OJEE 2024 B Pharm Unofficial Answer Key PDF (May 9, 2024) (Shift 1)

Physics

1. C
The speed of sound is directly proportional to the square root of the absolute temperature ($v \propto \sqrt{T}$). Using $v_{35} = 331 \times \sqrt{308/273}$, we get approximately 351.6 m/s.

2. C
According to Ampere's Law, the magnetic field outside a long straight current-carrying wire at a distance r is given by $B = \frac{\mu_0 I}{2\pi r}$. This applies since $r > a$, placing the point outside the wire.

3. B
A concave (diverging) lens always forms an image on the same side as the object. Regardless of the object's position, the image is always virtual, upright (erect), and diminished in size.

4. C
The equivalent EMF of the parallel batteries is $E_{eq} = \frac{(10/0.5)+(12/0.8)}{(1/0.5)+(1/0.8)} = 10.77$ V. The equivalent internal resistance is $r_{eq} = 0.307\,\Omega$. Total current $I = \frac{10.77}{20+0.307} \approx 0.53$ A.

5. C
Maximum intensity is $I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2 = (\sqrt{I} + \sqrt{4I})^2 = 9I$. Minimum intensity is $I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2 = (\sqrt{I} - \sqrt{4I})^2 = I$.

6. D
The provided nuclear equation contains an inherent error, as Silicon (Si) has an atomic number of 14, not 15 (which is Phosphorus). Because the question is flawed, none of the standard options perfectly balance the realistic physical transmutation.

7. D
The angle of deviation produced by a prism depends on the angle of the prism, the material's refractive index, and the wavelength (colour) of light. It does not depend on the physical size of the prism.

8. B
The mutual conductance (g_m) of a triode valve is the ratio of its amplification factor (μ) to its anode resistance (r_p). Calculating $g_m = \frac{20}{20000}$ yields 10^{-3} mho.

9. A
The capacitance is $C = \frac{\epsilon_0 \epsilon_r A}{d}$. Substituting the values ($A = 6 \times 10^{-4}$ m^2, $d = 10^{-3}$ m, $\epsilon_r = 3.7$) yields $C \approx 19.6 \times 10^{-12}$ F, which rounds to 20 pF.

10. D
The total charge is $Q = It = (80 \times 10^{-3}$ A$) \times (600$ s$) = 48$ C. The number of electrons is $n = \frac{Q}{e} = \frac{48}{1.6\times10^{-19}} = 3.0 \times 10^{20}$.

11. C
The inductive reactance is $X_L = 2\pi f L = 2\pi(25)(0.35) \approx 54.95\,\Omega$. The total

impedance is $Z = \sqrt{R^2 + X_L^2} = \sqrt{20^2 + 54.95^2} \approx 58.5\,\Omega$.

12. A
The induced back emf is calculated using Faraday's law of induction: $E = L\frac{di}{dt}$. Multiplying the inductance (0.008 H) by the rate of change (110 A/s) gives 0.88 V.

16. B
Nuclear reactors generate energy by splitting heavy, unstable atomic nuclei into lighter ones. This controlled splitting process is known as nuclear fission.

17. A
The primary source of energy in the Sun is nuclear fusion. This involves the conversion of lighter hydrogen nuclei into heavier helium nuclei under extreme conditions.

18. D
Number density is calculated by $n = \frac{N_A \times \text{density}}{\text{atomic weight}}$. Substituting the given values gives $n = \frac{6.022\times10^{23}\times10.5\times10^3}{107.8\times10^{-3}} \approx 5.86 \times 10^{28}$ carriers/m^3.

19. C
The energy of the emitted photon is given by $E = \frac{hc}{\lambda}$. Using $hc \approx 1240$ eV · nm, $E = \frac{1240}{589.6} \approx 2.1$ eV.

20. D
Dimensional analysis dictates that velocity $[LT^{-1}]$ must equal $[MLT^{-2}]^a[ML^{-1}]^b$. Solving for a and b gives $a = 1/2$ and $b = -1/2$.

21. B
The distance fallen in the first 3 seconds is $y = \frac{1}{2}g(3)^2 = 45$ m. The distance in the last second is $y = \frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2 = 5(2t-1)$. Setting $5(2t-1) = 45$ gives $t = 5$ s.

22. A
Maximum speed in SHM is given by $v_{max} = A\omega$, where $\omega = \frac{2\pi}{T}$. Substituting $A = 3$ cm and $T = 6$ s yields $v_{max} = 3 \times \frac{2\pi}{6} = \pi$ cm/s.

23. C
Acceleration is the second derivative of position with respect to time. $v(t) = 4\alpha t^3 - 3\beta t^2 + \gamma$, and $a(t) = 12\alpha t^2 - 6\beta t$.

24. A
The net force is $F_{net} = F_1 + F_2 = (20+8)i + (30-50)j = 28i - 20j$ N. Acceleration $a = \frac{F_{net}}{m} = \frac{28i-20j}{7} = 4i - \frac{20}{7}j$.

25. D
Velocity components are $v_x = \frac{dx}{dt} = 12t$ and $v_y = \frac{dy}{dt} = -20 + 16t$. At $t = 0$, initial velocity is $v_0 = \sqrt{(0)^2 + (-20)^2} = 20$ m/s.

26. D
The relative velocity of rain with respect to the woman dictates the perceived angle. Using vector subtraction and trigonometry, $\tan\beta$ is the ratio of the net horizontal velocity component to the vertical component: $\frac{8+10\sin\alpha}{10\cos\alpha}$.

27. A
The maximum safe speed on a banked curve without friction is $v = \sqrt{rg\tan\theta}$. $v = \sqrt{48 \times 9.8 \times 0.27} \approx 11.27$ m/s, which converts to approximately 40.6 km/h.

28. A

Power is related to voltage and current by $P = VI$ (assuming unity power factor). Therefore, the current drawn is $I = \frac{P}{V} = \frac{1500}{250} = 6$ A.

29. A
The gravitational force is $F = \frac{Gm^2}{r^2} = \frac{6.67\times10^{-11}\times(0.008)^2}{(0.5)^2} \approx 1.7\times10^{-14}$ N. Weight is $W = mg = 0.008\times9.81 \approx 0.078$ N. The ratio is $\frac{W}{F} \approx 4.6\times10^{12}$.

30. B
The force dF from an element dx is $Gm\frac{\lambda dx}{x^2}$. Integrating $\frac{A+Bx^2}{x^2}dx$ from a to $a+L$ yields $Gm\left[A\left(\frac{1}{a}-\frac{1}{a+L}\right)+BL\right]$.

33. A
Using conservation of energy: $mg(h_{fall}+x) = \frac{1}{2}kx^2$. The compression is $x = 0.25 - 0.10 = 0.15$ m. Thus, $m(9.81)(0.6+0.15) = \frac{1}{2}(2400)(0.15)^2$, giving $m \approx 3.67$ kg.

34. B
The mass flowing per unit time is $\frac{dm}{dt} = kv$. The rate of kinetic energy imparted is Power $= \frac{1}{2}\left(\frac{dm}{dt}\right)v^2 = \frac{1}{2}(kv)v^2 = \frac{1}{2}kv^3$.

35. C
For a single bulb, resistance $R = \frac{V^2}{P}$. For n bulbs in series, total resistance is nR. Total power drawn across the same voltage V is $P_{total} = \frac{V^2}{nR} = \frac{P}{n}$.

36. D
Work done in an adiabatic process is $W = -C_v\Delta T = -\frac{R}{\gamma-1}\Delta T$. Given $W = 12R$ and $\gamma = 5/3$, $12R = -\frac{R}{2/3}(T_f - T_i) \Rightarrow 12 = -1.5\Delta T \Rightarrow \Delta T = -8$ K.

37. A
Taking torques and forces at equilibrium: $N_{wall} = \mu N_{floor} = \mu(mg)$. Balancing torques about the base relates the distance the man climbs to the friction coefficient, solving to $\mu^2 h$ based on standard ladder geometry.

38. D
Torque $\tau = F\times r = 15\times0.10 = 1.5$ N $\cdot$ m. Angular acceleration $\alpha = \frac{\tau}{I} = \frac{1.5}{0.02} = 75$ rad/s^2.

39. C
For a uniform hollow cylinder with inner radius a and outer radius b, the moment of inertia about its central axis is $\frac{1}{2}M(a^2+b^2)$. This is derived by integrating thin cylindrical shells over the radial volume.

40. C
Extension $\Delta L = \frac{FL}{AY}$. Since F and Y are constant, $\Delta L \propto \frac{L}{d^2}$. Ratio $\frac{\Delta L_A}{\Delta L_B} = \left(\frac{L_A}{L_B}\right)\times\left(\frac{d_B}{d_A}\right)^2 = \left(\frac{1}{2}\right)\times\left(\frac{1}{2}\right)^2 = \frac{1}{8}$.

41. A
Angular momentum $\vec{L} = \vec{r}\times(m\vec{v}) = m(\vec{r}\times\vec{v})$. Calculating the cross product $(-2i+4j+6k)\times(5i+4j+6k)$ gives $m(0i+42j-28k)$.

42. A
Bulk modulus $K = \frac{\Delta P}{-\Delta V/V}$. $\Delta P = K\times\left(\frac{\Delta V}{V}\right) = (2.1\times10^9)\times(0.00004) = 8.4\times10^4$ N/m^2.

43. A

According to the equation of continuity, $A_1 v_1 = A_2 v_2$. Since area is proportional to the square of the radius, halving the radius reduces the area to 1/4, meaning velocity must increase by a factor of 4.

44. A
Using Boyle's Law ($P_1V_1 = P_2V_2$) assuming constant temperature. $P_{bottom} = P_{atm} + \rho gh$. Given $V_{surface} = 2V_{bottom}$, $P_{bottom} = 2P_{atm}$, solving for h using the specific gravities gives approximately 15 m.

45. D
Velocity of efflux $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 20} = 19.8$ m/s. Volume flow rate $= A \times v = (1 \times 10^{-6}\ \text{m}^2) \times 19.8\ \text{m/s} = 19.8 \times 10^{-6}\ \text{m}^3/\text{s} = 19.8\ \text{cm}^3/\text{s}$.

46. D
A temperature difference of 5°C is equivalent to a difference of 9°F. Therefore, a difference of 1°C is equal to $\frac{9}{5} = 1.8$°F.

47. A
The rate of heat transfer is proportional to thermal conductivity K. The time taken to melt the ice is inversely proportional to the rate of heat transfer. Thus, $\frac{K_P}{K_Q} = \frac{t_2}{t_1}$.

48. D
Using the Stefan-Boltzmann Law, $P = \sigma A T^4$. $T = \left(\frac{3.9 \times 10^{26}}{5.67 \times 10^{-8} \times 6.1 \times 10^{18}}\right)^{1/4} \approx$ 5800 K.

49. B
Using the ideal gas law $T_2 = T_1 \frac{P_2 V_2}{P_1 V_1}$. Assuming standard initial conditions ($T_1 \approx$ 273 K), $T_2 = 273 \times \frac{50}{16} \approx 853$ K.

50. B
For equilibrium of one of the Q charges, the net force must be zero: $\frac{kQ^2}{(2x)^2} + \frac{kQq}{x^2} = 0$. Solving for q gives $q = -\frac{Q}{4}$.

51. D
In an isovolumetric (isochoric) process, the volume remains constant ($\Delta V = 0$). Since work done by a gas is $W = P\Delta V$, the work done is exactly 0 J.

52. B
Vernier constant (Least Count) = 1 MSD − 1 VSD. Since 100 VSD = 99 MSD, 1 VSD = 0.99 mm. Thus, LC = 1 mm − 0.99 mm = 0.01 mm = 10μm.

53. A
Heat lost by body = Heat used to evaporate water. $M_{body} c \Delta T = m L_v$. $m = \frac{5000\text{ g} \times 0.83 \times 2}{580} \approx 14.3$ g.

54. D
In equilibrium, power radiated equals power absorbed. $P = \sigma A T^4$. $30000 = (5.67 \times 10^{-8})(4\pi \times 0.03^2)T^4$. Solving for T yields approximately 2600 K.

55. B
Using the conservation of moles: $n_{initial} = n_{final,hot} + n_{final,cold}$. $\frac{1 \times 600}{293} = \frac{P \times 400}{373} + \frac{P \times 200}{273}$. Solving for P yields $P \approx 1.13$ atm.

56. C
Root mean square speed $v_{rms} = \sqrt{\frac{3RT}{M}}$. Equating speeds: $\sqrt{\frac{T}{2}} = \sqrt{\frac{320}{32}} \Rightarrow \frac{T}{2} =$

$10 \Rightarrow T = 20$ K.

57. C

Terminal velocity is given by Stokes' Law: $v_t = \frac{2r^2(\rho-\sigma)g}{9\eta}$. Substituting the given density of water, air, and viscosity values will give a velocity of approximately 1.2 m/s.

58. C

The standard wave equation is $y = A\sin(\omega t - kx)$. Wave speed $v = \frac{\omega}{k} = \frac{30}{4.0} = 7.5$ m/s.

59. B

Focal length $f = R/2 = -18$ cm. Magnification $m = -1/9 = -\frac{v}{u}$, so $v = u/9$. Using mirror formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$, we get $\frac{9}{u} + \frac{1}{u} = -\frac{1}{18} \Rightarrow u = -180$ cm.

60. B

Wave speed $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{4}{0.0001}} = 200$ m/s. Fundamental frequency $f = \frac{v}{2L} = \frac{200}{2\times0.5} = 200$ Hz.

Chemistry

1. B

Solutions are classified as aqueous (if water is the solvent) or non-aqueous (if any other liquid is the solvent). This classification is strictly based on the nature of the solvent used.

2. A

An aqueous solution by definition uses water as its primary dissolving medium. Therefore, water is the solvent used to prepare them.

3. C

A true solution has extremely small particle sizes (less than 1 nm). These particles are too small to scatter light, which is why they do not exhibit the Tyndall effect.

4. C

The Tyndall effect is the scattering of light by particles in a mixture. It is exclusively exhibited by colloidal solutions and fine suspensions, where particles are large enough to scatter the light beam.

5. B

The Tyndall effect occurs due to the scattering of light. When light hits the relatively large colloidal particles, it is deflected in various directions, making the beam visible.

6. B

Colloidal particles generally range in size from 1 nm to 1000 nm. In Angstroms, this roughly translates to 10Å to $10,000$Å, making option B (0Å - 2000Å) the most appropriate functional range provided.

7. C

Suspensions contain macroscopic particles that eventually settle out under gravity. These particles are generally larger than 1000 nm, equating to more than $10,000$Å (or > 2000Å in the given options).

8. A
A supersaturated solution contains more dissolved solute than could be dissolved by the solvent under normal saturated conditions at that temperature.

9. C
Chalk (calcium carbonate) does not dissolve in water; instead, its relatively large particles remain temporarily suspended. Therefore, it forms a heterogeneous suspension.

10. A
In a true solution, the solute breaks down to individual ions or small molecules. These have a diameter typically less than 1 nm (or 1Å - 10Å).

11. B
Milk is an emulsion, which is a specific type of colloidal solution. It consists of liquid butterfat globules dispersed within a water-based liquid.

12. D
Nitrogen in the soil (specifically dissolved in soil moisture) represents a very dilute mixture. It acts as an unsaturated solution because the soil moisture can dissolve far more gases or nutrients.

13. A
Fog is an aerosol consisting of fine water droplets suspended in the air. Therefore, it is a colloidal system of a liquid dispersed in a gas.

14. B
Soda water is made by dissolving carbon dioxide gas into liquid water under pressure. It is a classic example of a gas-in-liquid solution.

15. B
Blood is a complex mixture consisting of cells, proteins, and other substances suspended in plasma. Because of the size of the proteins and cells, it functions as a colloidal solution.

16. A
In colloidal chemistry, the dispersed phase is the substance that is distributed as particles. This is analogous to the "solute" in a standard true solution.

17. B
Sugar and salt completely dissolve in water down to a molecular/ionic level, forming transparent, uniform mixtures. Hence, they form homogeneous true solutions.

18. C
Brownian movement refers to the erratic, random motion of colloidal particles. This behavior is driven by the kinetic energy of the surrounding dispersing medium molecules continuously colliding with them.

19. D
The term "aqueous" is derived from "aqua," the Latin word for water. Therefore, the solvent in any aqueous solution is always water.

20. B
If a solution can still dissolve more solute at a given temperature, it has not yet

reached its maximum capacity (saturation). It is therefore termed an unsaturated solution.

21. B
Cheese is a solid emulsion (or gel), where liquid (water/fats) is dispersed within a solid protein network (casein). Therefore, it is a colloid of a liquid in a solid.

22. D
Cork consists of a solid matrix of plant cell walls trapping pockets of air. This makes it a solid foam, which is a colloidal system of a gas dispersed in a solid.

23. D
Smoke is formed when solid unburned particles (like soot or ash) are suspended in the air. It is an example of a solid dispersed in a gas (a solid aerosol).

24. A
The standard solubility of copper(II) sulfate in water increases significantly with temperature. Reaching 20.7 g of solubility often aligns with near-boiling properties in specific lab conditions (100°C).

25. B
Sodium chloride (table salt) has a fairly constant solubility in water across standard temperatures. At 25°C, approximately 36 grams of NaCl will dissolve in 100 grams of water.

26. C
For sodium halides, solubility generally increases with the size of the halide ion due to decreasing lattice enthalpy. The correct increasing order of solubility is $NaCl < NaBr < NaI$.

27. C
When Calcium Oxide (CaO) dissolves/reacts with water to form Calcium Hydroxide, a large amount of heat is released. This makes the dissolution process highly exothermic.

28. A
Henry's Law states that the amount of dissolved gas in a liquid is proportional to its partial pressure above the liquid. Therefore, an increase in pressure increases the gas's solubility.

29. A
To avoid nitrogen narcosis and oxygen toxicity at extreme depths, deep-sea divers use a breathing mixture called Heliox. This is a mixture of Helium and Oxygen.

30. A
The continuous, erratic, and random zig-zag motion of microscopic particles suspended in a fluid is scientifically termed Brownian movement.

31. A
For most solid solutes in liquid solvents, the dissolution process is endothermic. According to Le Chatelier's principle, applying heat (increasing temperature) generally increases their solubility.

32. B
Henry's law provides the quantitative relationship between gas pressure and its sol-

ubility in a liquid. It dictates that solubility directly scales with the gas's partial pressure.

33. B

The scattering of a light beam by suspended particles (like dust in a room or colloids in a liquid) makes the light beam's path visible. This specific physical phenomenon is called the Tyndall effect.

34. B

The word 'atom' comes from the ancient Greek word 'atomos', which was used by Democritus. It literally translates to "uncuttable" or "indivisible."

35. B

Isotopes are variants of a particular chemical element. They share the same atomic number (protons) but differ in neutron count, which results in a different mass number.

36. A

Both Carbon-12 (^{12}C) and Carbon-14 (^{14}C) belong to the element Carbon (atomic number 6). Since they have different mass numbers, they are isotopes of each other.

37. B

Isobars are atoms (nuclides) of entirely different chemical elements that happen to have the exact same total number of nucleons. Thus, they possess the same atomic mass number.

38. D

Isotones are atoms of different elements that have different numbers of protons but share the exact same number of neutrons in their nuclei.

39. C

The chemical formula for an ozone molecule is O_3. Because there are three oxygen atoms bonded together in a single molecule, its atomicity is 3.

40. B

Primary elemental gases encountered under standard conditions (like H_2, N_2, O_2, Cl_2) exist as diatomic molecules. Therefore, their standard atomicity is 2.

41. A

In 1924, French physicist Louis de Broglie introduced the revolutionary hypothesis that all matter exhibits wave-like properties. This is known as the matter-wave concept or de Broglie hypothesis.

42. C

The Uncertainty Principle was formulated by Werner Heisenberg in 1927. It states that it is impossible to simultaneously know both the exact position and momentum of a quantum particle.

43. C

Argon-40 ($_{18}Ar^{40}$) and Calcium-40 ($_{20}Ca^{40}$) are atoms of different elements but have the same mass number (40). Therefore, they are classified as isobars.

44. D

While simple compounds like benzene (C_6H_6) and acetylene (C_2H_2) have a 1:1 empirical ratio, sucrose ($C_{12}H_{22}O_{11}$) has a complex, non-reducible atomic ratio.

45. D
Avogadro's hypothesis states that equal volumes of all gases, under the exact same conditions of temperature and pressure, contain an equal number of molecules.

46. C
Atomicity is formally defined as the total number of atoms that constitute a single molecule of that specific element or compound.

47. D
Mathematically, the atomicity of a homonuclear elemental molecule can be determined by dividing its total molecular mass by its individual atomic mass.

48. D
Carbon-13 ($_6C^{13}$) has 7 neutrons (13 - 6), and Nitrogen-14 ($_7N^{14}$) also has 7 neutrons (14 - 7). Since they have the same number of neutrons, they are isotones.

49. C
By definition, isotones are distinct nuclides of different elements that share the exact same number of neutrons.

50. C
In its most common standard state (white or yellow phosphorus), the element exists as tetra-atomic molecules (P_4). Therefore, its atomicity is 4.