Model Questions (Set 1)

WBJEE-2013

West Bengal Joint Entrance Examinations Board
AQ-13/1, Salt Lake, Sector V, Kolkata 700091

Mathematics

Category I (1 mark, 1 correct answer)

1. If $n = {}^{m}C_2$ then the value of ${}^{n}C_2$ is given by

A. ${}^{m-1}C_4$
B. ${}^{m+1}C_4$
C. $3.({}^{m+1}C_4)$
D. $3.({}^{m-1}C_4)$

2. If the roots α, β of the equation $(x^2 – bx)/(ax – c) = (\lambda - 1)/(\lambda + 1)$ are such that $(\alpha + \beta) = 0$, then the value of α is

A. c
B. 1/c
C. (a – b)/(a + b)
D. (a + b)/(a - b)

3. If the complex conjugate of (x + iy)(1 – i2) be 1 + i, then

A. x = 1/5
B. y = 3/5
C. x – iy = (1 – i)/(1 + i2)
D. x + iy = (1 – i)/(1 – i2)

4. The number of solutions of tan(x) + sec(x) = 2cos(x) lying in interval [0, 2π] is

A. 3
B. 2
C. 1
D. 0

5. The degree and order of the differential equation of all parabolas whose axis is the x-axis are respectively

A. 1,2
B. 2,1
C. 2,3
D. 3,2

6. $\sin(47^\circ) + \sin(61^\circ) - \sin(11^\circ) - \sin(25^\circ)$ equals

A. $\sin(36^\circ)$
B. $\cos(36^\circ)$
C. $\sin(7^\circ)$
D. $\cos(7^\circ)$

7. The line segment joining the points (1,2) and (-2,1) is divided by the line 3x + 4y = 7 in the ratio

A. 3:4

Correct answers are highlighted

B. 4:3
C. 9:4
D. 4:9

8. **If $2^x + 2^y = 2^{x+y}$, then the value of dy/dx ay x = y = 1 is**

A. 0
B. -1
C. 1
D. 2

9. **The value of $2\tan^{-1}(1/3) + \tan^{-1}(1/7)$ is**
A. π
B. π/2
C. π/4
D. π/8

10. **The value of $\sum_{n=1}^{13}(i^n + i^{n+1})$, where $i = \sqrt{-1}$ is**

A. i
B. i-1
C. $-i$
D. 0

Correct answers are highlighted

Category II (2 marks, 1 correct answer)

1. **If f(x) + f(y) = f(x + y) and** $\int_0^3 f(x)dx = \lambda$ **, then** $\int_{-3}^3 f(x)dx =$

A. -2λ
B. 2λ
C. 0
D. ½

2. **The area bounded by y = tan(x), y = cot(x) and x-axis in 0 ≤ x ≤ π/2**
A. $3\log_e 2$
B. $\log_e 2$
C. $2\log_e 2$
D. $5\log_e 2$

3. **The positive value of λ for which the lines y – 2x – 6 = 0, 3y + x – 4 = 0, λy + 4x + λ^2 = 0 are concurrent is**
A. λ = 2
B. λ = 3
C. λ = 4
D. λ = 5

4. **Let f(2) = 4 and f'(2) = 2. Then** $\lim_{x\to 2}\left(\frac{xf(2)-2f(x)}{(x-2)}\right)$ **is equal to**

A. -8
B. 4
C. 0
D. -4

5. **If x = (1 + i)/2 (where i = $\sqrt{-1}$), then the expression $2x^4 - 2x^2 + x + 3$ equals**
A. 3 + i/2
B. 3 – i/2
C. (3 + i)/2
D. (3 – i)/2

6. **The ratio of the greatest value of 2 – cosx + $\sin^2 x$ to its least value is**
A. 5/4
B. 9/4
C. 13/4
D. 15/4

7. **If the normal at the point "t_1" on the curve xy = c^2 meets the curve again at "t_2", then**
A. $(t_1)^3 t_2 = 1$
B. $(t_1)^3 t_2 = -1$

Correct answers are highlighted

C. $(t_2)^3 t_1 = -1$
D. $(t_2)^3 t_1 = 1$

8. If y = 4x – 5 is tangent to the curve $y^2 = px^3 + q$ at (2,3), then

A. p = 2, q = -7
B. p = -2, q = 7
C. p = -2, q = -7
D. p = 2, q = 7

9. Let $\frac{{}^{n}P_{r-1}}{a} = \frac{{}^{n}P_{r}}{b} = \frac{{}^{n}P_{r+1}}{c}$, then which of the following hold good

A. $c^2 = a(b + c)$
B. $a^2 = c(a + b)$
C. $b^2 = a(b + c)$
D. (1/a + 1/b + 1/c) = 1

10. Let $f(x) = (e^x + 1)/(e^x + 1)$ and $\int_0^1 x(\frac{e^x+1}{e^x-1})\,dx = \lambda$, then $\int_{-1}^{1} tf(t)\,dt$ equals

A. 0
B. 2λ
C. λ
D. 3λ

Correct answers are highlighted

Category III (2 marks, 1 or more than 1 correct answer)

1. **If $(1 + x)^n = C_0 + C_1x + C_2x^2 + \ldots\ldots\ldots\ldots\ldots + C_nx^n$, where n is a positive integer, then**

A. $C_0 - C_2 + C_4 - \ldots\ldots = 2^{(n/2)}\cos(n\pi/4)$

B. $C_1 - C_3 + C_5 - \ldots\ldots = 2^{(n/2)}\sin(n\pi/4)$

C. $C_0 + C_4 + C_8 + \ldots\ldots = 2^{(n-2)} + 2^{((n-2)/2)}\cos(n\pi/4)$

D. $C_0 + C_3 + C_6 + \ldots\ldots = (1/3).(2^n + 2\cos(n\pi/3))$

2. **If a>0, the roots of the equation**
$\log_a ax + \log_x a^2 + \log_{a^2x} a^3 = 0$, are giveb by

A. $a^{-(4/3)}$

B. $a^{-(3/4)}$

C. $a^{-(1/2)}$

D. a^{-1}

3. **If $\lim_{x \to a}(\frac{x^7 + a^7}{x+a}) = 7$, then the value of a is**

A. 1

B. 7

C. -1

D. -7

4. **Let $f(x) = x^2 + xg'(1) + g''(2)$ and $g(x) = x^2 + xf'(2) + f''(3)$, then**

A. $f'(1) = 4 + f'(2)$

B. $g'(2) = 8 + g'(1)$

C. $g''(2) + f''(2) = 4$

D. $f'(1) + g'(1) = 3$

5. **The value of the integral $\int_0^1 e^{x^2}\,dx$ is**

A. < 1

B. > 1

C. < e

D. > e

Correct answers are highlighted

Physics

Category I (1 mark, 1 correct answer)

1. **At given instant of time, two radioactive elements P and Q have the same number of atoms. It is also known that the *mean-life* time of P is the same as the *half-life* time of Q. then which of the following is correct?**
   A. The decay rate of P is larger than that of Q
   B. The decay rate of Q is larger than that of P
   C. The decay constant of P is less than that of Q
   D. The decay rate of P and Q will be same initially

2. **A non-conducting solid sphere of radius *R* is uniformly charged. At a distance *r* from the centre of the sphere the electric field (magnitude) due to the spherical charge distribution**
   A. $E \propto r$ *for* $r < R$ (inside sphere)
   B. $E \propto 1/r^2$ *for* $0 < r < \infty$ (everywhere except centre)
   C. $E \propto 1/r$ *for* $R < r < \infty$ (outside sphere)
   D. $E = 0$ *at* $r = R$ (at the surface)

3. **An object is moving away from a vertical concave mirror of focal length 25 m. When the distance of the object is 100 m, the velocity of the object is 5 m/s and it accelerates at the rate of 2 m/s². The distance of the object from the image after 5 sec is**
   A. 300 m
   B. 120 m
   C. 150 m
   D. 90 m

4. **In hydrogen spectrum, the longest wavelength in the U-U series is 122×10-9 meter. This corresponds to a transition of electron from the level**
   A. $n = 2$ to $n = 1$
   B. $n = 3$ to $n = 2$
   C. $n = 4$ to $n = 3$
   D. $n = 3$ to $n = 1$

5. **The quantities ε_0 and μ_0 denote the free-space permittivity and free-space permeability respectively. If *E* and *B* respectively denote the electric and magnetic fields, then which of the following has the dimension of velocity?**
   A. $(E/\varepsilon_0)\times(\mu_0/B)$
   B. E/B
   C. $\sqrt{\mu_0 \varepsilon_0}(E/B)$
   D. $\mu_0 \varepsilon_0 (B/E)^2$

Correct answers are highlighted

6. **If E = energy, G = gravitational constant, I = impulse and M = mass,the dimension of $(GIM^2)/E^2$ are same as that of**
A. mass
B. length
C. time
D. force

7. **A car moving at a speed of 20 km/hr stops by applying brakes after travelling 5m. If the same car is moving at 40 km/hr, the stopping distance after applying brakes will be**
A. 10m
B. 20m
C. 5m
D. 1m

8. **Two soap bubbles have radii in the ratio 2:1. What is the ratio of the excess pressure inside them?**
A. 2:1
B. 1:2
C. 1:4
D. 4:1

9. **The second overtone of an open pipe is in resonance with the first overtone of a closed pipe of length 2m. Length of the open pipe is**
A. 1m
B. 2m
C. 4m
D. 8m

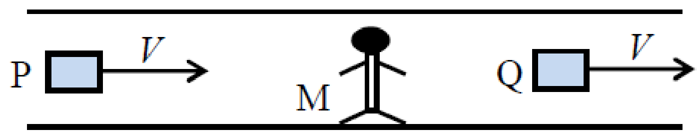
10. **The electrostatic potential energy between proton and electron separated by $1\dot{A}$ is**
A. -14.4 eV
B. -13.6 eV
C. -27.2 eV
D. -1.44 eV

Correct answers are highlighted

Category II (2 marks, 1 correct answer)

1. **A car P moves with a velocity *V* towards a stationary observer M. Another car Q moves away from M in the same direction with same velocity *V*. Both the cars continuously blow whistles of same frequency 380 Hz and the observer M hears 20 beats /sec. Assume the velocity of sound is 340 m/sec. The value of *V* in m/sec is**

A. 11.3
B. 17.0
C. 20.9
D. 8.5



2. **A solid homogeneous cube floats at the interface of two liquids, mercury and water, kept in a container such that the lower portion of the cube is immersed in mercury and the upper portion is in water. The density of the material of the cube is 7.3 gm/cc and those of mercury and water are respectively 13.6 gm/cc and 1.0 gm/cc. Then the % of volume of the cube immersed in mercury is**

A. 70%
B. 68%
C. 50%
D. 73%

3. **A proton is at rest and is free to move. Another proton moving with a velocity *V0* strikes the proton at rest. Denote proton mass and charge as *m* and *e* respectively and assume a head-on collision. Then the closest distance the incident proton approaches towards the other proton is**

A. $e^2/(4\pi\varepsilon_0 m V_0^2)$

B. $e^2/(2\pi\varepsilon_0 m V_0^2)$

C. $e^2/(\pi\varepsilon_0 m V_0^2)$

D. $2e^2/(\pi\varepsilon_0 m V_0^2)$

4. **The dimension of a quantity is given by $ML^2T^{-2}I^{-2}$, where *M* is mass, *L* is length, *T* is time, and *I* is electric current. Which of the following quantities has this dimension?**

A. Capacitor
B. Inductance
C. Magnetic Flux
D. Electric Flux

Correct answers are highlighted

5. If I is the moment of inertia and E is the kinetic energy of rotation of a body, its angular momentum will be

A. $\sqrt{EI}$
B. 2EI
C. E/I
D. $\sqrt{2EI}$

6. The same weight of mg is hung from two wires of length l, radius r, and length 2l, radius 2r respectively, having the same Young's modulus Y. Then, the net elongation equals

A. $(2mgl)/(3\pi r^2Y)$
B. $(mgl)/(3\pi r^2Y)$
C. $(mgl)/(2\pi r^2Y)$
D. $(3mgl)/(2\pi r^2Y)$

7. In a Carnot heat engine, 8000 J of heat is absorbed from a source of 400° K and 6000 J of heat is rejected to sink. The temperature of the sink is

A. 100° K
B. 300° K
C. 0° K
D. 273° K

8. A body cools from 50°C to 49.9°C in 5 sec. How long will it take to cool from 40°C to 39.9°C? (The temperature of the surroundings is 30°C)

A. 20 sec
B. 15 sec
C. 10 sec
D. 5 sec

9. A spherical black body of radius 12cm radiates 450W power at 500°K. If the radius is halved and temperature doubled, the power radiated in watts would be

A. 225
B. 450
C. 900
D. 1800

10. An oil drop of radius 10^{-6}m carries charge equal to that of 3 electrons. If density of oil is 2×10^3 kg/m^3, the electric field required to keep the drop stationary is

A. 1.71×10^5 V/m
B. 1.71×10^3 V/m
C. 1.71×10^6 V/m
D. 1.71 V/m

Correct answers are highlighted

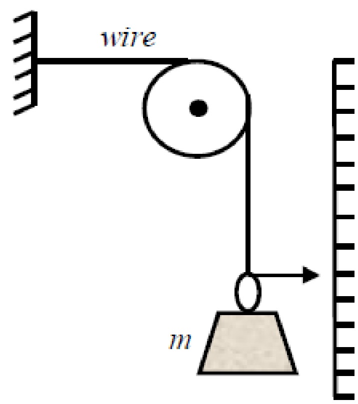
Category III (2 marks, 1 or more than 1 correct answer)

1. **A moving coil galvanometer has a resistance of 100 Ω and shows full-scale deflection at a current of 100 μA. The galvanometer has to be used as an ammeter in the range of 0–100 mA so that 100 mA is the full-scale deflection current. A resistance R has to be connected in parallel. Then**

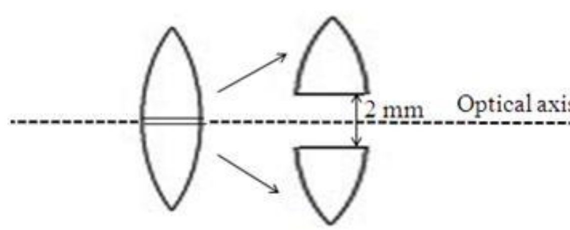
A. the value of R should be 0.10 Ω
B. when this new ammeter measures 100 mA current, the current through the galvanometer is 100 μA
C. for higher current measurement, the value of R should be larger than the present value of R
D. this new ammeter can measure both +100mA and -100mA

2. **An experiment to measure *Y* with a set of four wires of same material and same mass but of different lengths and diameters were performed using a frictionless pulling arrangement as shown. Different masses were used to create tension for the measurement of length-extension of each wire. In this experiment, which of the following quantities do/does not vary linearly?**

A. For a given applied mass, the extension of length vs diameter of wire
B. For a given applied mass, the extension of length vs length of the wires
C. For all wires, the extension of length versus applied mass
D. For same amount of extension of length of all wires, length of wire vs. the elastic potential energy



3. **A bi-convex lens of focal length 10 cm is cut along the horizontal diameter and the two halves are kept 2 mm apart symmetrically about the optical axis as shown in the figure. A monochromatic point source of light is now placed at a distance 10 cm on the optical axis. Then which of the following statements is/are correct?**

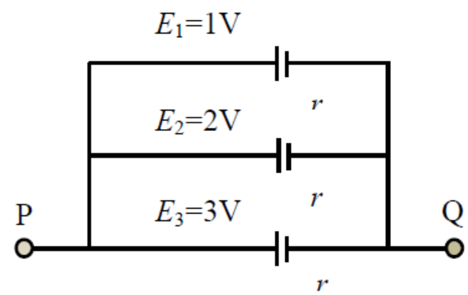


A. The rays emerging from each lens-half will be converging to a point on the optical axis at a distance of 10/3 cm from the lens-halves

Correct answers are highlighted

B. The rays emerging from each lens-half will be parallel making an angle of 10^{-2} radian with the optical axis
C. Rays from each lens-half will be diverging as if the source is on the optic axis at a distance of 10/3 cm behind the lens-halves
D. The rays emerging from the upper lens-half will appear to come from a point 10 cm behind the lens-halves and 1 mm below the optical axis

4. **A circuit consists of three batteries of e.m.f. $E1$ = 1V, $E2$ = 2V and $E3$ = 3V respectively and internal resistance of r = 1Ω each connected in parallel as shown in figure.**



A. The equivalent e.m.f. of the three batteries is E_{eq} = 2V
B. Internal resistance of the equivalent battery is 1/3 Ω
C. Potential difference between the points P and Q is V_{PQ} = 2V
D. Current flowing through the branch containing E_1=1V battery is i_1 = 0 amp

5. **When a potential difference is applied across, the current passing through**
A. an insulator at 0 K is zero
B. a semi-conductor at 0 K is zero
C. a metal at 0 K is finite
D. a p-n diode at 300 K is finite, if it is reverse-biased

Correct answers are highlighted

Chemistry

Category I (1 mark, 1 correct answer)

1. A reducing agent

A. loses electrons and is reduced.
B. gains electrons and is reduced.
C. loses electrons and is oxidized.
D. gains electrons and is oxidized.

2. (*S*)-(+)-lactic acid and (*R*)-(–)-lactic acid are nonsuperposable mirror images of each other. They are called

A. diastereomers
B. tautomers
C. enantiomers
D. structural isomers

3. Which of the following species has the maximum number of unpaired *d*-electrons?

A. Zn
B. Fe^{2+}
C. Ni^{2+}
D. Cu^{+}

4. Which of the following sets of quantum numbers (n, l, m_l, m_s) correctly represents an electron in the 5*f* subshell?

A. 5, 3, 4, +½
B. 5, 2, 1, 0
C. 5, 3, −2, +½
D. 5, 5, 2, −½

5. Arrange the following in decreasing order of reactivity with HCN.
HCHO, CH_3CHO, CH_3COCH_3

A. HCHO > CH_3CHO > CH_3COCH_3
B. CH_3CHO > HCHO > CH_3COCH_3
C. CH_3COCH_3 > CH_3CHO > HCHO
D. CH_3CHO > CH_3COCH_3 > HCHO=

6. The state of hybridization of the nitrogen atom bonded to hydrogen in hydrazoic acid (N_3H) is:

A. sp
B. sp^2
C. sp^3
D. none of these.

Correct answers are highlighted

7. **The cathode is slowly raised out of the melt by an electrical device during the electrolytic extraction of:**

A. sodium
B. magnesium
C. calcium
D. aluminium

8. **Deoxyribose is:**

A. an aldopentose with four hydroxyl groups
B. a ketopentose with four hydroxyl groups
C. an aldopentose lacking hydroxyl group at carbon-3
D. an aldopentose lacking hydroxyl group at carbon-2

9. **When a stream of chlorine gas is passed through an aqueous solution of potassium iodide for a long period of time at room temperature**

A. the solution turns violet-black
B. the solution throughout remains colourlrss
C. the solution becomes deep brown and then colourless
D. the solution provides a heavy white precipitate

10. **The unit of the rate constant for a first order reaction is:**

A. sec^{-1}
B. $mol.L^{-1}.sec^{-1}$
C. $L.mol^{-1}.sec^{-1}$
D. $L^{2}.mol^{-2}.sec^{-1}$

Correct answers are highlighted

Category II (2 marks, 1 correct answer)

1. **The value of the electromotive force for the following cell $Zn \mid ZnSO_4\ (0.05\ M) \mid\mid ZnSO_4\ (0.5\ M) \mid Zn$ at 298 K is**
   A. 0.059
   B. 0.0295
   C. -0.059
   D. -0.0295

2. **Arrange the following in increasing order of nucleophilic addition reaction: Acetophenone, p-tolualdehyde, p-nitrobenzaldehyde, Benzaldehyde**
   A. Acetophenone < p- Tolualdehyde < Benzaldehyde < *p*-Nitro benzaldehyde
   B. Acetophenone > Benzaldehyde > p- Tolualdehyde > *p*-Nitro benzaldehyde
   C. Acetophenone < Benzaldehyde < p- Tolualdehyde < *p*-Nitro benzaldehyde
   D. Acetophenone > p- Tolualdehyde > Benzaldehyde > *p*-Nitro benzaldehyde

3. **Which of the following is the correct option for free expansion of an ideal gas under adiabatic conditions?**
   A. $q=0$, □ $T < 0$, $w \neq 0$
   B. $q \neq 0$, □ $T = 0$, $w=0$
   C. $q=0$, □ $T \neq 0$, $w=0$
   D. $q=0$, □ $T = 0$, $w=0$

4. **Four metals A, B, C and D have E° values: – 0.76V, 0.34V, –2.13 V and 0.44V respectively. What is the correct order of their increasing oxidizing power?**
   A. A > B > C > D
   B. D > B > A > C
   C. D > A > B > C
   D. C> D > A > B

5. **Calculate the number of aluminium ions present in 0.51 gm of aluminium oxide.**
   A. 6.02×10^{21}
   B. 3.01×10^{21}
   C. 3.01×10^{22}
   D. 6.02×10^{22}

Correct answers are highlighted

6. **The coefficients on the L.H.S for the reactants and the R.H.S for the products in the balanced form of the reaction**

$$MnO_4^- + Mn^{2+} + H_2O \rightarrow MnO_2 + H^+$$

should be:

A. 2,3,2 and 5,4
B. 2,3,5 and 5,10
C. 3,2,3 and 5,4
D. 2,2,2 and 5,10

7. **A compound that behaves like a monobasic acid as well as an inorganic ester is:**

A. ethyl hydrogen phthalate
B. potassium hydrogen tartarate
C. trimethyl oxonium tetrafluoroborate
D. ethyl hydrogen sulphate

8. **Preparation of pentaerythritol from acetaldehyde and formaldehyde requires:**

A. first Claisen condensation and then aldol condensation
B. first Perkin reaction and then haloform reaction
C. first aldol condensation and then Cannizaro reaction
D. none of these

9. **The vapour pressure of pure water at 28°C is 28.35 torr. The vapour pressure of a solution containing 68.4 kg of cane sugar in 1000g of water at the same temperature will be:**

A. 28.34 torr
B. 28.24 torr
C. 25.24 torr
D. 26.44 torr

10. **If 5g of sample of bleaching powder liberates 574 ml of chlorine gas at NTP with dilute HCL, the percentage of available chlorine in the given sample is [Ca = 40, Cl = 35.5]:**

A. 18.19
B. 11.48
C. 36.38
D. 28.70

Correct answers are highlighted

Category III (2 marks, 1 or more than 1 correct answer)

1. **Which of the following do not play a significant role in ozone depletion?**
A. Oxides of Nitrogen
B. Sulfur dioxide
C. Carbon monoxide
D. Freons

2. **Which of the following represent(s) the correct order of ionic radii?**
A. $S^{2-} > K^{+} > Ca^{2+}$
B. $Na^{+} < Al^{3+} < Mg^{2+}$
C. $S^{2-} < K^{+} < Ca^{2+}$
D. $Na^{+} < Al^{3+} < Mg^{2+}$

3. **What is/are correct about Charles' law?**
A. $(dV/dT)_P$ = constant
B. $V \infty T$ at constant P and n
C. $V \infty P$ at constant T and n
D. $VT = constant$ at constant P and n

4. **A gas described by the van der Waal's equation**
A. behaves similar to an ideal gas in the limit of large molar volume
B. behaves similar to an ideal gas in the limit of high pressure values
C. is characterized by van der Waal's coefficients that are dependent on the identity of the gas
D. has pressure lower than the pressure exerted by the same gas behaving ideally

5. **Which of the following gases will have the same rate of diffusion under similar conditions?**
A. H_2 and He
B. CO_2 and N_2O
C. NO and CO
D. CO and C_2H_4

Correct answers are highlighted