

JEE Main 2019

Afternoon Session – Slot 2

January 9 – Paper 1

Actual Question Paper with Answer Key



JEE Main 2019 Paper 1 Question Paper & Answer Key – January 9, Slot 2

Section : Physics

Q.1 At a given instant, say $t=0$, two radioactive substances A and B have equal activities.

The ratio $\frac{R_B}{R_A}$ of their activities after

time t itself decays with time t as e^{-3t} . If the half-life of A is $\ln 2$, the half-life of B is :

Options 1. $4\ln 2$

2. $\frac{\ln 2}{2}$

3. $\frac{\ln 2}{4}$

4. $2\ln 2$

Q.2 A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary of the transformer is 5 A and its efficiency is 90%, the output current would be :

Options 1. 50 A

2. 45 A

3. 35 A

4. 25 A

Q.3 The energy associated with electric field is (U_E) and with magnetic field is (U_B) for an electromagnetic wave in free space. Then :

Options

1. $U_E = \frac{U_B}{2}$
2. $U_E > U_B$
3. $U_E < U_B$
4. $U_E = U_B$

Q.4 A force acts on a 2 kg object so that its position is given as a function of time as $x = 3t^2 + 5$. What is the work done by this force in first 5 seconds ?

Options

1. 850 J
2. 950 J
3. 875 J
4. 900 J

Q.5 A particle having the same charge as of electron moves in a circular path of radius 0.5 cm under the influence of a magnetic field of 0.5 T. If an electric field of 100 V/m makes it to move in a straight path, then the mass of the particle is (Given charge of electron = $1.6 \times 10^{-19} \text{C}$)

Options

1. $9.1 \times 10^{-31} \text{ kg}$
2. $1.6 \times 10^{-27} \text{ kg}$
3. $1.6 \times 10^{-19} \text{ kg}$
4. $2.0 \times 10^{-24} \text{ kg}$

Q.6 Two point charges $q_1(\sqrt{10} \mu\text{C})$ and $q_2(-25 \mu\text{C})$ are placed on the x -axis at $x=1 \text{ m}$ and $x=4 \text{ m}$ respectively. The electric field (in V/m) at a point $y=3 \text{ m}$ on y -axis is,

$$\left[\text{take } \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2} \right]$$

Options

1. $(63 \hat{i} - 27 \hat{j}) \times 10^2$
2. $(-63 \hat{i} + 27 \hat{j}) \times 10^2$
3. $(81 \hat{i} - 81 \hat{j}) \times 10^2$
4. $(-81 \hat{i} + 81 \hat{j}) \times 10^2$

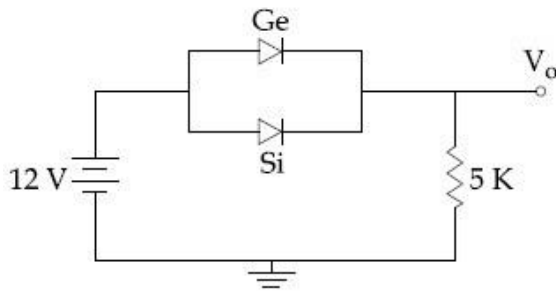
Q.7 Expression for time in terms of G (universal gravitational constant), h (Planck constant) and c (speed of light) is proportional to :

Options

1. $\sqrt{\frac{hc^5}{G}}$
2. $\sqrt{\frac{c^3}{Gh}}$
3. $\sqrt{\frac{Gh}{c^5}}$
4. $\sqrt{\frac{Gh}{c^3}}$

Q.8

Ge and Si diodes start conducting at 0.3 V and 0.7 V respectively. In the following figure if Ge diode connection are reversed, the value of V_o changes by : (assume that the Ge diode has large breakdown voltage)



- Options
1. 0.8 V
 2. 0.6 V
 3. 0.2 V
 4. 0.4 V

Q.9 The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to :

- Options
1. 6.0 m
 2. 4.8 m
 3. 9.6 m
 4. 2.9 m

Q.10 The energy required to take a satellite to a height 'h' above Earth surface (radius of Earth = $6.4 \times 10^3 \text{ km}$) is E_1 and kinetic energy required for the satellite to be in a circular orbit at this height is E_2 . The value of h for which E_1 and E_2 are equal, is :

- Options
1. $1.6 \times 10^3 \text{ km}$

2. 3.2×10^3 km
3. 6.4×10^3 km
4. 1.28×10^4 km

Q.11 Two Carnot engines A and B are operated in series. The first one, A, receives heat at $T_1 (= 600 \text{ K})$ and rejects to a reservoir at temperature T_2 . The second engine B receives heat rejected by the first engine and, in turn, rejects to a heat reservoir at $T_3 (= 400 \text{ K})$. Calculate the temperature T_2 if the work outputs of the two engines are equal :

- Options**
1. 600 K
 2. 400 K
 3. 300 K
 4. 500 K

Q.12 A series AC circuit containing an inductor (20 mH), a capacitor (120 μF) and a resistor (60 Ω) is driven by an AC source of 24 V/50 Hz. The energy dissipated in the circuit in 60 s is :

- Options**
1. 5.65×10^2 J
 2. 2.26×10^3 J
 3. 5.17×10^2 J
 4. 3.39×10^3 J

Q.13

A particle is executing simple harmonic motion (SHM) of amplitude A , along the x -axis, about $x=0$. When its potential Energy (PE) equals kinetic energy (KE), the position of the particle will be :

Options

1. $\frac{A}{2}$

2. $\frac{A}{2\sqrt{2}}$

3. $\frac{A}{\sqrt{2}}$

4. A

Q.14 A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is ($g = 10 \text{ ms}^{-2}$)

Options

1. 200 N

2. 140 N

3. 70 N

4. 100 N

Q.15 A 15 g mass of nitrogen gas is enclosed in a vessel at a temperature 27°C . Amount of heat transferred to the gas, so that rms velocity of molecules is doubled, is about :
[Take $R = 8.3 \text{ J/K mole}$]

Options

1. 0.9 kJ

2. 6 kJ

3. 10 kJ

4. 14 kJ

Q.16 In a Young's double slit experiment, the slits are placed 0.320 mm apart. Light of wavelength $\lambda = 500$ nm is incident on the slits. The total number of bright fringes that are observed in the angular range $-30^\circ \leq \theta \leq 30^\circ$ is :

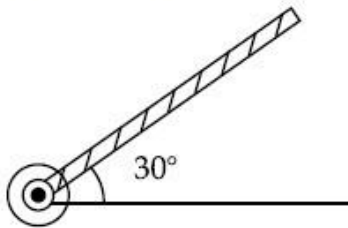
- Options**
1. 640
 2. 320
 3. 321
 4. 641

Q.17 Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror (M_1) and parallel to the second mirror (M_2) is finally reflected from the second mirror (M_2) parallel to the first mirror (M_1). The angle between the two mirrors will be :

- Options**
1. 45°
 2. 60°
 3. 75°
 4. 90°

Q.18

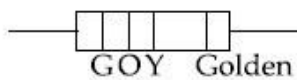
A rod of length 50 cm is pivoted at one end. It is raised such that it makes an angle of 30° from the horizontal as shown and released from rest. Its angular speed when it passes through the horizontal (in rad s^{-1}) will be ($g = 10 \text{ ms}^{-2}$)



Options

1. $\frac{\sqrt{30}}{2}$
2. $\sqrt{30}$
3. $\frac{\sqrt{20}}{3}$
4. $\frac{\sqrt{30}}{2}$

Q.19 A carbon resistance has a following colour code. What is the value of the resistance ?



- Options
1. $530 \text{ k}\Omega \pm 5\%$
 2. $5.3 \text{ M}\Omega \pm 5\%$
 3. $6.4 \text{ M}\Omega \pm 5\%$
 4. $64 \text{ k}\Omega \pm 10\%$

Q.20

One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current is passed in both, the ratio of the magnetic field at the central of the loop (B_L) to that at

the centre of the coil (B_C), i.e. $\frac{B_L}{B_C}$ will be :

- Options
1. N
 2. $\frac{1}{N}$
 3. N^2
 4. $\frac{1}{N^2}$

Q.21 A rod of mass ' M ' and length ' $2L$ ' is suspended at its middle by a wire. It exhibits torsional oscillations; If two masses each of ' m ' are attached at distance ' $L/2$ ' from its centre on both sides, it reduces the oscillation frequency by 20%. The value of ratio m/M is close to :

- Options
1. 0.77
 2. 0.57
 3. 0.37
 4. 0.17

Q.22 Charge is distributed within a sphere of radius R with a volume charge density

$$\rho(r) = \frac{A}{r^2} e^{-2r/a}, \text{ where } A \text{ and } a \text{ are constants.}$$

If Q is the total charge of this charge distribution, the radius R is :

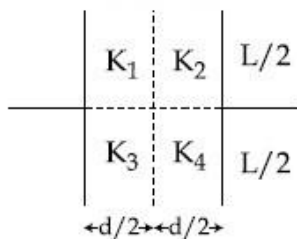
- Options
1. $a \log \left(1 - \frac{Q}{2\pi a A} \right)$

$$2. \frac{a}{2} \log \left(\frac{1}{1 - \frac{Q}{2\pi aA}} \right)$$

$$3. a \log \left(\frac{1}{1 - \frac{Q}{2\pi aA}} \right)$$

$$4. \frac{a}{2} \log \left(1 - \frac{Q}{2\pi aA} \right)$$

Q.23 A parallel plate capacitor with square plates is filled with four dielectrics of dielectric constants K_1, K_2, K_3, K_4 arranged as shown in the figure. The effective dielectric constant K will be :



Options

$$1. K = \frac{(K_1 + K_3)(K_2 + K_4)}{K_1 + K_2 + K_3 + K_4}$$

$$2. K = \frac{(K_1 + K_2)(K_3 + K_4)}{2(K_1 + K_2 + K_3 + K_4)}$$

$$3. K = \frac{(K_1 + K_2)(K_3 + K_4)}{K_1 + K_2 + K_3 + K_4}$$

$$4. K = \frac{(K_1 + K_4)(K_2 + K_3)}{2(K_1 + K_2 + K_3 + K_4)}$$

Q.24

The pitch and the number of divisions, on the circular scale, for a given screw gauge are 0.5 mm and 100 respectively. When the screw gauge is fully tightened without any object, the zero of its circular scale lies 3 divisions below the mean line.

The readings of the main scale and the circular scale, for a thin sheet, are 5.5 mm and 48 respectively, the thickness of this sheet is :

- Options
1. 5.755 mm
 2. 5.950 mm
 3. 5.725 mm
 4. 5.740 mm

Q.25 A musician using an open flute of length 50 cm produces second harmonic sound waves. A person runs towards the musician from another end of a hall at a speed of 10 km/h. If the wave speed is 330 m/s, the frequency heard by the running person shall be close to :

- Options
1. 666 Hz
 2. 753 Hz
 3. 500 Hz
 4. 333 Hz

Q.26 In a car race on straight road, car A takes a time t less than car B at the finish and passes finishing point with a speed ' v ' more than that of car B. Both the cars start from rest and travel with constant acceleration a_1 and a_2 respectively. Then ' v ' is equal to :

- Options
1. $\frac{2a_1 a_2}{a_1 + a_2} t$

2. $\sqrt{2a_1a_2} t$

3. $\sqrt{a_1a_2} t$

4. $\frac{a_1 + a_2}{2} t$

Q.27 The magnetic field associated with a light wave is given, at the origin, by

$$B = B_0 [\sin(3.14 \times 10^7)ct + \sin(6.28 \times 10^7)ct].$$

If this light falls on a silver plate having a work function of 4.7 eV, what will be the maximum kinetic energy of the photo electrons ?

$$(c = 3 \times 10^8 \text{ ms}^{-1}, h = 6.6 \times 10^{-34} \text{ J-s})$$

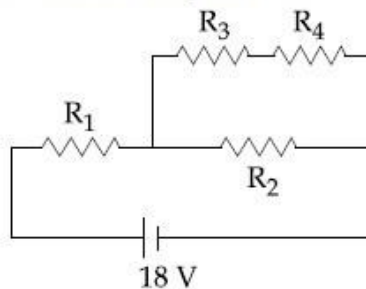
Options 1. 6.82 eV

2. 12.5 eV

3. 8.52 eV

4. 7.72 eV

Q.28 In the given circuit the internal resistance of the 18 V cell is negligible. If $R_1 = 400 \Omega$, $R_3 = 100 \Omega$ and $R_4 = 500 \Omega$ and the reading of an ideal voltmeter across R_4 is 5 V, then the value of R_2 will be :



Options 1. 300 Ω

2. 450 Ω

3. 550 Ω

4. 230 Ω

In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth. The number of channels accommodated for transmitting TV signals of band width 6 MHz are (Take velocity of light $c = 3 \times 10^8 \text{ m/s}$, $h = 6.6 \times 10^{-34} \text{ J-s}$)

Q.29

Options 1.

1. 3.75×10^6

2. 3.86×10^6

3. 6.25×10^5

4. 4.87×10^5

The position co-ordinates of a particle moving in a 3-D coordinate system is given by

$$x = a \cos \omega t$$

$$y = a \sin \omega t$$

$$\text{and } z = a \omega t$$

The speed of the particle is :

Q.30

Options

1. $\sqrt{2} a \omega$

1.

2. $a \omega$

2.

3. $\sqrt{3} a \omega$

3.

4. $2a \omega$

4.

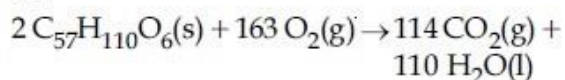
Section : Chemistry

The entropy change associated with the conversion of 1 kg of ice at 273 K to water vapours at 383 K is :

(Specific heat of water liquid and water vapour are $4.2 \text{ kJ K}^{-1} \text{ kg}^{-1}$ and $2.0 \text{ kJ K}^{-1} \text{ kg}^{-1}$; heat of liquid fusion and vapourisation of water are 334 kJ kg^{-1} and 2491 kJ kg^{-1} , respectively). ($\log 273 = 2.436$, $\log 373 = 2.572$, $\log 383 = 2.583$)

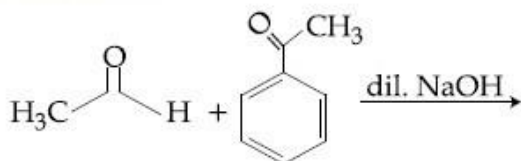
- Options
1. $7.90 \text{ kJ kg}^{-1} \text{ K}^{-1}$
 2. $2.64 \text{ kJ kg}^{-1} \text{ K}^{-1}$
 3. $8.49 \text{ kJ kg}^{-1} \text{ K}^{-1}$
 4. $9.26 \text{ kJ kg}^{-1} \text{ K}^{-1}$

Q.2 For the following reaction, the mass of water produced from 445 g of $\text{C}_{57}\text{H}_{110}\text{O}_6$ is :



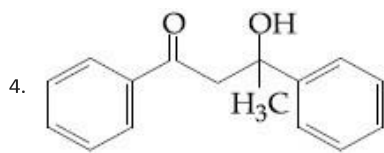
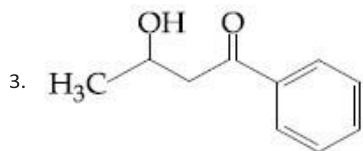
- Options
1. 490 g
 2. 445 g
 3. 495 g
 4. 890 g

Q.3 The major product formed in the following reaction is :



Options

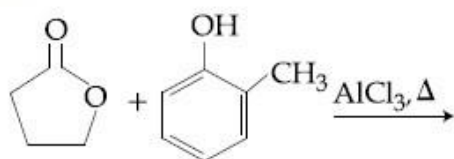
- 1.
- 2.



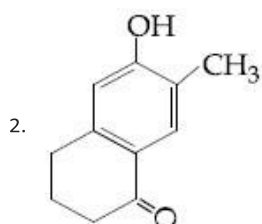
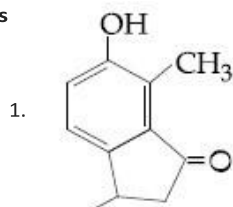
Q.4 Which of the following conditions in drinking water causes methemoglobinemia ?

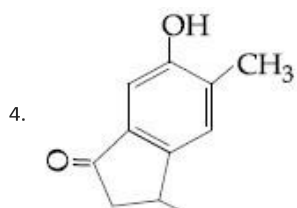
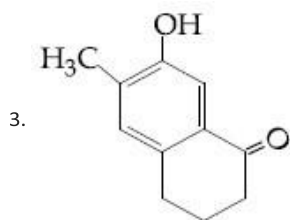
- Options
1. > 50 ppm of lead
 2. > 50 ppm of chloride
 3. > 50 ppm of nitrate
 4. > 100 ppm of sulphate

Q.5 The major product of the following reaction is :

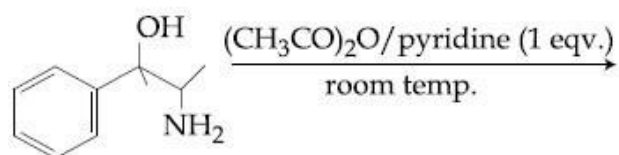


Options

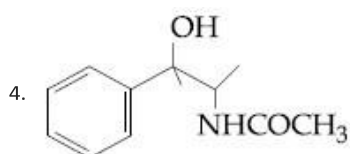
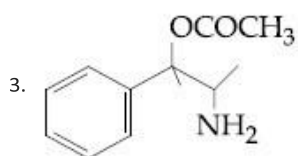
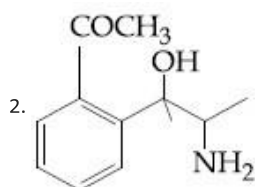
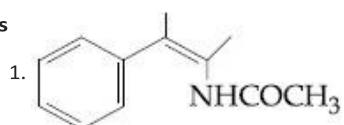




Q.6 The major product obtained in the following reaction is :

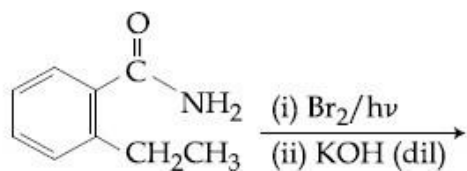


Options

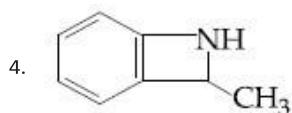
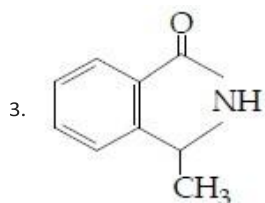
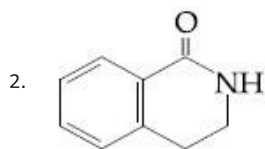
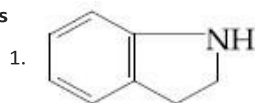


Q.7

The major product of the following reaction is :



Options



Q.8 The correct match between Item I and Item II is :

Item I	Item II
(A) Benzaldehyde	(P) Mobile phase
(B) Alumina	(Q) Adsorbent
(C) Acetonitrile	(R) Adsorbate

- Options
1. (A) \rightarrow (Q) ; (B) \rightarrow (P) ; (C) \rightarrow (R)
 2. (A) \rightarrow (R) ; (B) \rightarrow (Q) ; (C) \rightarrow (P)
 3. (A) \rightarrow (Q) ; (B) \rightarrow (R) ; (C) \rightarrow (P)
 4. (A) \rightarrow (P) ; (B) \rightarrow (R) ; (C) \rightarrow (Q)

Q.9 The metal that forms nitride by reacting directly with N_2 of air, is :

- Options
1. K

2. Li
3. Rb
4. Cs

Q.10 For coagulation of arsenious sulphide sol, which one of the following salt solution will be most effective ?

- Options**
1. BaCl_2
 2. AlCl_3
 3. NaCl
 4. Na_3PO_4

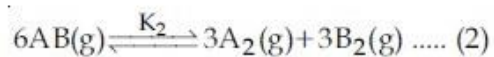
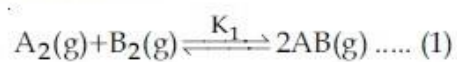
Q.11 The complex that has highest crystal field splitting energy (Δ), is :

- Options**
1. $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]\text{Cl}_3$
 2. $\text{K}_2[\text{CoCl}_4]$
 3. $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 4. $\text{K}_3[\text{Co}(\text{CN})_6]$

Q.12 The pH of rain water, is approximately :

- Options**
1. 5.6
 2. 7.5
 3. 7.0
 4. 6.5

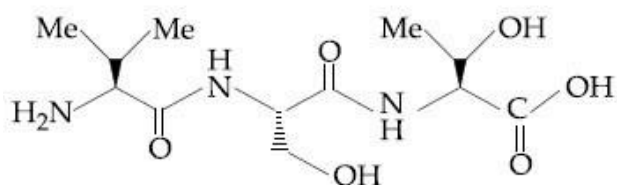
Q.13 Consider the following reversible chemical reactions :



The relation between K_1 and K_2 is :

- Options
1. $K_1 K_2 = \frac{1}{3}$
 2. $K_2 = K_1^3$
 3. $K_2 = K_1^{-3}$
 4. $K_1 K_2 = 3$

Q.14 The correct sequence of amino acids present in the tripeptide given below is :



- Options
1. Val - Ser - Thr
 2. Thr - Ser - Val
 3. Leu - Ser - Thr
 4. Thr - Ser - Leu

Q.15



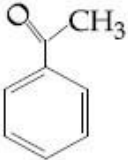
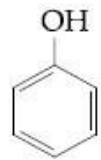
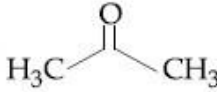
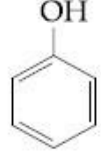
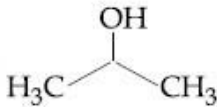
For the reaction, $2A + B \rightarrow \text{products}$, when the concentrations of A and B both were doubled, the rate of the reaction increased from $0.3 \text{ mol L}^{-1}\text{s}^{-1}$ to $2.4 \text{ mol L}^{-1}\text{s}^{-1}$. When the concentration of A alone is doubled, the rate increased from $0.3 \text{ mol L}^{-1}\text{s}^{-1}$ to $0.6 \text{ mol L}^{-1}\text{s}^{-1}$.

Which one of the following statements is correct?

- Options
1. Total order of the reaction is 4
 2. Order of the reaction with respect to B is 2
 3. Order of the reaction with respect to B is 1
 4. Order of the reaction with respect to A is 2

Q.16 The products formed in the reaction of cumene with O_2 followed by treatment with dil. HCl are :

Options

1.  and 
2.  and $\text{CH}_3\text{-OH}$
3.  and 
4.  and 

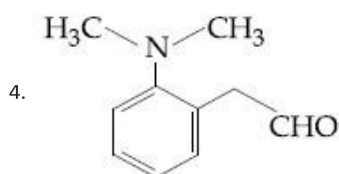
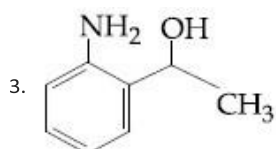
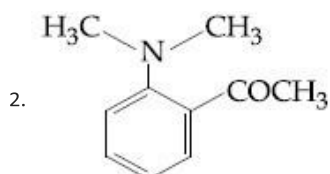
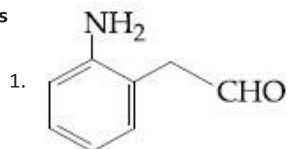
Q.17

The tests performed on compound X and their inferences are :

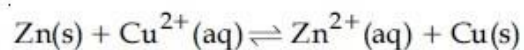
Test	Inference
(a) 2, 4 - DNP test	Coloured precipitate
(b) Iodoform test	Yellow precipitate
(c) Azo-dye test	No dye formation

Compound 'X' is :

Options



Q.18 If the standard electrode potential for a cell is 2 V at 300 K, the equilibrium constant (K) for the reaction



at 300 K is approximately

$$(R = 8 \text{ JK}^{-1}\text{mol}^{-1}, F = 96000 \text{ C mol}^{-1})$$

Options

1. e^{-80}

2. e^{-160}

3. e^{320}

4. e^{160}

Q.19 The temporary hardness of water is due to :

- Options
1. Na_2SO_4
 2. NaCl
 3. $\text{Ca}(\text{HCO}_3)_2$
 4. CaCl_2

Q.20 In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic ?

- Options
1. $\text{NO} \rightarrow \text{NO}^+$
 2. $\text{N}_2 \rightarrow \text{N}_2^+$
 3. $\text{O}_2 \rightarrow \text{O}_2^+$
 4. $\text{O}_2 \rightarrow \text{O}_2^{2-}$

Q.21 Which of the following combination of statements is true regarding the interpretation of the atomic orbitals ?

- (a) An electron in an orbital of high angular momentum stays away from the nucleus than an electron in the orbital of lower angular momentum.
- (b) For a given value of the principal quantum number, the size of the orbit is inversely proportional to the azimuthal quantum number.
- (c) According to wave mechanics, the ground state angular momentum is equal to $\frac{h}{2\pi}$.
- (d) The plot of ψ Vs r for various azimuthal quantum numbers, shows peak shifting towards higher r value.

- Options
1. (a), (d)

(a), (b)

(a), (c)

(b), (c)

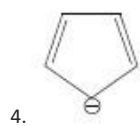
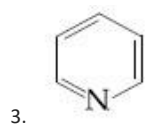
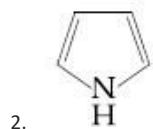
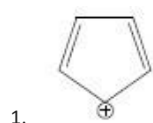
2.

3.

4.

Q.22
Options

Which of the following compounds is not aromatic ?

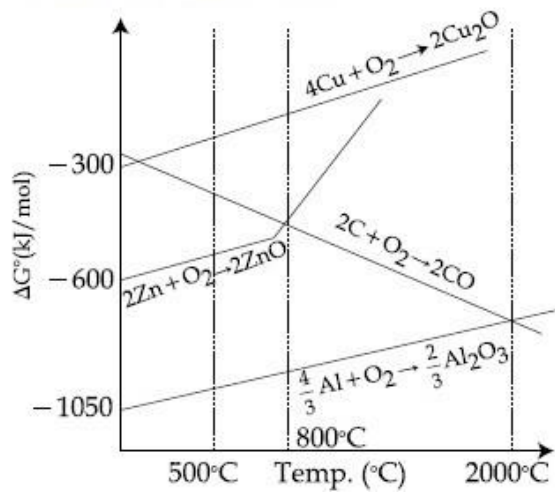


Q.23 Good reducing nature of H_3PO_2 is attributed to the presence of :

- Options 1. Two P – OH bonds
2. One P – H bond
3. Two P – H bonds
4. One P – OH bond

Q.24

The correct statement regarding the given Ellingham diagram is :



Options

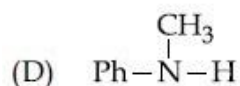
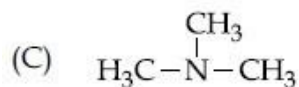
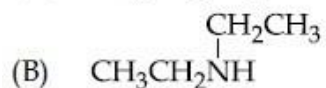
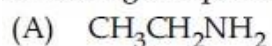
1. At 1400°C, Al can be used for the extraction of Zn from ZnO
2. At 500°C, coke can be used for the extraction of Zn from ZnO
3. Coke cannot be used for the extraction of Cu from Cu₂O.
4. At 800°C, Cu can be used for the extraction of Zn from ZnO.

Q.25 The transition element that has lowest enthalpy of atomisation, is :

- Options
1. Fe
 2. Cu
 3. V
 4. Zn

Q.26

The increasing basicity order of the following compounds is :



Options 1. (D)<(C)<(B)<(A)

2. (D)<(C)<(A)<(B)

3. (A)<(B)<(C)<(D)

4. (A)<(B)<(D)<(C)

Q.27 When the first electron gain enthalpy ($\Delta_{\text{eg}}H$) of oxygen is -141 kJ/mol , its second electron gain enthalpy is :

Options 1. a more negative value than the first

2. almost the same as that of the first

3. negative, but less negative than the first

4. a positive value

Q.28 At 100°C , copper (Cu) has FCC unit cell structure with cell edge length of $x \text{ \AA}$. What is the approximate density of Cu (in g cm^{-3}) at this temperature ?

[Atomic Mass of Cu = 63.55 u]

Options 1. $\frac{205}{x^3}$

2. $\frac{105}{x^3}$

3. $\frac{211}{x^3}$

4. $\frac{422}{x^3}$

A solution containing 62 g ethylene glycol in 250 g water is cooled to -10°C . If K_f for water is $1.86 \text{ K kg mol}^{-1}$, the amount of water (in g) separated as ice is :

Q.29

- Options 1. 48
2. 32
3. 64
4. 16

Homoleptic octahedral complexes of a metal ion ' M^{3+} ' with three monodentate ligands L_1 , L_2 and L_3 absorb wavelengths in the region of green, blue and red respectively. The increasing order of the ligand strength is :

Q.30

Options

1. $L_3 < L_1 < L_2$
2. $L_3 < L_2 < L_1$
3. $L_1 < L_2 < L_3$
4. $L_2 < L_1 < L_3$

The sum of the following series

$$1+6+\frac{9(1^2+2^2+3^2)}{7}+\frac{12(1^2+2^2+3^2+4^2)}{9} \\ +\frac{15(1^2+2^2+\dots+5^2)}{11}+\dots \text{ up to 15 terms,}$$

is :

- Options
1. 7520
 2. 7510
 3. 7830
 4. 7820

Q.2 For each $x \in \mathbf{R}$, let $[x]$ be the greatest integer less than or equal to x . Then

$$\lim_{x \rightarrow 0^-} \frac{x([x]+|x|) \sin [x]}{|x|} \text{ is equal to :}$$

- Options
1. $-\sin 1$
 2. 1
 3. $\sin 1$
 4. 0

Q.3 Let $f: [0, 1] \rightarrow \mathbf{R}$ be such that $f(xy) = f(x).f(y)$, for all $x, y \in [0, 1]$, and $f(0) \neq 0$. If $y = y(x)$ satisfies the differential equation,

$$\frac{dy}{dx} = f(x) \text{ with } y(0) = 1, \text{ then } y\left(\frac{1}{4}\right) + y\left(\frac{3}{4}\right)$$

is equal to :

- Options
1. 3
 2. 4
 3. 2
 4. 5

Q.4 If $x = \sin^{-1}(\sin 10)$ and $y = \cos^{-1}(\cos 10)$, then $y - x$ is equal to :

- Options
1. 0
 2. 10
 3. 7π
 4. π

Q.5 If $0 \leq x < \frac{\pi}{2}$, then the number of values of x for which $\sin x - \sin 2x + \sin 3x = 0$, is :

- Options
1. 3
 2. 1
 3. 4
 4. 2

Q.6 Let z_0 be a root of the quadratic equation, $x^2 + x + 1 = 0$. If $z = 3 + 6iz_0^{81} - 3iz_0^{93}$, then $\arg z$ is equal to :

- Options
1. $\frac{\pi}{4}$
 2. $\frac{\pi}{6}$
 3. $\frac{\pi}{3}$
 4. 0

Q.7 The area of the region

$A = \{(x, y): 0 \leq y \leq x|x| + 1 \text{ and } -1 \leq x \leq 1\}$ in sq. units, is :

- Options
1. $\frac{2}{3}$
 2. 2
 3. $\frac{4}{3}$
 4. $\frac{1}{3}$

Q.8 If the system of linear equations

$$x - 4y + 7z = g$$

$$3y - 5z = h$$

$$-2x + 5y - 9z = k$$

is consistent, then :

- Options
1. $g + 2h + k = 0$
 2. $g + h + 2k = 0$
 3. $2g + h + k = 0$
 4. $g + h + k = 0$

Q.9 The coefficient of t^4 in the expansion of

$$\left(\frac{1-t^6}{1-t} \right)^3 \text{ is :}$$

- Options
1. 14
 2. 15
 3. 10
 4. 12

Q.10 If both the roots of the quadratic equation $x^2 - mx + 4 = 0$ are real and distinct and they lie in the interval $[1, 5]$, then m lies in the interval :

- Options**
1. $(-5, -4)$
 2. $(4, 5)$
 3. $(5, 6)$
 4. $(3, 4)$

Q.11 Let S be the set of all triangles in the xy -plane, each having one vertex at the origin and the other two vertices lie on coordinate axes with integral coordinates. If each triangle in S has area 50 sq. units, then the number of elements in the set S is :

- Options**
1. 9
 2. 18
 3. 36
 4. 32

Q.12 Let a, b and c be the 7th, 11th and 13th terms respectively of a non-constant A.P. If these are also the three consecutive terms of a G.P., then $\frac{a}{c}$ is equal to :

- Options**
1. 2
 2. $\frac{1}{2}$
 3. $\frac{7}{13}$

Q.13 The logical statement
 $[\sim(\sim p \vee q) \vee (p \wedge r)] \wedge (\sim q \wedge r)$
 is equivalent to :

- Options**
1. $(\sim p \wedge \sim q) \wedge r$
 2. $\sim p \vee r$
 3. $(p \wedge r) \wedge \sim q$
 4. $(p \wedge \sim q) \vee r$

Q.14 The equation of the plane containing the
 straight line $\frac{x}{2} = \frac{y}{3} = \frac{z}{4}$ and perpendicular
 to the plane containing the straight lines

$$\frac{x}{3} = \frac{y}{4} = \frac{z}{2} \text{ and } \frac{x}{4} = \frac{y}{2} = \frac{z}{3} \text{ is :}$$

- Options**
1. $x - 2y + z = 0$
 2. $3x + 2y - 3z = 0$
 3. $x + 2y - 2z = 0$
 4. $5x + 2y - 4z = 0$

Q.15 A data consists of n observations :

$$x_1, x_2, \dots, x_n. \text{ If } \sum_{i=1}^n (x_i + 1)^2 = 9n \text{ and}$$

$$\sum_{i=1}^n (x_i - 1)^2 = 5n, \text{ then the standard}$$

deviation of this data is :

Options 1. 2

2. $\sqrt{5}$

3. 5

4. $\sqrt{7}$

Q.16 If

$$A = \begin{bmatrix} e^t & e^{-t} \cos t & e^{-t} \sin t \\ e^t & -e^{-t} \cos t - e^{-t} \sin t & -e^{-t} \sin t + e^{-t} \cos t \\ e^t & 2e^{-t} \sin t & -2e^{-t} \cos t \end{bmatrix},$$

then A is :

Options 1. invertible for all $t \in \mathbf{R}$.

2. invertible only if $t = \pi$.

3. not invertible for any $t \in \mathbf{R}$.

4. invertible only if $t = \frac{\pi}{2}$.

Q.17

If $f(x) = \int \frac{5x^8 + 7x^6}{(x^2 + 1 + 2x^7)^2} dx, (x \geq 0)$, and

$f(0) = 0$, then the value of $f(1)$ is :

Options 1. $-\frac{1}{2}$

2. $-\frac{1}{4}$

3. $\frac{1}{2}$

4. $\frac{1}{4}$

Q.18
Options

Let f be a differentiable function from \mathbf{R} to \mathbf{R} such that $|f(x) - f(y)| \leq 2|x - y|^{3/2}$, for all $x, y \in \mathbf{R}$. If $f(0) = 1$ then $\int_0^1 f^2(x) dx$ is equal to :

1. 1
2. 2
3. $\frac{1}{2}$
4. 0

Q.19
Options

If $x = 3 \tan t$ and $y = 3 \sec t$, then the value of $\frac{d^2 y}{dx^2}$ at $t = \frac{\pi}{4}$, is :

1. $\frac{1}{3\sqrt{2}}$
2. $\frac{1}{6\sqrt{2}}$
3. $\frac{3}{2\sqrt{2}}$
4. $\frac{1}{6}$

The number of natural numbers less than 7,000 which can be formed by using the digits 0, 1, 3, 7, 9 (repetition of digits allowed) is equal to :

1. 374
2. 372

Q.20 Options

375

250

3.

4.

Q.21
Options If the circles $x^2 + y^2 - 16x - 20y + 164 = r^2$ and $(x - 4)^2 + (y - 7)^2 = 36$ intersect at two distinct points, then :

1. $r > 11$
2. $0 < r < 1$
3. $r = 11$
4. $1 < r < 11$

Q.22
Options

A hyperbola has its centre at the origin, passes through the point (4, 2) and has transverse axis of length 4 along the x-axis.

Then the eccentricity of the hyperbola is :

1. $\frac{3}{2}$
2. $\sqrt{3}$
3. 2
4. $\frac{2}{\sqrt{3}}$

Let A(4, -4) and B(9, 6) be points on the parabola, $y^2 = 4x$. Let C be chosen on the arc AOB of the parabola, where O is the origin, such that the area of ΔACB is maximum. Then, the area (in sq.units) of ΔACB , is :

Q.23
Options

1. $31\frac{1}{4}$

2. $30\frac{1}{2}$

3. 32

4. $31\frac{3}{4}$

Q.24 Let the equations of two sides of a triangle be $3x - 2y + 6 = 0$ and $4x + 5y - 20 = 0$. If the orthocentre of this triangle is at $(1, 1)$, then the equation of its third side is :

- Options**
1. $122y - 26x - 1675 = 0$
 2. $122y + 26x + 1675 = 0$
 3. $26x + 61y + 1675 = 0$
 4. $26x - 122y - 1675 = 0$

Q.25 An urn contains 5 red and 2 green balls. A ball is drawn at random from the urn. If the drawn ball is green, then a red ball is added to the urn and if the drawn ball is red, then a green ball is added to the urn ; the original ball is not returned to the urn. Now, a second ball is drawn at random from it. The probability that the second ball is red, is :

- Options**
1. $\frac{21}{49}$
 2. $\frac{27}{49}$
 3. $\frac{26}{49}$
 4. $\frac{32}{49}$

Q.26 If the lines $x = ay + b$, $z = cy + d$ and $x = a'z + b'$, $y = c'z + d'$ are perpendicular, then :

- Options
1. $ab' + bc' + 1 = 0$
 2. $cc' + a + a' = 0$
 3. $bb' + cc' + 1 = 0$
 4. $aa' + c + c' = 0$

Q.27 Let $\vec{a} = \hat{i} + \hat{j} + \sqrt{2}\hat{k}$, $\vec{b} = b_1\hat{i} + b_2\hat{j} + \sqrt{2}\hat{k}$ and $\vec{c} = 5\hat{i} + \hat{j} + \sqrt{2}\hat{k}$ be three vectors such that the projection vector of \vec{b} on \vec{a} is \vec{a} . If $\vec{a} + \vec{b}$ is perpendicular to \vec{c} , then $|\vec{b}|$ is equal to :

- Options
1. $\sqrt{32}$
 2. 6
 3. $\sqrt{22}$
 4. 4

Q.28 The number of all possible positive integral values of α for which the roots of the quadratic equation, $6x^2 - 11x + \alpha = 0$ are rational numbers is :

- Options
1. 3
 2. 2
 3. 4
 4. 5

Q.29 Let $A = \{x \in \mathbf{R} : x \text{ is not a positive integer}\}$.

Define a function $f: A \rightarrow \mathbf{R}$ as $f(x) = \frac{2x}{x-1}$,

then f is :

Options 1. not injective

2. neither injective nor surjective

3. surjective but not injective

4. injective but not surjective

Q.30

If $\int_0^{\pi/3} \frac{\tan \theta}{\sqrt{2k \sec \theta}} d\theta = 1 - \frac{1}{\sqrt{2}}$, ($k > 0$), then the

value of k is :

Options 1. 4

2. $\frac{1}{2}$

3. 1

4. 2