

Solution of All Sets

Questions (Physics)	Answers (Physics)
1. In the circuit shown, $L = 1 \mu\text{H}$, $C = 1 \mu\text{F}$ and $R = 1 \text{k}\Omega$. They are connected in series with an a.c. source $V = V_0 \sin \omega t$ as shown. Which of the following options is/are correct ?	(1) At $\omega \sim 0$ the current flowing through the circuit becomes nearly zero, (2) The frequency at which the current will be in phase with the voltage is independent of R.
2. For an isosceles prism of angle A and refractive index μ , it is found that the angle of minimum deviation $\delta_m = A$. Which of the following options is/are correct ?	(1) For the angle of increase $i_1 = A$, the ray inside the prism is parallel to the base of the prism, (2) At minimum deviation, the incident angle i_1 and the refracting angle r_1 at the first refracting surface are related by $r_1 = (i_1/2)$, (3) For this prism, the emergent ray at the second surface will be tangential to the surface when the angle of incidence at the first surface is $i_1 = \sin^{-1} \left[\sin A \sqrt{4 \cos^2 \frac{A}{2} - 1} - \cos A \right]$
3. A circular insulated copper wire loop is twisted to form two loops of area A and 2A as shown in the figure. At the point of crossing the wires remains electrically insulated from each other. The entire loop lies in the plane (of the paper). A uniform magnetic field \vec{B} points into the....	(1) The rate of change of the flux is maximum when the plane of the loops is perpendicular to plane of the paper, (2) The amplitude of the maximum net emf induced due to both the loops is equal to the amplitude of maximum emf induced in the smaller loop alone.
4. A flat plate is moving normal to its plane through a gas under the action of a constant force F. The gas is kept at a very low pressure. The speed of the plate v is much less than the average speed u of the gas molecules. Which.....	(1) At a later time the external force F balances the resistive force, (2) The pressure difference between the leading and trailing faces of the plate is proportional to uv.
5. A block of mass M has a circular cut with a frictionless surface as shown. The block rests on the horizontal frictionless surface of a fixed table. Initially the right edge of the block is at $x = 0$, in a co-ordinate system fixed to the table. A point mass m is released from rest at the topmost point of the path as shown and it slides down....	(1) The velocity of the point mass m is : $v = \sqrt{\frac{2gR}{1 + \frac{m}{M}}}$, (2) The x component of displacement of the center of mass of the block M is : $-\frac{mR}{M + m}$
6. A block M hangs vertically at the bottom end of a uniform rope of constant mass per unit length. The top end of the rope is attached to a fixed rigid support at O. A transverse wave pulse (Pulse 1) of wavelength λ_0 is produced at point O on the rope. The pulse takes.....	(1) The time $T_{AO} = T_{OA}$, (2) The velocity of any pulse along the rope is independent of its frequency and wavelength, (3) The velocities of the two pulses (Pulse 1 and Pulse 2) are the same at the midpoint of rope.
7. A human body has a surface area of approximately 1 m^2 . The normal body temperature is 10 K above the surrounding room temperature T_0 . Take the room temperature to be $T_0 = 300 \text{ K}$. For $T_0 = 300 \text{ K}$, the value of $\sigma T_0^4 = 460 \text{ Wm}^{-2}$ (where σ is the Stefan-Boltzmann constant). Which of the following options is/are correct ?	(1) If the surrounding temperature reduces by a small amount $\Delta T_0 < T_0$, then to maintain the same body temperature the same (living) human being needs to radiate $\Delta W = 4\sigma T_0^3 \Delta T_0$ more energy per unit time, (2) The amount of energy radiated by the body in 1 second is close to 60 Joules, (3) Reducing the exposed surface area of the body (e.g. by curling up) allows humans to maintain the same body temperature while reducing the energy lost by radiation.
8. Integer : An electron in a hydrogen atom undergoes...	5 (five)
9. Integer : A drop of liquid of radius $R = 10^{-2} \text{ m}$ having...	6 (six)
10. Integer : A stationary source emits sound of frequency...	6 (six)
11. Integer : ^{131}I is an isotope of iodine that β decays to an...	5 (five)
12. Integer : A monochromatic light is travelling in a	8 (eight)
13. In which case would the particle move in a straight line along the negative direction of y-axis (i.e., move amog...)	Proton with $\vec{v} = 0 \rightarrow \vec{E} = -E_0\hat{y} \rightarrow \vec{B} = B_0\hat{y}$
14. In which case will the particle move in a straight line with constant velocity ?	Electron with $\vec{v} = \frac{E_0}{B_0}\hat{y} \rightarrow \vec{E} = -E_0\hat{x} \rightarrow \vec{B} = B_0\hat{z}$
15. In which case will the particle describe a helical path....	Proton with $\vec{v} = 2\frac{E_0}{B_0}\hat{x} \rightarrow \vec{E} = E_0\hat{z} \rightarrow \vec{B} = B_0\hat{z}$
16. Which one of the following options correctly represents a thermodynamic process that is determination of the speed of sound in an ideal gas ?	$W_{1 \rightarrow 2} = \frac{1}{\gamma - 1}(P_2V_2 - P_1V_1) \rightarrow$ Adiabatic \rightarrow 
17. Which of the following options is the only correct representation of a process in which $\Delta U = \Delta Q - P\Delta V$?	$W_{1 \rightarrow 2} = -PV_2 + PV_1 \rightarrow$ Isobaric \rightarrow 
18. Which one of the following options is the correct combination ?	$W_{1 \rightarrow 2} = 0 \rightarrow$ Isochoric \rightarrow 
Questions (Chemistry)	Answers (Chemistry)
19. The colour of the X_2 molecules of group 17 elements....	(1) Decrease in HOMO-LUMO gap down the group, (2) Decrease in $\pi^* - \sigma^*$ gap down the group.
20. Addition of excess aqueous ammonia to a pink....	(1) The hybridization of the central metal ion in Y is d^2sp^3 (2) When X and Z are in equilibrium at 0°C , the colour of the solution is pink, (3) Z is a tetrahedral complex.
21. An ideal gas is expanded from (p_1, V_1, T_1) to (p_2, V_2, T_2)	(1) If the expansion is carried out freely, it is simultaneously both isothermal as well as adiabatic, (2) The work done by the gas is less when it is expanded reversibly from V_1 to V_2 under adiabatic

	conditions as compared to that when expanded reversibly from V_1 to V_2 under isothermal conditions, (3) The work done on the gas is maximum when it is compressed irreversibly from (p_2, V_2) to (p_1, V_1) against constant pressure p_1
22. For a solution formed by mixing liquids L and M, the.....	(1) Attractive intermolecular interactions between L-L in pure liquid L and M-M in pure liquid M are stronger than those between L-M when mixed in solution, (2) The point Z represents vapour pressure of pure liquid L and Raoult's law is obeyed when $x_L \rightarrow 1$
23. The IUPAC name(s) of the following compound is(are)...	(1) 1-chloro-4-methylbenzene, (2) 4-chlorotoluene
24. The correct statement(s) for the following addition.....	(1) Bromination proceeds through trans-addition in both the reactions, (2) (M and O) and (N and P) are two pairs of diastereomers.
25. The correct statement(s) about the oxoacids, HClO_4	(1) The conjugate base of HClO_4 is weaker base than H_2O , (2) The central atom in both HClO_4 and HClO is sp^3 hybridized, (3) HClO_4 is more acidic than HClO because of the resonance stabilization of its anion.
26. Integer : The conductance of a 0.0015 M aqueous	6 (six)
27. Integer : The sum of the number of lone pairs of....	6 (six)
28. Integer : Among the following, the number of atomati...	5 (five)
29. Integer : A crystalline solid of a pure substance has....	2 (two)
30. Integer : Among H_2 , He_2^+ , Li_2 , Be_2 , B_2 , C_2 , N_2 , O_2^-	6 (six)
31. For He^+ ion, the only INCORRECT combination is.....	1s orbital $\rightarrow \psi_{n,l,m} \propto \left(\frac{Z}{a_0}\right)^{\frac{5}{2}} re^{-\left(\frac{Zr}{2a_0}\right)} \cos\theta \rightarrow$ Probability density is maximum at nucleus.
32. For the given orbital in Column 1, the only CORRECT...	2s orbital \rightarrow One radial node \rightarrow 
33. For hydrogen atom, the only CORRECT combination....	1s orbital $\rightarrow \psi_{n,l,m} \propto \left(\frac{Z}{a_0}\right)^{\frac{3}{2}} e^{-\left(\frac{Zr}{a_0}\right)} \rightarrow$ Energy needed to excite electron from $n = 2$ state to $n = 4$ state is 27/32 times the energy needed to excite electron from $n = 2$ state to $n = 6$ state.
34. The only CORRECT combination in which the reaction...	Toluene $\rightarrow \text{Br}_2/h\nu \rightarrow$ Substitution
35. For the synthesis of benzoic acid, the only CORRECT...	Acetophenone $\rightarrow \text{NaOH}/\text{Br}_2 \rightarrow$ Haloform
36. The only CORRECT combination that gives two.....	Benzaldehyde $\rightarrow (\text{CH}_3\text{CO})_2\text{O}/\text{CH}_3\text{COOK} \rightarrow$ Condensation
Questions (Mathematics)	
Answers (Mathematics)	
37. Let a, b, x and y be real numbers such that $a - b = 1$	(1) $-1 + \sqrt{1 - y^2}$, (2) $-1 - \sqrt{1 - y^2}$
38. Let $f: \mathbb{R} \rightarrow (0, 1)$ be a continuous function. Then,	(1) $x^9 - f(x)$, (2) $x - \int_0^{\pi-x} f(t) \cos t dt$
39. If $2x - y + 1 = 0$ is a tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{16} = \dots$	(1) a, 4, 1, (2) a, 4, 2, (3) 2a, 8, 1
40. Let X and Y be two events such that $P(X) = \frac{1}{3}$, $P(X Y) = \dots$	(1) $P(Y) = \frac{4}{15}$, (2) $P(X' Y) = \frac{1}{2}$
41. Which of the following is(are) NOT the square of a 3×3 ...	(1) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$, (2) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$
42. Let $[x]$ be the greatest integer less than or equals to x...	(1) $x = 1$, (2) $x = 2$, (3) $x = -1$
43. If a chord, which is not a tangent, of the parabola $y^2 = \dots$	$p = 2$, $h = 3$; $k = -4$
44. Integer : The sides of a right angled are in arithmetic....	6 (six)
45. Integer : For a real number α , if the system.....	1 (one)
46. Integer : Words of length 10 are formed using the.....	5 (five)
47. Integer : For how many values of p, the circle $x^2 + y^2 + \dots$	1 (one)
48. Integer : Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function....	2 (two)
49. The tangent to a suitable conic (Column 1) at $(\sqrt{3}, 1/2)$...	$x^2 + a^2y^2 = a^2 \rightarrow y = mx + \sqrt{a^2m^2 + 1} \rightarrow \left(\frac{-a^2m}{\sqrt{a^2m^2 + 1}}, \frac{1}{\sqrt{a^2m^2 + 1}}\right)$
50. If a tangent to a suitable conic (Column 1) is found to....	$y^2 = 4ax \rightarrow my = m^2x + a \rightarrow \left(\frac{a}{m^2}, \frac{2a}{m}\right)$
51. For $a = \sqrt{2}$, if a tangent is drawn to a suitable conic....	$x^2 + y^2 = a^2 \rightarrow y = mx + a\sqrt{m^2 + 1} \rightarrow \left(\frac{-ma}{\sqrt{m^2 + 1}}, \frac{a}{\sqrt{m^2 + 1}}\right)$
52. Which of the following options is the only CORRECT....	$f'(x) = 0$ for some $x \in (1, e) \rightarrow \lim_{x \rightarrow \infty} f'(x) = -\infty \rightarrow f'$ is decreasing in (e, e^2)
53. Which of the following options is the only CORRECT.	$f'(x) = 0$ for some $x \in (1, e) \rightarrow \lim_{x \rightarrow \infty} f(x) = -\infty \rightarrow f$ is decreasing in (e, e^2)
54. Which of the following options is the only INCORRECT...	$f'(x) = 0$ for some $x \in (0, 1) \rightarrow \lim_{x \rightarrow \infty} f(x) = 0 \rightarrow f'$ is increasing in $(0, 1)$