FIITJEE

Solutions to JEE (Main)-2021

JEE–Main–2021 –Feb–26–First–Shift

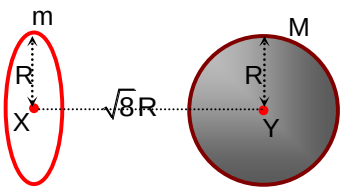
PHYSICS, CHEMISTRY & MATHEMATICS

(PHYSICS)

SECTION A

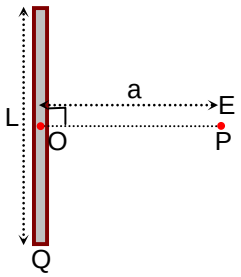
Q1. A short straight object of height 100cm lies before the central axis of a spherical mirror whose focal length has absolute value | f | = 40 cm. The image of object produced by the mirror is of height 25cm and has the same orientation of the object. One may conclude from the information:
(A) Image is virtual, opposite side of concave mirror.
(B) Image is real, same side of convex mirror.
(C) Image is real, same side of concave mirror.
(D) Image is virtual, opposite side of convex mirror.

Q2. Find the gravitational force of attraction between the ring and sphere as shown in the diagram, where the plane of the ring is perpendicular to the line joining the centres. If $\sqrt{8}$ R is the distance between the centres of a ring (of mass ' m ') and a sphere (mass 'M') where both have equal radius 'R'.



(A) $\frac{\sqrt{8}}{9}.\frac{GmM}{R}$
(B) $\frac{1}{3\sqrt{8}}.\frac{GMm}{R^2}$
(C) $\frac{\sqrt{8}}{27}.\frac{GmM}{R^2}$
(D) $\frac{2\sqrt{2}}{3}.\frac{GMm}{R^2}$

Q3. Find the electric field at point P (as shown in figure) on the perpendicular bisector of a uniformly charged thin wire of length L carrying a charge Q. The distance of the point P from the centre of the rod is a = $\frac{\sqrt{3}}{2}$L.



(A) $\frac{Q}{3\pi\varepsilon_0 L^2}$
(B) $\frac{Q}{2\sqrt{3}\pi\varepsilon_0 L^2}$
(C) $\frac{Q}{4\pi\varepsilon_0 L^2}$
(D) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 L^2}$

Q4. In a typical combustion engine the work done by a gas molecule is given by $W = \alpha^2\beta e^{-\frac{\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be :
(A) [M L T^{-1}]
(B) [M^0 L T^0]
(C) [M^2 L T^{-2}]
(D) [M L T^{-2}]

Q5. A particle is moving with uniform speed along the circumference of a circle of radius of radius R under the action of a central fictitious force F which is inversely proportional to R^3. Its time period of revolution will be given by:

(A) $T \alpha R^{\frac{3}{2}}$ (B) $T \alpha R^{\frac{5}{2}}$

(C) $T \alpha R^{\frac{4}{3}}$ (D) $T \alpha R^2$

Q6. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Body 'P' having mass M moving with speed 'u' has head – on collision elastically with another body 'Q' having mass 'm' initially at rest. If m << M, Body 'Q' will have a maximum speed equal to'2u' after collision.

Reason R : During elastic collision, the momentum and kinetic energy are both conserved.

In the light of the above statements, choose the most appropriate answer from the options given below:

(A) **A** is correct but **R** is not correct.
(B) **A** is not correct but **R** is correct.
(C) Both **A** and **R** are correct and **R** is the correct explanation of **A**.
(D) Both **A** and **R** correct but **R** is **NOT** the correct explanation of **A**.

Q7. Assume that a tunnel is dug along a chord of the earth, at a perpendicular distance (R/2) from the earth's centre, where 'R' is the radius of the Earth. The wall of the tunnel is frictionless. If a particle is released in this tunnel, it will execute a simple harmonic motion with a time period :

(A) $2\pi\sqrt{\frac{R}{g}}$ (B) $\frac{g}{2\pi R}$ (C) $\frac{1}{2\pi}\sqrt{\frac{g}{R}}$ (D) $\frac{2\pi R}{g}$

Q8. A large number of water drops, each of radius r, combine to have a drop of radius R. If the surface tension is T and mechanical equivalent of heat is J, the rise in heat energy per unit volume will be:

(A) $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$ (B) $\frac{2T}{rJ}$

(C) $\frac{3T}{rJ}$ (D) $\frac{2T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

Q9. Consider the combination of 2 capacitors C_1 and C_2 , with $C_2 > C_1$,when connected in parallel, the equivalent capacitance is $\frac{15}{4}$ times the equivalent capacitance of the same connected in series, Calculate the ratio of capacitors, $\frac{C_2}{C_1}$.

(A) $\frac{111}{80}$ (B) $\frac{15}{4}$

(C) $\frac{29}{15}$ (D) $\frac{15}{11}$

Q10. Four identical solid spheres each of mass 'm' and radius 'a' are placed with their centres on the four corners of a square of side 'b'. The moment of inertia of the system about side of square where the axis of rotation is parallel to the plane of the square is :

(A) $\frac{4}{5}ma^2$ (B) $\frac{4}{5}ma^2 + 2mb^2$

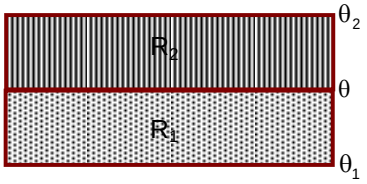
(C) $\frac{8}{5}ma^2 + 2\,mb^2$ (D) $\frac{8}{5}ma^2 + mb^2$

Q11. LED is constructed from Ga – As – P semiconducting material. The energy gap of this LED is 1.9 eV. Calculate the wavelength of light emitted and its colour.

[$h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^8$ ms^{-1}]

(A) 654 nm and orange colour (B) 1046 nm and blue colour
(C) 1046 nm and red colour (D) 654 nm and red colour

Q12. The temperature θ at the junction of two insulating sheets, having thermal resistances R_1 and R_2 as well as top and bottom temperatures θ_1 and θ_2 (as shown in figure) is given by :



(A) $\frac{\theta_1 R_2 + \theta_2 R_1}{R_1 + R_2}$

(B) $\frac{\theta_1 R_1 + \theta_2 R_2}{R_1 + R_2}$

(C) $\frac{\theta_2 R_2 - \theta_1 R_1}{R_2 - R_1}$

(D) $\frac{\theta_1 R_2 - \theta_2 R_1}{R_2 - R_1}$

Q13. If two similar spring each of spring constant K_1 are joined in series, the new spring constant and time period would be changed by a factor :

(A) $\frac{1}{2}, \sqrt{2}$ (B) $\frac{1}{2}, 2\sqrt{2}$

(C) $\frac{1}{4}, 2\sqrt{2}$ (D) $\frac{1}{4}, \sqrt{2}$

Q14. A planet revolving in elliptical orbit has :

(A) a constant velocity of revolution.

(B) has the least velocity when it is nearest to the sun.

(C) its areal velocity is directly proportional to its velocity.

(D) areal velocity is inversely proportional to its velocity.

(E) To follow a trajectory such that the areal velocity is constant.

Choose the correct answer from the options given below:

(A) C only (B) A only

(C) D only (D) E only

Q15. An alternating is given by the equation $i = i_1 \sin \omega t + i_2 \cos \omega t$. Then rms current will be:

(A) $\frac{1}{\sqrt{2}} \left(i_1^2 + i_2^2\right)^{\frac{1}{2}}$ (B) $\frac{1}{\sqrt{2}} (i_1 + i_2)^2$

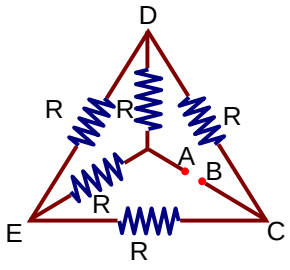
(C) $\frac{1}{\sqrt{2}} (i_2 + i_2)$ (D) $\frac{1}{2} \left(i_1^2 + i_2^2\right)^{\frac{1}{2}}$

Q16. If λ_1 and λ_2 are the wavelengths of the third member of Lyman and first member of the Paschen series respectively, then the value of $\lambda_1 : \lambda_2$ is :

(A) 1 : 3 (B) 7 : 108

(C) 1 : 9 (D) 7 : 135

Q17. Five equal resistances are connected in a network as shown in figure. The net resistance between the points A and B is :



(A) $\frac{3R}{2}$ (B) R

(C) $\frac{R}{2}$ (D) 2R

Q18. Given below are two statements : one is labelled as **Assertion A** and the other is labeled as **Reason R**.

Assertion A : An electron microscope achieve better resolving power than an optical microscope.

Reason R : The de Broglie's wavelength of the electrons emitted from an electron gun is much less than wavelength of visible

light. In the light of the above statements, choose the correct answer from the options given below :

(A) **A** is true but **R** is false.

(B) **A** is false but **R** is true.

(C) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(D) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

Q19. The normal density of a material its ρ and its bulk modulus of elasticity is K. The magnitude of increase in density of material, when a pressure P is applied uniformly on all sides, will be :

(A) $\frac{K}{\rho P}$ (B) $\frac{PK}{\rho}$

(C) $\frac{\rho K}{P}$ (D) $\frac{\rho P}{K}$

Q20. In a Young's double slit experiment two slits are separated by 2mm and the screen is placed one meter away. When a light of wavelength 500 nm used, the fringe separation will be :

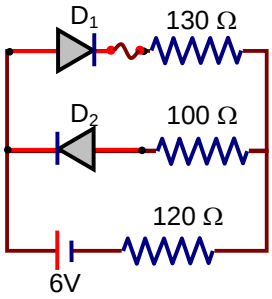
(A) 1 mm (B) 0.75 mm

(C) 0.25 mm (D) 0.50 mm

SECTION B

Q1. A container is divided into two chambers by a partition . The volume of first chamber is 4.5 litre and second chamber is 5.5 litre. The first chamber contain 3.0 moles of gas at pressure 2.0 atm and second chamber contain 4.0 moles of gas at pressure 3.0 atm. After the partition is removed and the mixture attains equilibrium, then, the common equilibrium pressure existing in the mixture is x $\times 10^{-1}$ atm. Value of x is ---------.

Q2. The circuit contains two diodes each with a forward resistance of 50 Ω and with infinite reverse resistance. If the battery voltage is 6 V, the current through the 120 Ω resistance is ---------- m A.

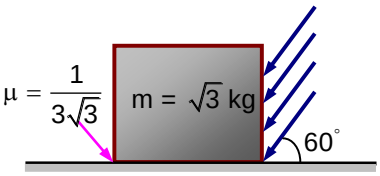


Q3. In an electrical circuit, a battery is connected to pass 20 C of charge through it in a certain given time. The potential difference between two plates of the battery is maintained at 15V. The work done by the battery is ---------- J.

Q4. The maximum and minimum amplitude of an amplitude modulated wave is 16V and 8V respectively. The modulation index for this amplitude wave is x × 10^{-2}. The value of x is ----------.

Q5. A boy pushes a box of mass 2kg with a force $\vec{F} = \left(20\hat{i} + 10\hat{j}\right)$ N on a frictionless surface. If the box was initially at rest, then ---------- m is displacement along the x – axis after 10s.

Q6. As shown in the figure, a block of mass $\sqrt{3}$ kg is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle 60° with horizontal such that it does not move, will be 3x. The value of x will be ----------.



[g = 10 m/s^2 ; sin 60° = $\frac{\sqrt{3}}{2}$; cos60° = $\frac{1}{2}$]

Q7. In a series LCR resonant circuit, the quality factor is measured as 100. If the inductance is increased by two fold and resistance is decreased by two fold, then the quality factor after this change will be -------.

Q8. A person standing on a balance inside a stationary lift measures 60 kg. The weight of that person if the lift descends with uniform downward acceleration of 1.8 m/s^2 will be ---------- N. [g = 10 m/s^2]

Q9. A radiation is emitted by 1000 W bulb and it generates an electric field and magnetic field at P, placed at a distance of 2 m. The efficiency of the bulb is 1.25%. The value of peak electric field at P is x × 10^{-1} V/m. Value of x is ----------. (Rounded – off to the nearest integer)

[Take ε_0 = 8.85 × 10^{-12} C^2 N^{-1} m^{-2}, c=3×10^8 ms^{-1}]

Q10. The mass per unit length of a uniform wire is 0.135 g/cm. A transverse wave of the form $y = -0.21 \sin(x + 30t)$ is produced in it, where x is in meter and t is in second. Then, the expected value of tension in the wire is $x \times 10^{-2}$ N. Value of x is ----------. (Round-off to the nearest integer)

PART –B (CHEMISTRY)

SECTION A

Q1. Match List – I with List – II.

List – I Electronic configuration of elements	List – II $\Delta_i H$ in kJ mol^{-1}
(a) $1s^2\ 2s^2$	(i) 801
(b) $1s^2\ 2s^2\ 2p^4$	(ii) 899
(c) $1s^2 2s^2 2p^3$	(iii) 1314
(d) $1s^2 2s^2 2p^1$	(iv) 1402

Choose the most appropriate answer from the options given below:

(A) (a) → (ii), (b) → (iii), (c) → (iv), (d) → (i)
(B) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)
(C) (a) → (i), (b) → (iv), (c) → (iii), (d) → (ii)
(D) (a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

Q2. Which one of the following lanthanoids does not form MO_2 ?
[M is lanthanoid metal]
(A) Pr
(B) Dy
(C) Yb
(D) Nd

Q3. On treating a compound with warm dil. H_2SO_4, gas X is evolved which turns $K_2Cr_2O_7$ paper acidified with dil. H_2SO_4 to a green compound Y. X and Y respectively are :
(A) X = SO_2, Y = $Cr_2(SO_4)_3$
(B) X = SO_2, Y = Cr_2O_3
(C) X = SO_3, Y = Cr_2O_3
(D) X = SO_3, Y = $Cr_2 (SO_4)_3$

Q4. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A : Dipole – dipole interactions are the only non – covalent interactions, resulting in hydrogen bond formation.
Reason R : Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.
In the light of the above statements, choose the most appropriate answer from the options given below :
(A) **A** is true but **R** is false
(B) **A** is false but **R** is true
(C) Both **A** and **R** are true and **R** is the correct explanation of **A**
(D) Both **A** and **R** are true but **R** is **NOT** the correct explanation of **A**

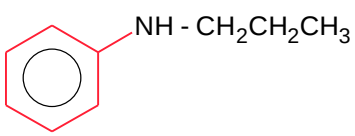
Q5. Given below are two statements :
Statement I : A mixture of chloroform and aniline can be separated by simple distillation.
Statement II : When separating aniline from a mixture of aniline and water by steam distillation aniline boils below its boiling point.
In the light of the above statements, choose the most appropriate answer from the options given below :

(A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is false but statement II is true
(D) Statement I is true but Statement II is false

Q6. Which of the following vitamin is helpful in delaying the blood clotting ?
(A) Vitamin B
(B) Vitamin K
(C) Vitamin E
(D) Vitamin C

Q7. An amine on reaction with benzenesulphonyl chloride produces a compound insoluble in alkaline solution. This amine can be prepared by ammonolysis of ethyl chloride. The correct structure of amine is:

(A) $CH_3CH_2CH_2NHCH_3$

(B) 

(C) $CH_3CH_2NH_2$

(D) $CH_3CH_2CH_2\underset{\underset{H}{|}}{N} - CH_2\ CH_3$

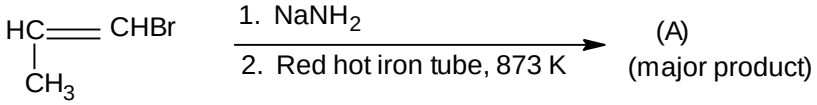
Q8.

$$\underset{(C_4H_8Cl_2)}{\overset{A}{}} \xrightarrow[373\ K]{\text{Hydrolysis}} \underset{(C_4H_8O)}{\overset{B}{}}$$

B reacts with Hydroxyl amine but does not give Tollen's test. Identify A and B.

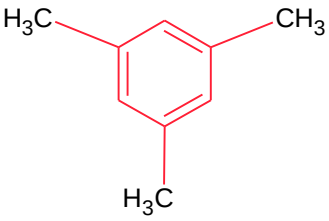
(A) 1, 1 – Dichlorobutane and Butanal
(B) 2,2 – Dichlorobutane and Butanal
(C) 1, 1- Dichlorobutane and 2 – Butanone
(4) 2,2 – Dichlorobutane and Butan – 2 – one

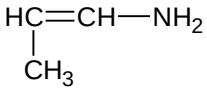
Q9. For the given reaction :



What is 'A' ?

(A) $CH_3CH_2CH_2NH_2$

(B) 

(C) 

(D) 

Q10. The orbital having two radial as well as two angular nodes is :

(A) 4d
(B) 5d
(C) 4f
(D) 3p

Q11. Find A, B and C in the following reactions :

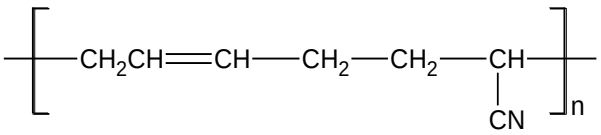
$NH_3 + A + CO_2 \rightarrow (NH_4)_2CO_3$
$(NH_4)_2CO_3 + H_2O + B \rightarrow NH_4HCO_3$
$NH_4HCO_3 + NaCl \rightarrow NH_4Cl + C$

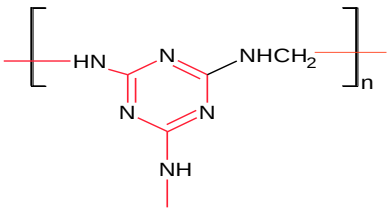
(A) A – H_2O ; B – O_2 ; C – $NaHCO_3$
(B) A – H_2O ; B – CO_2 ; C – $NaHCO_3$
(C) A – H_2O ; B – O_2 ; C – Na_2CO_3
(D) A – O_2 ; B – CO_2 ; C – Na_2CO_3

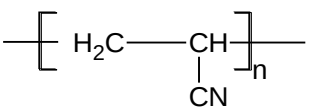
Q12. Compound A used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries. Compound A is :

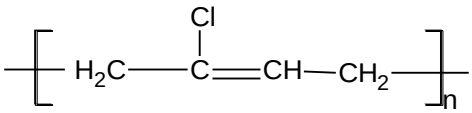
(A) $PbSO_4$
(B) Pb_3O_4
(C) PbO
(D) PbO_2

Q13. The structure of Neoprene is :

(A) 

(B) 

(C) 

(D) 

Q14. Which of the following is 'a' FALSE statement ?
(A) Carius method is used for the estimation of nitrogen in an organic compound.
(B) Carius tube is used in the estimation of sulphur in an organic compound.
(C) Kjeldahl's method is used for the estimation of nitrogen in an organic compound.
(D) Phosphoric acid produced on oxidation of phosphorus present in an organic compound is precipitated as $Mg_2P_2O_7$ by adding magnesia mixture.

Q15. Match list – I with List – II.

List – I (Ore)	List – II (Element Present)
(a) Kernite	(i) Tin
(b) Cassiterite	(ii) Boron
(c) Calamine	(iii) Fluorine
(d) Cryolite	(iv) Zinc

Choose the most appropriate answer from the options given below :
(A) (a) $\rightarrow$ (i) , (b) $\rightarrow$ (iii) , (c) $\rightarrow$ (iv) , (d) $\rightarrow$ (ii)
(B) (a) $\rightarrow$ (ii), (b) $\rightarrow$ (i), (c) $\rightarrow$ (iv), (d) $\rightarrow$ (iii)
(C) (a) $\rightarrow$ (iii), (b) $\rightarrow$ (i) , (c) $\rightarrow$ (ii) , (d) $\rightarrow$ (iv)
(D) (a) $\rightarrow$ (ii), (b) $\rightarrow$ (iv), (c) $\rightarrow$ (i), (d) $\rightarrow$ (iii)

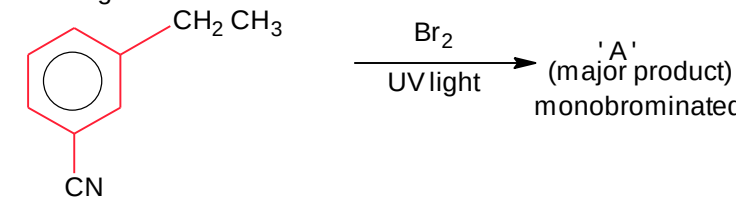
Q16. Given below are two statements :
Statements I : o– Nitrophenol is steam volatile due to intramolecular hydrogen bonding.
Statement II : o– Nitrophenol has high meliting due to hydrogen bonding.
In the light of the above statements, choose the most appropriate answer from the options given below :
(A) Statement I is false but Statement II is true
(B) Both Statement I and Statement II are true
(C) Both Statement I and Statement II are false
(D) Statement I is true but Statement II is false

Q17. The presence of ozone in troposphere :
(A) generates photochemical smog
(B) Protects us from the X – ray radiation
(C) protects us from the UV radiation
(D) protects us from greenhouse effect

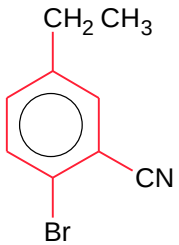
Q18. Statements about heavy water are given below :
(A) Heavy water is used in exchange reactions for the study of reaction mechanisms.
(B) Heavy water is prepared by exhaustive electrolysis of water
(C) Heavy water has higher boiling point than ordinary water.
(D) Viscosity of H_2O is greater than D_2O.
Choose the most appropriate answer from the options given below:

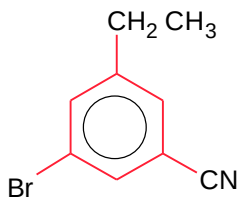
(A) A and D only
(B) A, B and C only
(C) A and B only
(D) A and C only

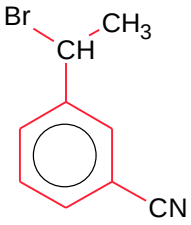
Q19. For the given reaction :

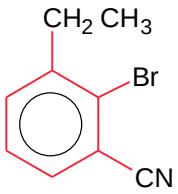


What is 'A' ?

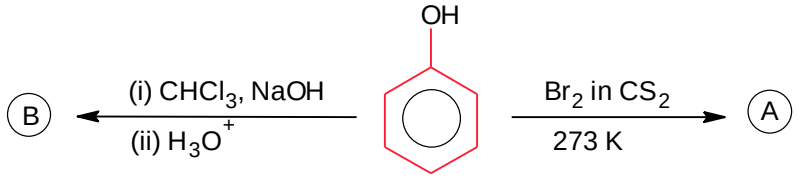
(A)


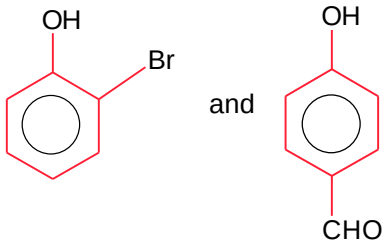
(B)


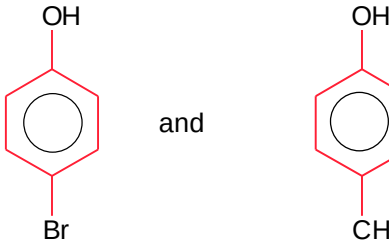
(C) 

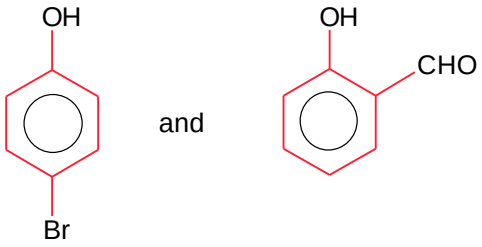
(C) 

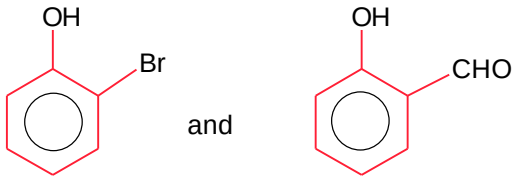
Q20. Identify the major products A and B respectively in the following reactions of phenol :



(A) 

(B) 

(C) 

(D) 

SECTION B

Q1. Number of bridging CO ligands in $[Mn_2(CO)_{10}]$ is ----------.

Q2. A certain gas obeys $P(V_m - b) = RT$. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$. The value of x is----------.
(Integer answer) (Z : compressibility factor)

Q3. Consider the following reaction
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O, E^\circ = 1.51V$.
The quantity of electricity required in Faraday to reduce five moles of MnO_4^- is ---------.
(Interger answer)

Q4. An exothermic reaction $X \rightarrow Y$ has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is -20 kJ, then the activation energy for the reverse reaction in kJ is ----------. (Integer answer)

Q5. A homogeneous ideal gaseous reaction $AB_{2(g)} \rightleftharpoons A_{(g)} + 2B_{(g)}$ is carried out in a 25 litre flask at 27°C. The initial amount of AB_2 was 1 mole and the equilibrium pressure was 1.9 atm. The value of K_p is $x \times 10^{-2}$. The value of x is ----------. (Integer answer).
[$R = 0.08206\ dm^3 atm\ K^{-1}\ mol^{-1}$]

Q6. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is ----------.

Q7. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is ---------.
[R = 0.0821 L atm K^{-1} $mole^{-1}$]

Q8. 224 mL of $SO_{2(g)}$ at 298 K and 1 atm is passed through 100mL of 0.1 M NaOH solution. The non – volatile solute produced is dissolved is 36 g of water. The lowering of vapour pressure of solution (assuming the solution is dilute) $\left(P^{\circ}_{(H_2O)} = 24\text{mm of Hg}\right)$ is x × 10^{-2}mm of Hg, the value of x is ----------. (Integer answer)

Q9. The number of significant figures in 50000.020 × 10^{-3} is ……...

Q10. For a chemical reaction A + B $\rightleftharpoons$ C+D
($\Delta_r H^{\Theta} = 80\text{kJ mol}^{-1}$) the entropy change $\Delta_r S^{\Theta}$ depends on the temperature T (in K) as $\Delta_r S^{\Theta} = 2T$ ($JK^{-1}mol^{-1}$).
Minimum temperature at which it will become spontaneous is ---------- K. (Integer)

PART–C (MATHEMATICS)

SECTION A

Q1. If $\frac{\sin^{-1}x}{a}=\frac{\cos^{-1}x}{b}=\frac{\tan^{-1}y}{c}$; $0<x<1$, then the value of $\cos\left(\frac{\pi c}{a+b}\right)$ is :

(A) $1-y^2$

(B) $\frac{1-y^2}{1+y^2}$

(C) $\frac{1-y^2}{2y}$

(D) $\frac{1-y^2}{y\sqrt{y}}$

Q2. The value of $\begin{vmatrix}(a+1)(a+2) & a+2 & 1\\ (a+2)(a+3) & a+3 & 1\\ (a+3)(a+4) & a+4 & 1\end{vmatrix}$ is :

(A) -2

(B) 0

(C) (a+1) (a+2) (a+ 3)

(D) (a+2) (a+3) (a+4)

Q3. The value of $\int_{-\pi/2}^{\pi/2}\frac{\cos^2 x}{1+3^x}\,dx$ is :

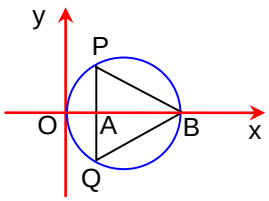
(A) 2π

(B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$

(D) 4π

Q4. In the circle given below, let OA = 1 unit, OB = 13 unit and PQ $\perp$ OB. Then, the area of the triangle PQB (in square units) is :



(A) $24\sqrt{3}$

(B) $26\sqrt{2}$

(C) $24\sqrt{2}$

(D) $26\sqrt{3}$

Q5. The number of seven digit integers with sum of the digits equal to 10 and formed by using the digits 1,2 and 3only is:

(A) 77

(B) 42

(C) 35

(D) 82

Q6. The maximum slope of the curve $y=\frac{1}{2}x^4-5x^3+18x^2-19x$ occurs at the point :

(A) (2, 9)

(B) (0, 0)

(C) (2, 2)

(D) $\left(3,\frac{21}{2}\right)$

Q7. The value of $\sum_{n=1}^{100}\int_{n-1}^{n}e^{x-[x]}\,dx$, where [x] is the greatest integer $\le$ x, is:

(A) 100 (1- e)

(B) 100(1+ e)

(C) 100e

(D) 100 (e – 1)

Q8. The value of $\lim\limits_{h\to 0} 2\left\{\dfrac{\sqrt{3}\sin\left(\frac{\pi}{6}+h\right)-\cos\left(\frac{\pi}{6}+h\right)}{\sqrt{3}h\left(\sqrt{3}\cos h-\sin h\right)}\right\}$ is :

(A) $\dfrac{2}{\sqrt{3}}$ (B) $\dfrac{3}{4}$

(C) $\dfrac{2}{3}$ (D) $\dfrac{4}{3}$

Q9. The intersection of three lines x- y = 0, x+ 2y = 3 and 2x+ y = 6 is a :

(A) Right angled triangle (B) Isosceles triangle

(C) Equilateral triangle (D) None of the above

Q10. Let f be any function defined on **R** and let it satisfy the condition :

$|f(x)-f(y)|\le|(x-y)^2|, \forall (x, y)\in R$

If $f(0) = 1$, then :

(A) $f(x) > 0, \forall x\in$ **R** (B) $f(x) = 0, \forall x\in$ **R**

(C) $f(x)$ can take any value in **R** (D) $f(x) < 0, \forall x\in$ **R**

Q11. If (1, 5, 35), (7, 5, 5), $(1, \lambda, 7)$ and $(2\lambda, 1, 2)$ are coplanar, then the sum of all possible values of λ is :

(A) $-\dfrac{39}{5}$ (B) $\dfrac{39}{5}$

(C) $\dfrac{44}{5}$ (D) $-\dfrac{44}{5}$

Q12. Let A be a symmetric matrix of order 2 with integer entries. If the sum of the diagonal elements of A^2 is 1, then the possible number of such matrices is :

(A) 1 (B) 6

(C) 4 (D) 12

Q13. The rate of growth of bacteria in a culture is proportional to the number of bacteria present and the bacteria count is 1000 at initial time t = 0. The number of bacteria is increased by 20% in 2 hours. If the population of bacteria is 2000 after $\dfrac{k}{\log_e\left(\frac{6}{5}\right)}$ hours, then $\left(\dfrac{k}{\log_e 2}\right)^2$ is equal to :

(A) 4 (B) 8

(C) 2 (D) 16

Q14. The sum of the infinite series $1+\dfrac{2}{3}+\dfrac{7}{3^2}+\dfrac{12}{3^3}+\dfrac{17}{3^4}+\dfrac{22}{3^5}+\ldots\ldots$ is equal to :

(A) $\dfrac{15}{4}$ (B) $\dfrac{11}{4}$

(C) $\dfrac{9}{4}$ (D) $\dfrac{13}{4}$

Q15. A fair coin is tossed a fixed number of times. If the probability of getting 7 heads is equal to probability of getting 9 heads, then the probability of getting 2 heads is :

(A) $\dfrac{15}{2^{14}}$ (B) $\dfrac{15}{2^{12}}$

(C) $\dfrac{15}{2^8}$ (D) $\dfrac{15}{2^{13}}$

Q16. The maximum value of term independent of 't' in the expansion of $\left(t x^{\frac{1}{5}} + \frac{(1-x)^{\frac{1}{10}}}{t}\right)^{10}$ where $x \in (0, 1)$ is :

(A) $\frac{10!}{\sqrt{3}(5!)^2}$ (B) $\frac{2.10!}{3\sqrt{3}(5!)^2}$

(C) $\frac{10!}{3(5!)^2}$ (D) $\frac{2.10!}{3(5!)^2}$

Q17. If $\vec{a}$ and $\vec{b}$ are perpendicular, then $\vec{a} \times \left(\vec{a} \times \left(\vec{a} \times \left(\vec{a} \times \vec{b}\right)\right)\right)$ is equal to:

(A) $\vec{0}$ (B) $\vec{a} \times \vec{b}$

(C) $|\vec{a}|^4 \vec{b}$ (D) $\frac{1}{2}|\vec{a}|^4 \vec{b}$

Q18. Consider the three planes
P_1: 3x + 15y + 21z = 9,
P_2: x- 3y – z = 5, and
P_3: 2x + 10y + 14z = 5
Then, which one of the following is true ?
(A) P_1 and P_3 are parallel. (B) P_1, P_2 and P_3 all are parallel.
(C) P_1 and P_2 are parallel. (D) P_2 and P_3 are parallel.

Q19. Let R = {(P,Q) | P and Q are at the same distance from the origin} be a relation, then the equivalence class of (1, -1) is the set :
(A) $S = \{(x, y) \mid x^2 + y^2 = 1\}$ (B) $S = \{(x, y) \mid x^2 + y^2 = \sqrt{2}\}$
(C) $S = \{(x, y) \mid x^2 + y^2 = 2\}$ (D) $S = \{(x, y) \mid x^2 + y^2 = 4\}$

Q20. In an increasing geometric series, the sum of the second and the sixth term is $\frac{25}{2}$ and the product of the third and fifth term is 25. Then, the sum of 4^{th} , 6^{th} and 8^{th} terms is equal to :
(A) 26 (B) 35
(C) 30 (D) 32

SECTION B

Q1. The area bounded by the lines y = || x - 1| - 2 | is ----------.

Q2. If $\sqrt{3}(\cos^2 x) = (\sqrt{3} - 1)\cos x + 1$, the number of solutions of the given equation when $x \in \left[0, \frac{\pi}{2}\right]$ is ----.

Q3. The number of solution of the $\log_4 (x-1) = \log_2 (x-3)$ is ----------.

Q4. If y = y(x) is the solution of the equation $e^{\sin y}\cos y\frac{dy}{dx} + e^{\sin y}\cos x = \cos x$, y(0) = 0; then

$1 + y\left(\frac{\pi}{6}\right) + \frac{\sqrt{3}}{2}y\left(\frac{\pi}{3}\right) + \frac{1}{\sqrt{2}}y\left(\frac{\pi}{4}\right)$ is equal to ----------.

Q5. Let $(\lambda, 2, 1)$ be a point on the plane which passes which through the point (4, -2, 2). If the plane is perpendicular to the line joining the points (-2, -21, 29) and (-1, -16, 23), then $\left(\frac{\lambda}{11}\right)^2 - \frac{4\lambda}{11} - 4$ is equal to ----------.

Q6. The number of integral values of 'k' for which the equation 3sinx + 4cos x = k + 1 has a solution, $k \in R$ is ----------.

Q7. The sum of 162^{th} power of the roots of the equation $x^3 - 2x^2 + 2x - 1 = 0$ is ----------.

Q8. Let m, n $\in$ N and gcd (2, n) = 1. If $30\binom{30}{0} + 29\binom{30}{1} + \ldots\ldots + 2\binom{30}{28} + 1\binom{30}{29} = n.\ 2^m$, then n + m is equal to --------.

$\left(\text{Here } \binom{n}{k} = {}^nC_k\right)$

Q9. The difference between degree and order of a differential equation that represents the family of curves given by $y^2 = a\left(x + \frac{\sqrt{a}}{2}\right)$, a > 0 is ----------.

Q10. The value of the integral $\int_0^{\pi} |\sin 2x|\, dx$ is ----------.