mg (c) Co (d) Fe

Sol. **(c)**
In vitamine B_{12}. “Co” is present.

111. One of the bivalent metals of Group IIA forms a soluble sulphate and an insoluble hydroxide. But its hydroxide is soluble in solutions of strong alkalies. The metal is :
(a) Ba (b) Ca (c) Mg (d) Be

Sol. **(d)**
$BeSO_4$ is soluble sulphate $Be(OH)_2$ is insoluble.

112. $PbCl_2$ produces a yellow precipitate, when it is added to a solution of K_2CrO_4. But when $PbCl_2$ is added to moderately concentrated HCl and the mixture is cooled :
(a) no precipitate is formed (b) white precipitate is formed
(c) yellow precipitate is formed (d) light grey precipitate is formed

Sol. (b)

$PbCl_2 \xrightarrow{+K_2CrO_4} PbCrO_4$ (yellow precipitate)

Complex $PbCl_4^{-2}$ is formed.

113. The oxide which is solid at room temperature is :

(a) N_2O (b) Br_2O (c) Cl_2O (d) SeO_2

Sol. (d)

SeO_2 is white yellowish solid.

114. The purpose of making alloys is to

1. increases the hardness of the metal.
2. enhance tensile strength.
3. increases corrosion resistance

Select the correct answer using the code given below.

(a) 1, 2 and 3 (b) 1 only (c) 2 and 3 only (d) 2 only

Sol. (a)

There are all purpose of making alloys.

115. Which one of the following is used for drying of ammonia?

(a) 18 N H_2SO_4 (b) CaO (c) P_2O_5 (d) Oleum

Sol. (b)

CaO does not react with ammonia. So, it is used drying agent for ammonia.

116. In which one of the following compounds, hydroxyl group is attached to a vinyl carbon atom?

(a) $CH_2 = CH - CH_2 - OH$ (b) $CH_3 - CH = CH - OH$

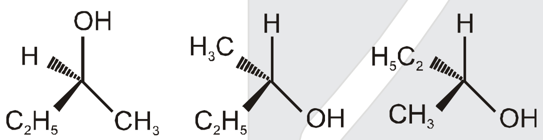
(c) $CH_2 = CH - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - OH$ (d) $CH_2 = CH - \underset{\underset{CH_3}{|}}{CH} - OH$

Sol. (b)

$CH_2 = CH -$ group is called

vinylic group.

117. Consider the following compounds :



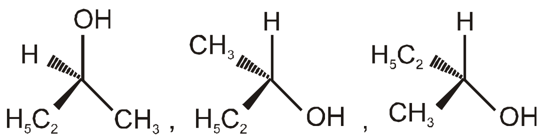
(I) (II) (III)

Which one of the following is correct in respect of the above compounds?

(a) I and II are enantiomers (b) I and III are enantiomers

(c) II and III are identical (d) I and III are identical

Sol. (b)

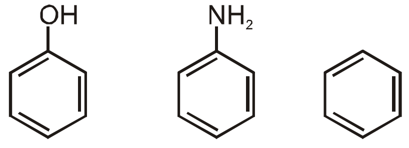


(I) (II) (III)

S S R

I and III are enantiomers.

118. Consider the following compounds :



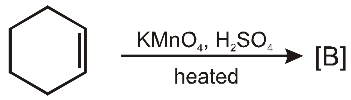
Which of the above compounds will react with bromine water to give tribromo substitution product?

(a) I and II (b) II only (c) I and II (d) III only

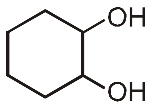
Sol. **(a)**

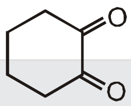
Both I and II have activated aromatic nucleus, hence tribromo substitution product is formed with I and II.

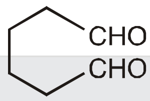
119. Consider the following reaction :

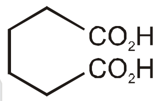


What is the major product [B] of the reaction ?

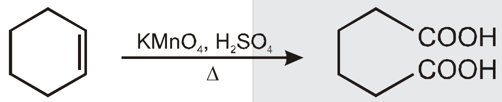
(a) 

(b) 

(c) 

(d) 

Sol. **(d)**



120. Which one of the following is **not** correct in respect of aromatic and aliphatic compounds :

(a) Aliphatic amines are less basic than aromatic amines.

(b) Alcohol are neutral while phenols are acidic in nature.

(c) Aliphatic compounds are generally poorer in carbon content than the aromatic ones.

(d) Aliphatic compounds have open-chain structures while aromatic compounds are closed-chain structure.

Sol. **(a)**

Aliphatic amines are usually more basic than aromatic amines.