29/01/2023
Morning

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Memory Based
Answers & Solutions

Time : 3 hrs. *for* M.M. : 300

JEE (Main)-2023 (Online) Phase-1

(Physics, Chemistry and Mathematics)

IMPORTANT INSTRUCTIONS:

(1) The test is of **3 hours** duration.

(2) The Test Booklet consists of 90 questions. The maximum marks are 300.

(3) There are **three** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each part (subject) has two sections.

(i) **Section-A:** This section contains 20 multiple choice questions which have only one correct answer. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer.

(ii) **Section-B:** This section contains 10 questions. In Section-B, attempt any **five questions out of 10.** The answer to each of the questions is a numerical value. Each question carries **4 marks** for correct answer and **–1 mark** for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

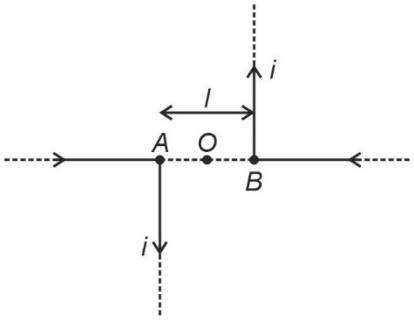
PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1.



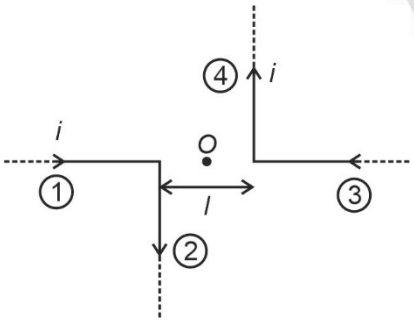
Point *O* and two long wires are kept in same plane such that point *O* lies at mid of line. Then magnetic field at point *O* due to the current *i* flowing in both the wires is equal to

(1) $\frac{\mu_0 i}{2\pi l}$ (2) $\frac{\mu_0 i}{\pi l}$

(3) $\frac{2\pi\mu_0 i}{l}$ (4) $\frac{\mu_0 i}{2l}$

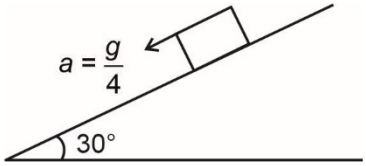
Answer (2)

Sol. Wire section 1 and 3 will not generate field at *O* but 2 and 4 does so



$$B = 2\times\frac{\mu_0 i}{4\pi\frac{l}{2}} = \frac{\mu_0 i}{\pi l}$$

2. A block is sliding down an inclined plane of inclination 30°, with an acceleration of $\frac{g}{4}$:



Find the co-efficient of friction between the block and incline.

(1) $\frac{1}{\sqrt{3}}$ (2) $\frac{1}{2\sqrt{3}}$

(3) $\frac{1}{3}$ (4) $\frac{1}{2}$

Answer (2)

Sol. $mg\sin\theta - \mu mg\cos\theta = ma$

$$\Rightarrow \quad \frac{g}{4} = g\sin\theta - \mu g\cos\theta$$

$$\Rightarrow \quad \mu = \frac{1}{2\sqrt{3}}$$

3. A car is moving on a circular track of radius 50 cm with coefficient of friction being 0.34. On this horizontal track the maximum safe speed for turning is equal to (g = 10 m/s^2)

(1) 1.03 (2) 1.7

(3) 1.3 (4) 1.8

Answer (3)

Sol. Friction will provide required centripetal acceleration to move in the circle.

so,

$$\frac{mv^2}{R} = \mu mg$$

or $v = \sqrt{\mu gR}$

$$= \sqrt{0.34\times 10\times\frac{1}{2}}$$

= 1.3 m/s

4. Find the ratio of maximum wavelength of Lyman series of hydrogen atom to minimum wavelength of Balmer series of helium atom.

(1) $\frac{4}{3}$ (2) 1

(3) $\frac{3}{2}$ (4) $\frac{3}{4}$

Answer (1)

Sol. For Lyman series, (for hydrogen atom)

λ_{max} then ΔE will be from n = 2 to n = 1

$$\Delta E = 13.6 \times \left(1 - \frac{1}{4}\right) \text{eV}$$

$$= \left(\frac{3}{4} \times 13.6\right) \text{eV}$$

$$\lambda_{max} = \frac{12400}{\left(\frac{3}{4} \times 13.6\right)} (\text{Å})$$

For λ_{min} in Balmer series, for He atom from $n = \infty$ to $n = 2$

$$\Delta E = 13.6 \times 4\left(\frac{1}{4}\right) = 13.6 \text{ eV}$$

$$\lambda_{min} = \frac{12400}{(13.6)} \text{Å}$$

$$\frac{\lambda_{max}}{\lambda_{min}} = \frac{(13.6)}{\left(\frac{3}{4} \times 13.6\right)} = \left(\frac{4}{3}\right)$$

5. If dimensional formula of pressure gradient is X, electric field has Y, energy density has W and latent heat has Z. Find dimensional formula of $\frac{[X][Y]}{[Z][W]}$ is

(1) $ML^{-2}T^{-1}A^{1}$ (2) $ML^{-2}T^{-1}A^{-1}$

(3) $M^{-1}L^{2}T^{-1}A^{-1}$ (4) $ML^{2}T^{-1}A^{-1}$

Answer (2)

Sol. $[X] = \left[\frac{\Delta P}{\Delta X}\right] = \frac{MLT^{-2}}{L^3} = [ML^{-2}T^{-2}]$

$[Y] = [E] = [MLT^{-3}A^{-1}]$

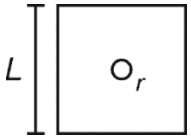
$$[W] = \left[\frac{MLT^{-2}}{L^2}\right] = [ML^{-1}T^{-2}]$$

$$[Z] = \left[\frac{ML^2T^{-2}}{M}\right] = [L^2T^{-2}]$$

$$\frac{[X][Y]}{[Z][W]} = \frac{[ML^{-2}T^{-2}][MLT^{-3}A^{-1}]}{[L^2T^{-2}][ML^{-1}T^{-2}]}$$

$= [ML^{-2}T^{-1}A^{-1}]$

6. A small circular loop of radius r is placed in the plane of a square loop of side length L ($r << L$). Circular loop is at the center of square as shown in the figure. Find mutual inductance.

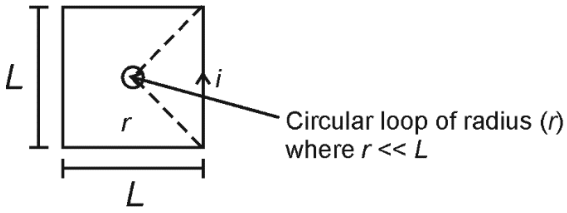


(1) $\frac{\mu_0 r^2}{\sqrt{2}L}$ (2) $\frac{\pi\mu_0 r^2}{2L}$

(3) $\frac{2\sqrt{2}\mu_0 r^2}{L}$ (4) $\frac{4\mu_0 r^2}{L}$

Answer (3)

Sol.



B_{at} centre of rectangular loop

$$= \frac{\mu_0 i}{4\pi\left(\frac{L}{2}\right)}\left[\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right] \times 4$$

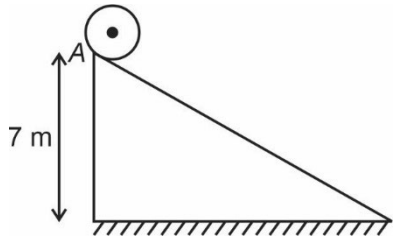
$$= \frac{\mu_0 i}{2\pi L}\left[\frac{2}{\sqrt{2}}\right] \times 4$$

$$= \frac{4\mu_0 i}{\sqrt{2}\pi L} = \left(\frac{2\sqrt{2}\mu_0 i}{\pi L}\right)$$

Flux in circular loop (ϕ) = $\pi r^2 x(B)$

Self inductance = $\frac{\phi}{i} = \left(\frac{2\sqrt{2}\mu_0 r^2}{L}\right)$

7. A solid sphere is released from point O at the top of an incline as shown. Find the value of velocity of centre of mass of sphere at the bottommost point of the incline after it reaches there doing pure rolling. (g = 10 m/s^2)



(1) 3 m/s (2) 7 m/s

(3) 10 m/s (4) 0.7 m/s

Answer (3)

Sol. Using energy conservation.

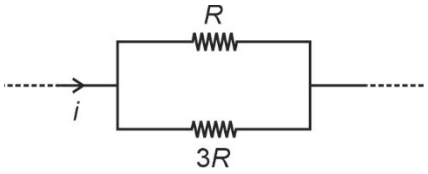
$$\frac{1}{2}mv_{cm}^2 + \frac{1}{2}\frac{2mR^2}{5}\left(\frac{v_{cm}}{R}\right)^2 = mgh$$

$$\frac{7}{10}mv_{cm}^2 = mgh$$

$$v_{cm} = \sqrt{\frac{10}{7}gh}$$

= 10 m/s

8. In the part of a circuit shown



find the ratio of rate of heat produced in R to that in $3R$.

(1) 1 : 9 (2) 1 : 3

(3) 3 : 1 (4) 9 : 1

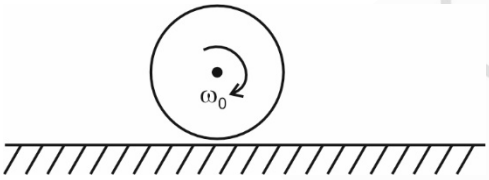
Answer (3)

Sol. $P = \frac{V^2}{R}$

Since V is same

$$\Rightarrow \text{Ratio} = \frac{\frac{1}{R}}{\frac{1}{3R}} = 3$$

9. A disk of radius R is given ω_0 angular speed and placed gently on a rough horizontal surface. Find the velocity of center of disk when pure rolling starts.

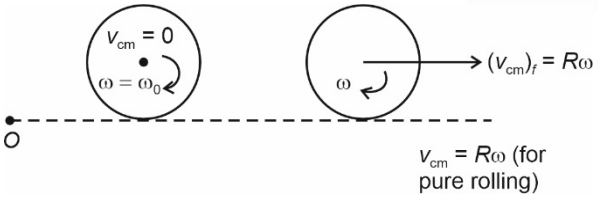


(1) $\frac{R\omega_0}{3}$ (2) $R\omega_0$

(3) $\frac{R\omega_0}{4}$ (4) $2R\omega_0$

Answer (1)

Sol.



Applying angular momentum conservation about point 'O'.

$$I_{cm}\omega_0 = \left(I_{cm} + MR^2\right)\omega$$

$$\frac{1}{2}MR^2\omega_0 = \frac{3}{2}MR^2\omega$$

$$\Rightarrow \boxed{\frac{R\omega_0}{3} = (v_{cm})_f}$$

Finally velocity of centre of mass = $\left(\frac{R\omega_0}{3}\right)$

10. In a standard YDSE first minima is obtained in front of a slit for λ = 800 nm. If distance between the slit and screen is 5 m then separation between the slits is equal to

(1) 5×10^{-2} m (2) 5 mm

(3) 3 mm (4) 2 mm

Answer (4)

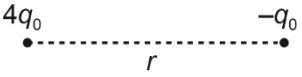
Sol. $\frac{d}{2} = \frac{\lambda D}{2d}$

$$d = \sqrt{\lambda D}$$

$$= \sqrt{800 \times 10^{-9} \times 5}$$

= 2 mm

11. Two point charges are arranged as shown:



Find the distance from $4q_0$ where net electric field is zero.

(1) $4r$ (2) $3r$

(3) $\frac{r}{2}$ (4) $2r$

Answer (4)

Sol. $\frac{1}{4\pi\varepsilon_0}\frac{4q_0}{x^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(x-r)^2}$

$$\Rightarrow x = 2r$$

12. Wavelength of shortest wavelength of Lyman series for hydrogen atom is λ_0, then longest wavelength of Balmer series for He^+ ion is equal to

(1) $\frac{17\lambda_0}{13}$ (2) $\frac{11\lambda_0}{7}$

(3) $\frac{9\lambda_0}{5}$ (4) $\frac{25\lambda_0}{19}$

Answer (3)

Sol. $\frac{1}{\lambda_0} = R\left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$

(For Lyman series for hydrogen atom)

$$\lambda_0 = \frac{1}{R}$$

$$\frac{1}{\lambda} = R \times 2^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

(For Balmer series for He^+ ion)

$$\frac{1}{\lambda} = 4R \times \frac{5}{36}$$

$$\lambda = \frac{9\lambda_0}{5}$$

13. Find excess pressure inside a soap bubble of radius 'R' and surface tension 'T'.

(1) $\frac{T}{R}$ (2) $\frac{2T}{R}$

(3) $\frac{3T}{R}$ (4) $\frac{4T}{R}$

Answer (4)

Sol. $(\Delta P)_{\text{soap bubble}} = \left(\frac{4T}{R}\right)$

14. Two point masses (mass m each) are moving in a circle of radius R under mutual gravitational attraction. Find the speed of each mass.

(1) $\sqrt{\frac{Gm}{4R}}$ (2) $\sqrt{\frac{Gm}{2R}}$

(3) $\sqrt{\frac{Gm}{8R}}$ (4) $\sqrt{\frac{Gm}{R}}$

Answer (1)

Sol. $\frac{G(m)(m)}{(2R)^2} = \frac{mv^2}{R}$

$\Rightarrow v = \sqrt{\frac{Gm}{4R}}$

15. Find out work done in expanding the soap bubble from radius r_1 = 3.5 cm to r_2 = 7.0 cm.

(Given surface tension of soap solution, T = 0.03 N/m)

(1) 0.14 mJ (2) 1.4 mJ

(3) 0.7 mJ (4) 2.8 mJ

Answer (2)

Sol. Work done = change in surface energy of soap babble

Work done = $T(4\pi R^2 - 4\pi r^2)$

$= 4\pi T[7^2 - (3.5)^2] \times 10^{-4}$ J

$= 4\pi T[3.5 \times 10.5] \times 10^{-4}$ J

$= 1.4$ mJ

16. In an isochoric process on an ideal gas initial temperature is equal to 27°C with initial pressure being equal to 270 kPa. Now if final temperature is made equal to 36°C then final pressure is equal to approximately

(1) 298 kPa (2) 270 kPa

(3) 360 kPa (4) 278 kPa

Answer (4)

Sol. As the process is isochoric so

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{270 \times 10^3}{300} = \frac{P_f}{309}$

$P_f = 270 \times 10^3 \times \frac{309}{300}$

P_f = 278.1 × 10^3 Pa = 278.1 kPa

17. If half life of a sample is 30 minutes. Find the fraction of undecayed sample after 90 minutes.

(1) $\frac{1}{4}$ (2) $\frac{3}{4}$

(3) $\frac{1}{8}$ (4) $\frac{7}{8}$

Answer (3)

Sol. $N = N_0 e^{-\lambda t}$

$\lambda = \left(\frac{\ln 2}{t_{\frac{1}{2}}}\right)$

N = Number of undecayed nuclie.

$N = N_0 e^{-\lambda \times (90)}$

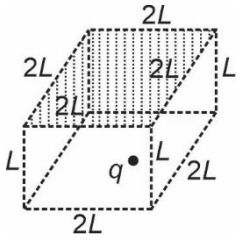
$= N_0 e^{-\left(\frac{\ln 2}{30} \times 90\right)}$

$= N_0 e^{-\ln(8)}$

$N = \left(\frac{N_0}{8}\right)$

Fraction undecayed $= \frac{N}{N_0} = \left(\frac{1}{8}\right)$

18. A charge q is placed at the centre of bottom face as shown:



Find the flux through the shaded surface.

(1) $\frac{2q}{7\varepsilon_0}$ (2) $\frac{q}{12\varepsilon_0}$

(3) $\frac{q}{4\varepsilon_0}$ (4) $\frac{q}{6\varepsilon_0}$

Answer (4)

Sol. Place a similar box at the bottom. We get a cube of side 2*L*. charge *q* is then at the centre.

$$\Rightarrow \quad \phi = \frac{1}{6}\left(\frac{q}{\varepsilon_0}\right)$$

$$\Rightarrow \quad \phi = \frac{q}{6\varepsilon_0}$$

19. Two coherent waves of amplitude 8 cm each are superimposed on one another. If the amplitude of resultant wave is 8 cm then the phase difference between two waves is equal to

(1) $2\pi/3$ (2) $\pi/3$

(3) $\pi/4$ (4) $3\pi/4$

Answer (1)

Sol. $A_1 = A_2 = 8$ cm

$A_R = 8$ cm

$$A_R = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

$$8 = \sqrt{64 + 64 + 128\cos\phi}$$

$$\Rightarrow \quad \cos\phi = -\frac{1}{2}$$

$$\phi = \frac{2\pi}{3}$$

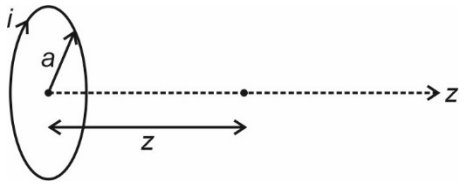
20. A current carrying loop of radius *a* is placed in *X*-*Y* plane with its center at origin. Find magnetic field on the point (0, 0, *a*).

(1) $\frac{\mu_0 i}{2\sqrt{2}a}$ (2) $\frac{\mu_0 i}{4\sqrt{2}a}$

(3) $\frac{2\mu_0 i}{a}$ (4) $\frac{\mu_0 i}{4a}$

Answer (2)

Sol.



$$\vec{B} = \frac{\mu_0}{4\pi}\frac{2\vec{\mu}}{(a^2+z^2)^{3/2}}$$

$$|\vec{\mu}| = (\pi a^2)i$$

$$B = \frac{\mu_0 a^2 i}{2(a^2+z^2)^{3/2}}$$

as $z = a$

$$B = \frac{\mu_0 a^2 i}{2(2a^2)^{3/2}} = \left(\frac{\mu_0 i}{4\sqrt{2}a}\right)$$

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. A ball of mass 2 kg is dropped from a height of 9.8 m and rebounds to a height of 4.9 m. If it remains in contact with ground for 0.2 seconds, the average force on the ball by the ground is $x\left(\sqrt{2}+1\right)$ Newtons. Find *x*. (Take $g = 9.8$ m/s^2)

Answer (98)

Sol. $v_{\text{initial}} = \sqrt{2g(9.8)}\downarrow$

$v_{\text{final}} = \sqrt{2g(4.9)}\uparrow$

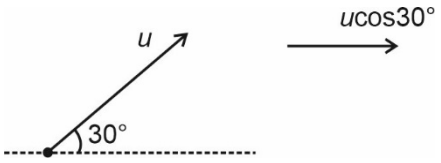
$\Rightarrow F \times \Delta t = m(v_{\text{final}} - v_{\text{initial}})$

$\Rightarrow F = 98\left(\sqrt{2}+1\right)\text{N}$

22. A stone is thrown at an angle 30° with the horizontal on a plane ground. The ratio of kinetic energy at maximum height to the kinetic energy at the point of projection is equal to

Answer (0.75)

Sol.



At the point of projection, speed is *u* so $\text{KE}_1 = \frac{1}{2}mu^2$

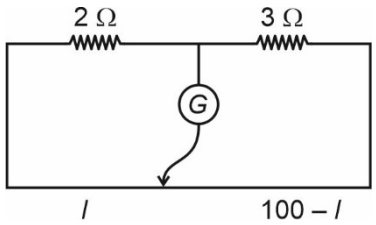
At maximum height, the speed is *u*cos30°

So, $\text{KE}_2 = \frac{1}{2}m(u\cos 30°)^2$

$$= \frac{3}{8}mu^2$$

So, $\frac{\text{KE}_1}{\text{KE}_2} = \frac{4}{3}$

23. Consider the meter bridge setup shown :



If a shunt resistance $x\ \Omega$ is added to 3 Ω resistor, balance point shifts by 22.5 cm. Find x.

Answer (2)

Sol. $\frac{2}{3}=\frac{l}{100-l}$

$\Rightarrow\ l = 40$ cm

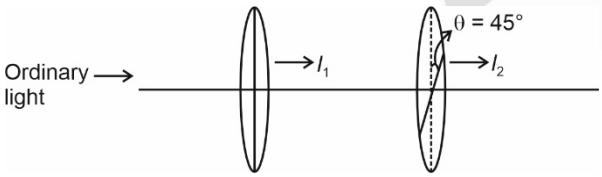
$\Rightarrow\ \frac{2}{R}=\frac{62.5}{37.5}$ where $R=\frac{3x}{3+x}$

$\Rightarrow\ \frac{3x}{3+x}=\frac{75}{62.5}$

$\Rightarrow x = 2\ \Omega$

24. Two polarizers P_1 & P_2 are placed such that their transmission axis are at 45° from each other. Ordinary light is passed through P_1 & I_1 intensity is observed. When this light is passed through P_2, I_2 intensity is observed.

Find $\frac{I_1}{I_2}$?



Answer (2)

$I_1=\frac{I}{2}$

$I_2=\frac{I}{2}\cos^2 45^\circ=\frac{I}{2}\times\frac{1}{2}=\frac{I}{4}$

so, $\frac{I_1}{I_2}=\frac{\frac{I}{2}}{\left(\frac{I}{4}\right)}=2$

25. Magnetic field through a circular loop is 0.8 T. The radius of the loop is expanding at 2 cm/s. The induced emf in the loop, when radius of the loop is 10 cm, is $x\pi \times 10^{-4}$ volts. Find x.

Answer (32)

Sol. $\phi = B(\pi r^2)$

$$|r|=\left|\frac{-d\phi}{dt}\right|=\pi B\left(2r\frac{dr}{dt}\right)$$

$$=\pi\times 0.8\times 2\times\frac{10}{100}\times\frac{2}{100}$$

$= 32\pi \times 10^{-4}$ volts

26. Consider the nuclear reaction:

$$^{292}_{92}X\longrightarrow {}^{282}_{p}Y+2\alpha+{}^{0}_{1}e+2\,{}^{0}_{-1}e$$

Find the value of p.

Answer (89)

Sol. Conserving charge:

$p + 2 \times 2 + 1 + 2 \times (-1) = 92$

$\Rightarrow p = 89$

27. ??

28. ??

29. ??

30. ??

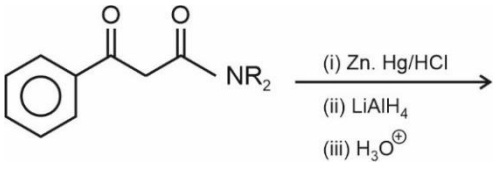
CHEMISTRY

SECTION – A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

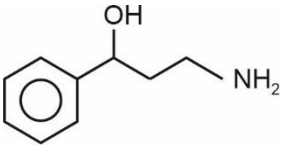
Choose the correct answer :

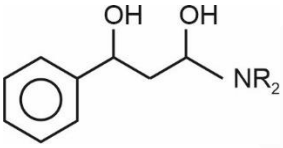
1. Consider the following sequence of reactions:

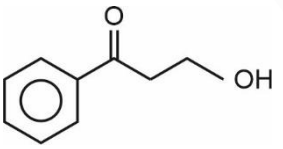


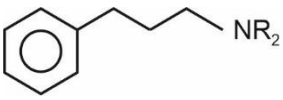
Product 'P'

The product 'P' is

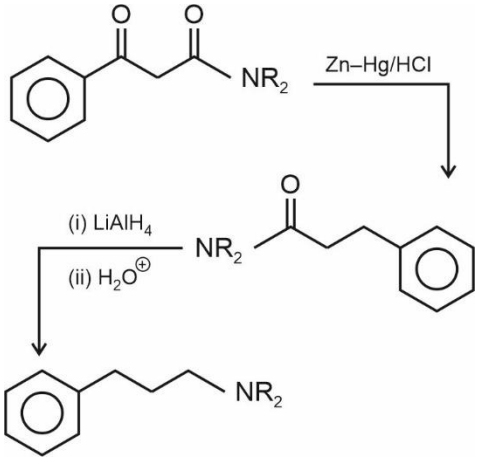
(1) 

(2) 

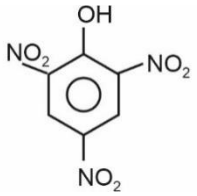
(3) 

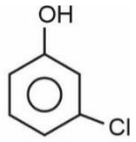
(4) 

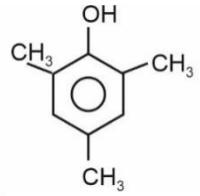
Answer (4)

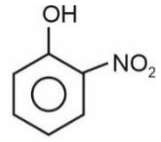
Sol. 

2. Following compounds are given

(I) 

(II) 

(III) 

(IV) 

Compare pK_a values

(1) I > IV > II > III (2) I > IV > III > II

(3) III > II > IV > I (4) IV > I > III > II

Answer (3)

Sol. Acidic Strength $\propto$ – I, – M Groups

$$\propto = \frac{1}{+I, +M} \text{ groups}$$

Acidic strength order

I > IV > II > III

pKa order

III > II > IV > I

3. Which of the following molecules has the highest bond dissociation energy?

(1) I_2 (2) F_2

(3) Cl_2 (4) Br_2

Answer (3)

Sol. Cl_2 has the highest bond dissociation energy among the halogens.

4. Select the correct statement among the following.

(1) Photochemical smog has high concentration of oxidising agent

(2) Classical smog has high concentration of oxidising agent

(3) Classical smog contains NO_2

(4) None of these

Answer (1)

Sol. Photochemical smog has high concentration of oxidising agent.

5. Which of the following compound(s) is/are paramagnetic?

(a) NO_2

(b) NO

(c) K_2O

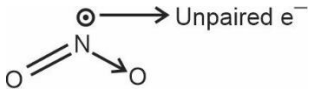
(d) Na_2O_2

(1) a & b only (2) a, b, c only

(3) a, b, c, d (4) a, b, d only

Answer (1)

Sol. NO_2



NO (N_e = 15)

1 unpaired electron as per MOT

6. Find out the magnetic character of Li_2O, KO_2 and MgO in that order.

(1) Diamagnetic, Paramagnetic and Diamagnetic

(2) Paramagnetic, Paramagnetic and Diamagnetic

(3) Diamagnetic, Paramagnetic and Paramagnetic

(4) Diamagnetic, Diamagnetic and Diamagnetic

Answer (1)

Sol. Li_2O has Li^+ and O^{2-}. Both the cation and anion have all their electrons paired. So, it is diamagnetic

KO_2 has K^+ and O_2^-. It is paramagnetic as O_2^- has one unpaired electron.

$$O_2^- : \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2p_z}^2\pi_{2p_x}^2 = \pi_{2p_y}^2\pi_{2p_x}^{*2} = \pi_{2p_y}^{*1}$$

MgO has Mg^{2+} and O^{2-}. It is diamagnetic as Mg^{2+} and O^{2-} have all their electrons paired.

7. Which of the following option contains the correct decreasing order of hydration energy of the following ions?

$K^+, Mg^{2+}, Cs^+, Ca^{2+}, Rb^+$

(1) $Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

(2) $Ca^{2+} > Mg^{2+} > Cs^+ > Rb^+ > K^+$

(3) $Mg^{2+} > Ca^{2+} > Cs^+ > Rb^+ > K^+$

(4) $Cs^+ > Rb^+ > K^+ > Ca^{2+} > Mg^{2+}$

Answer (1)

Sol. Hydration energy $\propto$ charge density

$\therefore$ correct order is : - $Mg^{2+} > Ca^{2+} > K^+ > Rb^+ > Cs^+$

8. How many of the following compounds are odd electron species?

NO_2, NO_2^+, ICl_4^-, BrF_3, NO

(1) 3 (2) 2

(3) 5 (4) 4

Answer (2)

Sol. NO and NO_2 are the odd electron species.

9. Which of the following reaction corresponds to Mond process?

(1) $ZrI_4 \xrightarrow{1800\ K} Zr + 2I_2$

(2) $Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$

(3) $2\left[Au(CN)_2\right]^-(aq) + Zn(s) \longrightarrow 2Au(s) + \left[Zn(CN)4\right]^{2+}(aq)$

(4) $2Al_2O_3 + 3C \rightarrow 4Al + 3CO_2$

Answer (2)

Sol. Mond process for refining Nickel.

$$Ni + 4CO \xrightarrow{300-350\ K} Ni(CO)_4$$

$$Ni(CO)_4 \xrightarrow{450-470\ K} Ni + 4CO$$

10. Cannizzaro reaction is an example of disproportionation reaction. What is the catalyst used in Cannizzaro reaction?

(1) $FeCl_3$

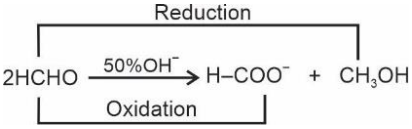
(2) $NaOH/H_2O$

(3) $ZnCl_2/H^+$

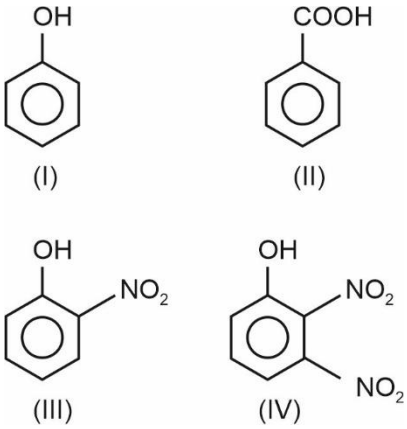
(4) $H_2/Pd/BaSO4$

Answer (2)

Sol.



11. Arrange the following in increasing pK_a value



(1) IV > III > II > I

(2) I > III > IV > II

(3) IV > III > I > II

(4) IV > II > III > I

Answer (2)

Sol. Acidity $\propto \frac{1}{pK_a}$

The order of acidity is : II > IV > III > I

$\therefore$ Their value of pK_a will be : II < IV < III < I

12. Which of the following option contains the correct match

List-I	List-II
(A) Clemmensen reduction	(i) Con. KOH
(B) Reimer tiemann Reaction	(ii) Br_2/NaOH
(C) Cannizzaro reaction	(iii) $CHCl_3$/KOH
(D) Hoffmann bromamide degradation reaction	(iv) Zn-Hg/HCl

(1) A $\rightarrow$ (i); B $\rightarrow$ (ii); C $\rightarrow$ (iii); D $\rightarrow$ (iv)

(2) A $\rightarrow$ (iv); B $\rightarrow$ (iii); C $\rightarrow$ (i); D $\rightarrow$ (ii)

(3) A $\rightarrow$ (ii); B $\rightarrow$ (iii); C $\rightarrow$ (iv); D $\rightarrow$ (i)

(4) A $\rightarrow$ (iii); B $\rightarrow$ (iv); C $\rightarrow$ (i); D $\rightarrow$ (ii)

Answer (2)

Sol. Clemmensen reduction $\rightarrow$ Zn-Hg/HCl

Reimer tiemann reaction $\rightarrow$ $CHCl_3$/KOH

Cannizzaro reaction $\rightarrow$ Con. KOH/Δ

Hoffmann bromamide degradation reaction $\rightarrow$ Br_2/KOH, Δ

13. **Assertion :** First law of thermodynamics has equation : $\Delta U = q + w$

Reason : First law of thermodynamics is based on the law of conservation of energy

(1) 'A' is correct and 'R' is correct and 'R' is the correct explanation of 'A'

(2) 'A' and 'R' both are correct and 'R' is not the correct explanation of 'A'

(3) 'A' is correct while 'R' is incorrect

(4) 'A' is incorrect while 'R' is correct

Answer (1)

Sol. First law of thermodynamics is based on the law of conservation of energy and it has equation as $\Delta U = q + w$

14. Match the column

(A) Siderite	(i) $ZnCO_3$
(B) Galena	(ii) $FeCO_3$
(C) Calamine	(iii) PbS

(1) A(i), B(ii), C(iii) (2) A(ii), B(iii), C(i)

(3) A(iii), B(ii), C(i) (4) A(ii), B(i), C(iii)

Answer (2)

Sol. Siderite — $FeCO_3$

Galena — PbS

Calamine — $ZnCO_3$

15. Number of cyclic tripeptides are formed with two amino acids A and B are

(1) 2

(2) 3

(3) 4

(4) 5

Answer (2)

Sol. Cyclic tripeptide contains 2 amino acids.

AA
BB
AB

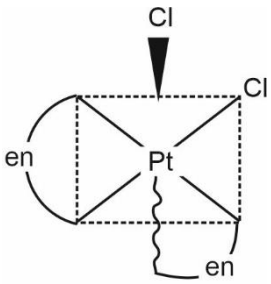
16. Which of the following complex is optically active?

(1) Cis-$[Pt(NH_3)_2Cl_2]$ (2) Trans-$[Pt(NH_3)_2Cl_2]$

(3) Cis-$[Pt(en)_2Cl_2]$ (4) Trans-$[Pt(en)_2Cl_2]$

Answer (3)

Sol.



It does not have POS and COS, so it is optically active.

17. Which of the following will give positive Lassaigne test

(1) NH_4OH (2) NH_4Cl

(3) N_2H_4 (4) $CH_3\text{-}NH_2$

Answer (4)

Sol. Only 4th compound has C and N. So, it gives positive Lassaigne's test.

18. Following compounds are given

I :

II :

III :

IV :

(1) I > II > III > IV (2) I > II > IV > III

(3) III > IV > II > I (4) III > IV > I > II

Answer (3)

Sol. BP $\propto$ Molecular mass

R – I > R – Br > R – Cl > R – F

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

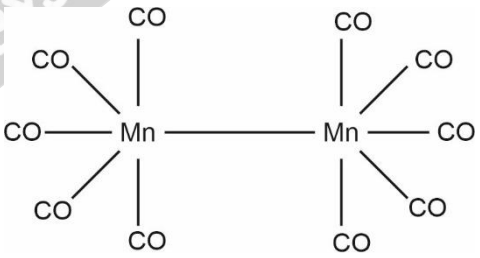
21. X : Number of Bridge bonds present in compound $Mn_2(CO)_{10}$

Y : Number of Bridge bonds present in compound $W(CO)_6$

Find out (X + Y)

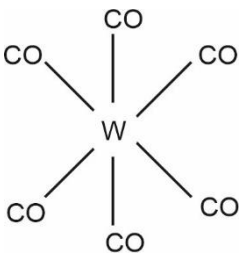
Answer (00.00)

Sol. $Mn_2(CO)_{10}$



$\boxed{X = 0}$

$W(CO)_6$



$\boxed{Y = 0}$

(X + Y) = 0

22. For a Hypothetical reaction

$A \rightleftharpoons B;\ K_{eq} = 10^2$

(Use T = 27° C, R = 8.3 $JK^{-1}mol^{-1}$ log 10 = 2.3)

If the value of ΔG^o for the above reaction is – x kJ, the value of 2x will be (Round off to the nearest integer)

Answer (23)

Sol. $\Delta G^o = -RT \ln K_{eq}$

$= -8.3 \times 300 \times 2.3 \log (10^2)$

$\Delta G^\circ = -11454\ J$

$2\Delta G^o = -22908\ J$

23. A radioactive substance decays into products with half life of 30 min. The fraction left after 90 min. is given by $\left(\frac{1}{2t}\right)$. Find out 't'.

Answer (04.00)

Sol. $N_0 \xrightarrow{30\ min.} \frac{N_0}{2} \xrightarrow{30\ min.} \frac{N_0}{4} \xrightarrow{30\ min.} \frac{N_0}{8}$

$\Rightarrow \frac{1}{8} = \frac{1}{2t}$

$\boxed{t = 4}$

24. An element $^{239}_{92}X$ decays as

$^{239}_{92}X \rightarrow {}^{231}_{Z}Y + 2\alpha + 1\beta$

Then find the value of Z in the above reactions.

Answer (89)

Sol. $^{239}_{92}X \rightarrow {}^{231}_{89}Y + 2\,{}^{4}_{2}He^{2+} + {}^{0}_{-1}e$

$\therefore$ Value of Z = 89

25. The shortest wavelength in Lyman series of H-atom is λ. The longest wavelength in Balmer series of He^+ is $\frac{x\lambda}{5}$. Find the value of x.

Answer (9)

Sol. The shortest wavelength in Lyman series of H-atom is given by

$\frac{1}{\lambda} = R_H\left[\frac{1}{(1)^2} - \frac{1}{(\infty)^2}\right] = R_H$

$\Rightarrow \quad \lambda = \frac{1}{R_H}$

The longest wavelength in Balmer series of He^+ ion is given by

$\frac{1}{\lambda'} = (2)^2 R_H\left[\frac{1}{(2)^2} - \frac{1}{(3)^2}\right] = \frac{5R_H}{9}$

$\lambda' = \frac{9}{5R_H} = \frac{9\lambda}{5}$

$\therefore$ x = 9

26. How many elements can liberate H_2 from dilute acids?

V, Cr, Mn, Fe, Co, Ni, Cu

Answer (6)

Sol. Except Cu, all other elements have negative $E^o_{M^{+2}/M}$

Hence, they can liberate H_2 from dilute acids.

Number of elements = 6

27. Consider the following reaction

$H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$

If K_{eq} = 2 × 10^{-3} at 2300 K and initial pressure of $H_2O(g)$ is 1 atm, then degree of dissociation of above reaction will be x × 10^{-2}, the value of x is

Answer (2)

Sol. $K_{eq} = \frac{(P_{H_2})(P_{O_2})^{1/2}}{(P_{H_2O})} = \frac{(\alpha)\left(\frac{2}{2}\right)^{1/2}}{(1-\alpha)} = 2 \times 10^{-3}$

$\Rightarrow \alpha^{3/2} = 2^{3/2} \times \left(10^{-2}\right)^{3/2}$

$\Rightarrow \alpha = 2 \times 10^{-2}$

$\therefore$ x = 2

28.

29.

30.

MATHEMATICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Consider a function $f(x)=\frac{2x^2+x+1}{x^2+1}$, which of the following options is correct?

(1) $f(x)$ is one-one for $x\in(0, 2)$

(2) $f(x)$ is many-one for $x\in(0, 2)$

(3) $f(x)$ is one-one for $x\in(0, \infty)$

(4) $f(x)$ is one-one for $x\in(1, \infty)$

Answer (1)

Sol. $f(x)=2+\frac{x-1}{x^2+1}$

$$f'(x)=\frac{-x^2+2x+1}{\left(x^2+1\right)^2}$$

$Q(x) = -x^2 + 2x + 1$ is having positive sign in interval (0, 2) so function is one-one

2. If real part of the product of z_1 and z_2 is zero, *i.e.* $\text{Re}(z_1z_2) = 0$ and $\text{Re}(z_1 + z_2) = 0$, then $\text{Im}(z_1)$ and $\text{Im}(z_2)$ is

(1) $> 0, > 0$ (2) $< 0, < 0$

(3) $= 0, = 0$ (4) $> 0, < 0$

Answer (4)

Sol. Let $z_1 = a_1 + ib_1$ and $z_2 = a_2 + ib_2$

$\text{Re}(z_1z_2) = 0$

$\Rightarrow a_1a_2 = b_1b_2$ ...(i)

$\text{Re}(z_1 + z_2) = 0 \Rightarrow a_2 = -a_1$ ...(ii)

From (i) and (ii), $b_1b_2 = -a_1^2 < 0$

$\therefore$ $\text{Re}(z_1)$ and $\text{Re}(z_2)$ are of opposite sign.

3. Consider $y = f(x)$ passing through (1, 1) satisfying the following differential equation.

$y(x + 1)\,dx + x^2\,dy = 0$, then $y = f(x)$ is given by

(1) $\ln xy=\frac{1}{x}-1$ (2) $\ln xy=\frac{1}{x}$

(3) $\ln xy=\frac{1}{x}+1$ (4) $\ln xy=\frac{1}{x^2}$

Answer (1)

Sol. $y(x + 1)\,dx + x^2\,dy = 0$

$$\int\frac{x+1}{x^2}dx=\int-\frac{1}{y}dy$$

$$\ln x-\frac{1}{x}=-\ln y+c$$

$\because$ It passes (1, 1)

So, $\boxed{-1=c}$

$\therefore$ $\ln x-\frac{1}{x}=-\ln y-1$

$\Rightarrow$ $\boxed{\ln xy=\frac{1}{x}-1}$

4. If $[A]$ is 3×3 matrix and $A^2 = 3A + aI$, $A^4 = 21A + bI$, then $a + b$ is

(1) -9 (2) -10

(3) 9 (4) 10

Answer (1)

Sol. $A^4 = A^2 \cdot A^2$

$= (3A + aI)(3A + aI)$

$= 9A^2 + 6aA + a^2I = 21A + bI$

Again using $A^2 = 3A + aI$ in LHS

$\Rightarrow$ $9(3A + aI) + 6aA + a^2I = 21A + bI$

$\Rightarrow$ $(27 + 6a)A + (9a + a^2)I = 21A + bI$

$\therefore$ $27 + 6a = 21$ and $9a + a^2 = b$

$\therefore$ $a = -1, b = -8$

$\therefore$ $a + b = -9$

5. Find area common to following region $x^2 + y^2 \le 21$, $x \ge 1$ & $y^2 \le 4x$

(1) $8\sqrt{3} - \frac{8}{3} + \frac{21}{2} - \frac{21}{2}\sin^{-1}\left(\sqrt{\frac{3}{7}}\right)$

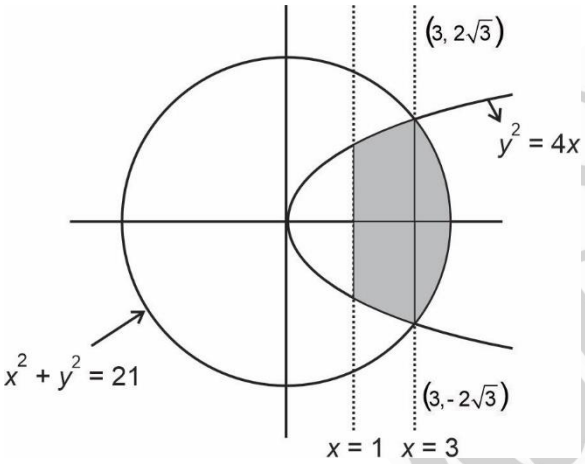
(2) $2\sqrt{3} + \frac{21\pi}{2} - \frac{8}{3} - 21\sin^{-1}\left(\sqrt{\frac{3}{7}}\right)$

(3) $8\sqrt{3} + \frac{21\pi}{2} - \frac{8}{3}$

(4) $8\sqrt{3} + \frac{21\pi}{2} - \frac{8}{3} - 21\sin^{-1}\left(\sqrt{\frac{3}{11}}\right)$

Answer (2)

Sol. Area of Required Region



$$= 2\left(\int_1^3 2\sqrt{x}\,dx + \int_3^{\sqrt{21}}\sqrt{21-x^2}\,dx\right)$$

$$= 2\left(2\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\Bigg|_1^3 + \frac{21\sin^{-1}\left(\frac{x}{\sqrt{21}}\right) + x\sqrt{21-x^2}}{2}\Bigg|_3^{\sqrt{21}}\right)$$

$$= 2\left(4\sqrt{3} - \frac{4}{3}\right) + \left(21\sin^{-1}1 + 0\right)$$

$$-\left(21\sin^{-1}\frac{3}{\sqrt{21}} + 3\sqrt{12}\right)$$

$$= 8\sqrt{3} - \frac{8}{3} + \frac{21\pi}{2} - 6\sqrt{3} - 21\sin^{-1}\sqrt{\frac{3}{7}}$$

$$= 2\sqrt{3} + \frac{21\pi}{2} - \frac{8}{3} - 21\sin^{-1}\left(\sqrt{\frac{3}{7}}\right)$$

6. Domain of $f(x) = \frac{\log_x(x-1)}{\log_{(x-1)}(x-4)}$ is

(1) (0, 1)

(2) (4, ∞)

(3) [1, 4]

(4) (4, ∞) – {5}

Answer (4)

Sol. For domain

$x > 0$, $x - 1 > 0$, $x - 4 > 0$

And $x - 1 \ne 1$, $x \ne 1$, $x - 4 \ne 1$

$\Rightarrow$ $x \in (4, \infty) - \{5\}$

7. Consider $f(x) = \max\{x^2, 1+[x]\}$ where $[x]$ is greatest integer function. Then the value of $\int_0^2 f(x)dx$ is

(1) $\frac{4\sqrt{2}+5}{3}$ (2) $\frac{6\sqrt{2}+5}{3}$

(3) $\frac{8\sqrt{2}+5}{3}$ (4) $\frac{8\sqrt{2}+3}{5}$

Answer (1)

Sol. $f(x) = \begin{cases} 1+[x], & 0 \le x \le \sqrt{2} \\ x^2 & \sqrt{2} < x \le 2 \end{cases}$

$$\int_0^2 f(x)dx = \int_0^{\sqrt{2}} (1+[x])dx + \int_{\sqrt{2}}^2 x^2 dx$$

$$= \int_0^1 1dx + \int_1^{\sqrt{2}} 2dx + \frac{x^3}{3}\Bigg]_{\sqrt{2}}^2$$

$$= 1 + 2\left(\sqrt{2}-1\right) + \frac{1}{3}\left(8 - 2\sqrt{2}\right)$$

$$= \frac{4\sqrt{2}+5}{3}$$

8. In a football club, there are 15 players each player has a T-shirt of their own name. Find the probability that at least thirteen players pick the correct T-shirt of their own name.

(1) 107 (2) 106

(3) 108 (4) 109

Answer (2)

Sol. At least 13 players pick correct T-shirt = exactly 13 T-shirt players pick correct + exactly 14 players pick correct + exactly 15 players pick correct T-shirt.

$= {}^{15}C_2 \times 1 + 0 + 1$

$= 105 + 0 + 1$

$= 106$

9. If 3 bad and 7 good apples are mixed, then find probability of finding 4 good apples, if 4 apples are drawn simultaneously

(1) $\frac{5}{12}$ (2) $\frac{1}{6}$

(3) $\frac{7}{13}$ (4) $\frac{6}{7}$

Answer (2)

Sol. $P(E) = \frac{{}^7C_4}{{}^{10}C_4} = \frac{7!}{4!3!}\ \frac{4!6!}{10!}$

$= \frac{4 \cdot 5 \cdot 6}{8 \cdot 9 \cdot 10}$

$= \frac{1}{2} \cdot \frac{1}{3} = \frac{1}{6}$

10. If $x = 2$ is a root of $x^2 + px + q = 0$ and

$$f(x) = \begin{cases} \frac{1-\cos\left(x^2-4px+q^2+8q+16\right)}{(x-2p)^2} & , \quad x \neq 0 \\ 0 & , \quad x = 2p \end{cases}$$

then $\lim\limits_{x \to 2p^+} f(x)$ is

(1) $\frac{1}{2}$ (2) $\frac{1}{4}$

(3) 0 (4) $-\frac{1}{2}$

Answer (1)

Sol. $2p + q = -4$

OR $(q + 4)^2 = 4p^2$

$$\lim_{x \to 2p^+} \frac{1-\cos\left(x^2-4px+4p^2\right)}{(x-2p)^2}$$

$$= \lim_{x \to 2p^+} \frac{\left(x^2-4px+4p^2\right)^2}{2} \cdot \frac{1}{(x-2p)^2}$$

$= \frac{1}{2}$

11. Incident ray $y = \frac{x}{\sqrt{3}}$ is reflected by surface $x + y = 1$. Find the point of intersection of reflecting ray with x-axis.

(1) $\left(1-\frac{1}{\sqrt{3}}, 0\right)$

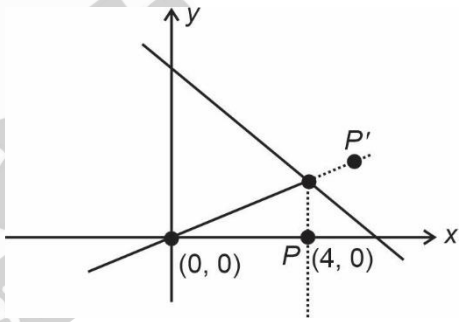
(2) $\left(1+\frac{1}{\sqrt{3}}, 0\right)$

(3) $\left(\frac{1}{\sqrt{3}}, 0\right)$

(4) $\left(\frac{2}{\sqrt{3}}, 0\right)$

Answer (1)

Sol. Let intersection point is $P(h, 0)$ then it's image with respect to the line $x + y = 1$ will be P' which lies on $y = \frac{x}{\sqrt{3}}$.



$\therefore \quad \frac{x-h}{1} = \frac{y}{1} = \frac{-2(h-1)}{2}$

$\therefore \quad x = -h + 1 + h = 1,$

$y = -h + 1$

So, $-h + 1 = \frac{1}{\sqrt{3}} \Rightarrow h = 1 - \frac{1}{\sqrt{3}}$

$\therefore \quad P \equiv \left(1-\frac{1}{\sqrt{3}}, 0\right)$

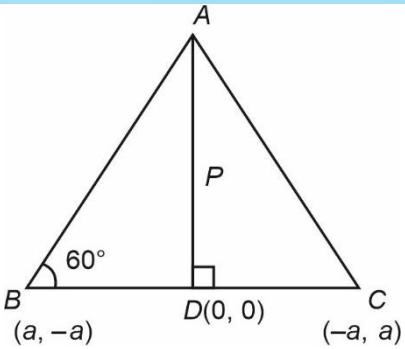
12. In an equilateral triangle ABC, point A lies on line $y - 2x = 2$ and point B and C are lying on line $y + x = 0$. Points B and C are symmetric with respect to origin. Find Area of ΔABC.

(1) $4\sqrt{3}$ sq. units (2) 8 sq. units

(3) $\frac{8}{\sqrt{3}}$ sq. units (4) $8\sqrt{3}$ sq. units

Answer (3)

Sol.



A lies on perpendicular bisector of BC

i.e., $y = x$

A is point of intersection of $y = x$ and $y - 2x = 2$

$\Rightarrow \quad A = (-2, -2)$

$P = AD = 2\sqrt{2}$

Area of $\Delta ABC = \frac{1}{2} \cdot \frac{2P}{\sqrt{3}} \cdot P$

$= \frac{P^2}{\sqrt{3}} = \frac{8}{\sqrt{3}}$ sq. unit

13. It is given that $((p \wedge q) \vee r) \vee (p \wedge r) \rightarrow (\sim q) \vee r$ is fallacy. Then truth values of p, q and r are given by

(1) p : True, q : True, r : False

(2) p : False, q : False, r : False

(3) p : True, q : True, r : True

(4) None of these

Answer (1)

Sol. $s \rightarrow t$ is always false if s is true and t is false

$\therefore \quad (\sim q) \vee r$ is false

$\Rightarrow$ $(\sim q)$ is false and r is false

$\Rightarrow$ q is true and r is false

Also, if p is true, then $(p \wedge q) \vee r) \vee (p \wedge r)$ is true

14. Let region for $x \in [0, 1]$ given by

$A : 2x \le y \le \sqrt{4(x-1)^2}$ with y-axis

$B : y = \min\left\{2x, \sqrt{4(x-1)^2}\right\}$, with x-axis then

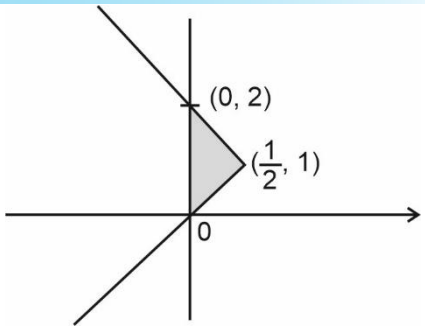
$\frac{A}{B}$ equals

(1) 1 (2) 2

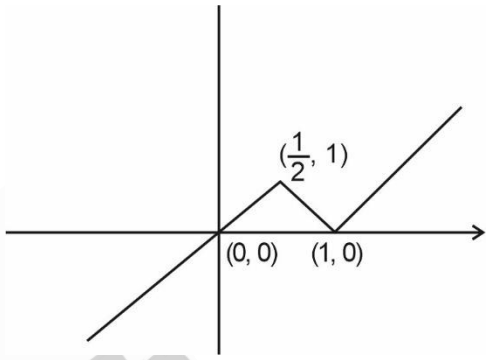
(3) 3 (4) 4

Answer (1)

Sol.



$A = \frac{1}{2} \times 2 \times \frac{1}{2} = \frac{1}{2}$



$B = \frac{1}{2} \times 1 \times 1 = \frac{1}{2}$

$\frac{A}{B} = 1$

15.

16.

17.

18.

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. A function $f(x)$ is such that $f(x + y) = f(x) + f(y) - 1$ $\forall$ $x, y \in R$, also $f'(0) = 2$, then $|f(-2)|$ is

Answer (3)

Sol. $f(x + y) = f(x) + f(y) - 1$

Put $x = y = 0$

We get $f(0) = f(0) + f(0) - 1$

$\therefore \quad f(0) = 1$

Now,

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 0} \frac{f(x) + f(h) - 1 - f(x)}{h}$$

$f'(x) = f'(0)$

$f'(x) = 2$

Integrating both side

$f(x) = 2x + c$

Now,

$\because \quad f(0) = 1$

$\Rightarrow \quad 1 = c$

$\therefore \quad f(x) = 2x + 1$

$f(-2) = -3$

$|f(-2)| = 3$

22. If $a_1, a_2, \ldots$ are positive numbers in G.P. such that $a_5 + a_7 = 12$ and $a_4 \cdot a_6 = 9$ then $a_7 + a_9$ equals

Answer (36)

Sol. Let first term of G.P. be a with common ratio r

$\therefore \quad a(r^4 + r^6) = 12$ & $a^2r^8 = 9$

$\Rightarrow \quad ar^4 = 3$

$\Rightarrow \quad a_5 = 3$ & $a_7 = 9$

$\therefore \quad r = \sqrt{3} \quad \Rightarrow a_9 = 27$

$\therefore \quad a_7 + a_9 = 9 + 27 = 36$

23. If $f(x + y) = f(x) + f(y)$, $f(1) = \frac{1}{5}$ and

$$\sum_{n=1}^{n} \frac{f(n)}{n(n+1)(n+2)} = \frac{1}{12},$$ then the value of n is

Answer (10)

Sol. $f(x + y) = f(x) + f(y)$

$\Rightarrow \quad f(x) = kx$

$$f(1) = \frac{1}{5} \Rightarrow k = \frac{1}{5}$$

$$\therefore \quad f(x) = \frac{1}{5}x$$

$$\sum_{n=1}^{n} \frac{f(n)}{n(n+1)(n+2)} = \sum_{n=1}^{n} \frac{\frac{1}{5}n}{n(n+1)(n+2)}$$

$$= \frac{1}{5} \sum_{n=1}^{n} \left(\frac{1}{n+1} - \frac{1}{n+2} \right)$$

$$= \frac{1}{5} \left(\frac{1}{2} - \frac{1}{n+2} \right)$$

$$= \frac{n}{10(n+2)} = \frac{1}{12}$$

$\Rightarrow \quad n = 10$

24. Let $S = \{1, 2, 3, 5, 7\}$. The rank of 35773 if all 5 digit number formed by the set S are arranged in a dictionary in ascending order and repetition of digits is allowed.

Answer (1748)

Sol. For rank of 35773

All number starting from 1 and 2 will come first

i.e. $1 \_ \_ \_ \_ \rightarrow 5^4$

$2 \_ \_ \_ \_ \rightarrow 5^4$

If first digit is 3 (number of number that comes before 35773)

$3\ \underline{1}\ \_ \_ \_ \rightarrow 5^3$

$3\ \underline{2}\ \_ \_ \_ \rightarrow 5^3$

$3\ \underline{3}\ \_ \_ \_ \rightarrow 5^3$

$35\ \underline{1}\ \_ \_ \rightarrow 5^2$

$35\ \underline{2}\ \_ \_ \rightarrow 5^2$

$35\ \underline{3}\ \_ \_ \rightarrow 5^2$

$35\ \underline{5}\ \_ \_ \rightarrow 5^2$

$357\ \underline{1}\ \_ \rightarrow 5$

$357\ \underline{2}\ \_ \rightarrow 5$

$357\ \underline{3}\ \_ \rightarrow 5$

$357\ \underline{5}\ \_ \rightarrow 5$

3577 $\underline{1}$ $\rightarrow 1$

3577 $\underline{2}$ $\rightarrow 1$

3577 $\underline{3}$ $\rightarrow 1$

$\therefore$ Rank $= 2\left(5^4\right)+3\left(5^3\right)+4\left(5^2\right)+4(5)+3$

$= 1250 + 375 + 100 + 20 + 3$

$= 1748$

25. If coefficient of 3 consecutive terms in expansion of $(1 + 2x)^n$ is 10 : 35 : 84, then n is equal to

Answer (10.00)

Sol. $\dfrac{{}^nC_r\ 2^r}{{}^nC_{r+1}\ 2^{r+1}} = \dfrac{2}{7}$

or $\dfrac{r+1}{n-r}\cdot\dfrac{1}{2} = \dfrac{2}{7}$ ...(1)

$\dfrac{{}^nC_{r+1}\ 2^{r+1}}{{}^nC_{r+2}\ 2^{r+2}} = \dfrac{5}{12}$

or $\dfrac{r+2}{n-r-1}\cdot\dfrac{1}{2} = \dfrac{5}{12}$ ...(2)

Solving (1) and (2)

$n = 10$ and $r = 3$

26. Consider 3 coplanar vectors

$\vec{a} = 3\hat{i} - 4\hat{j} + \lambda\hat{k}$

$\vec{b} = 4\hat{i} + 3\hat{j} - \hat{k}$ and

$\vec{c} = \hat{i} + 3\hat{j} - 4\hat{k}$

Then 9λ is

Answer (87.00)

Sol. For co-planar vectors

$$\begin{vmatrix} 3 & -4 & \lambda \\ 4 & 3 & -1 \\ 1 & 3 & -4 \end{vmatrix} = 0$$

$3[-12 + 3] + 4[-16 + 1] + \lambda[12-3] = 0$

$\Rightarrow -27 - 60 + 9\lambda = 0$

$\Rightarrow 9\lambda = 87$

27.

28.

29.

30.

❑ ❑ ❑