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Department of Chemistry
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Graduate Studies for MSc
Competitive Examination
Subject: Physical Chemistry

Q1: Choose the correct answer (put circle) for the following: (12 M)

1. According to reaction rate law, the rate is a proportional with integer power of the concentrations of: a) reactants. b) products.
2. The reaction rate constant unit is usually: a) $mol^{1-n} . L^{n-1} . time^{-1}$ b) $mol^{n-1} . L^{1-n} . time^{-1}$, when n is reaction order.
3. The differential equation for a first order reaction (A → B) is: a) $\frac{d[A]}{dt} = k[A]$ b) $-\frac{d[A]}{dt} = k[A]$
4. In the integral rate equation for second order reaction ($kt = \frac{1}{[A]} - \frac{1}{[A_0]}$), the half – life ($t_{1/2}$) is given by: a) $t_{1/2} = \frac{1}{k[A_0]}$ b) $t_{1/2} = \frac{1}{k[A]}$
5. If the half – life of a first order reaction (A → B) was 10 minutes, the percent of A remains after one hour will be: a) 1.56% b) 3.36%
6. In the reversible reaction ($A + B \underset{k_2}{\overset{k_1}{\Leftrightarrow}} C$) at equilibrium, the differential rate equation is:
   a) $\frac{d[C]}{dt} = k_1[A][B] - k_2[C]$ b) $-\frac{d[C]}{dt} = k_1[A][B] - k_2[C]$
7. If the slope of the line in a first order reaction (A → B) is (– 2.7) according to equation ($log[A] = -\frac{kt}{2.303} + log[A_0]$) , the rate constant (k) is: a) 6.22 $time^{-1}$ b) 1.17 $time^{-1}$
8. For the kinetic reaction (A + 2B → C) , the rate is: a) $\frac{d[C]}{dt} = k[A][B]^2$ b) $\frac{-d[C]}{dt} = k[A]^{n_1}[B]^{n_2}$, when n_1 , n_2 are experimental value.
9. The coulomb is the quantity of electricity carried by: a) a current of (1 amp) in (1 sec). b) a voltage of (1 volt) in (1 sec).
10. The quantity of electricity necessary to deposit (1 mole) of Cu from Cu(II) solution, is: a) 96500 coulombs b) 2(96500) coulombs.
11. The number of electrons in one faraday is: a) 6.02×10^{23} electron b) 1.602×10^{19} electron
12. In conductance cell, the relation between conductivity (L) and resistance (R) of any electrolytic conductor is given by: a) $L = K_{cell} . R$ b) $L = K_{cell} / R$
13. The molar conductivity (ρ by mho. $cm^2 . mol^{-1}$) is defined for solution its concentration (M by mol. L^{-1}) and its conductivity (L by simens. cm^{-1}) as follow: a) $\rho = 1000\ L/M$ b) $\rho = L/M$
14. The conductivity (L) of an electrolytic substance (its resistivity (r)) is: a) L = 1/r b) $L = K_{cell}/r$, when K_{cell} is cell constant.

15. The relation between the conductivities (L) of solution and its components is:
a) $L_{solution} = L_{solute} - L_{solvent}$ b) $L_{solute} = L_{solution} - L_{solvent}$

16. Photon energy calculates from the equation: a) $E = h\nu$ b) $E = m c^2$

17. Lambert-beer's low represents the equation formula: a) $\log I_0/I = \varepsilon .C.L$ b) $\log I/I_0 = \varepsilon .C.L$

18. Conversion factor between the energy (by MeV) and mass (by amu) is:
a) 931.5 $MeV.amu^{-1}$ b) 913.5 $MeV.amu^{-1}$

19. For an ideal gas: a) $(\frac{\partial U}{\partial V})_T = 0$ b) $(\frac{\partial U}{\partial T})_P = 0$

20. The gas constant is: a) 8.314 $J.mol^{-1}.K^{-1}$ b) 0.082 $atm.mol^{-1}.K^{-1}$

21. The process of changing a solid to a gas state is called: a) vaporization b) sublimation

22. Exothermic process means a value of: a) $\Delta H = +$ b) $\Delta H = -$

23. The internal energy (U) define by equation: a) $U = H - PV$ b) $U = H - RT$

24. The mass density of nitrogen gas (its MW 28 $g.mol^{-1}$) at STP is approximately:
a) 1.251 $g.L^{-1}$ b) 1.25 $g.ml^{-1}$

Q2: Answer on the following questions: (8 Marks)

1) If V = f(P,T), write the total differential equation for the V.
2) For the following Arrhenius equation $k = A.\ e^{-E_a/RT}$. Draw diagram to calculate (E_a) and (A).
3) Draw schematic figure shows energy levels of molecular orbitals and the different electronic transitions.
4) Write down equation of de Broglie, then shows (by equations only) how can you calculate the linear momentums of photon and electron.