

BITSAT Solved Paper 2022

1. Which of the following processes play a part in the formation of a rainbow?

(i) Refraction
(ii) Total internal reflection
(iii) Dispersion
(iv) Interference

(A) (i), (ii) and (iii) (B) (i) and (ii)
(C) (i), (ii) and (iv) (D) (iii) and (iv)

Correct Option: A

Solution:

Rainbow is formed due to the dispersion of light suffering refraction and total internal reflection (TIR) in the droplets present in the atmosphere.

2. The terminal velocity of a small sphere of radius a in a viscous liquid is proportional to

(A) a^2 (B) a^3 (C) a (D) a^{-1}

Correct Option: A

Solution:

Terminal velocity in a viscous medium is given by:

$$V_T = \frac{2a^2(\rho - \sigma)g}{9\eta}$$

$$\therefore V_T \propto a^2$$

3. 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?

(A) 850 J (B) 950 J (C) 875 J (D) 900 J

Correct Option: D

Solution:

Position, $x = 3t^2 + 5$

$$\therefore \text{Velocity, } v = \frac{dx}{dt} \Rightarrow v = \frac{d(3t^2+5)}{dt}$$

$$\Rightarrow v = 6t + 0$$

$$\text{At } t = 0, v = 0$$

$$\text{And at } t = 5 \text{ sec, } v = 30 \text{ m/s}$$

According to work-energy theorem, $w = \Delta KE$

$$\text{or, } W = \frac{1}{2}mv^2 - 0 = \frac{1}{2}(2)(30)^2 = 900 \text{ J}$$

4. A transverse wave is represented by

$$y = \frac{10}{\pi} \sin \left(\frac{2\pi}{T} t - \frac{2\pi}{\lambda} x \right)$$

For what value of the wavelength the wave velocity is twice the maximum particle velocity?

(A) 40 cm (B) 20 cm (C) 10 cm (D) 60 cm

Correct Option: A

Solution:

Amplitude $a = 10 \text{ cm}$

Wave velocity = $2 \times$ maximum particle velocity

$$\text{i.e., } \frac{\omega \lambda}{2\pi} = 2 \frac{a\omega}{\pi}$$

$$\text{or, } \lambda = 4a = 4 \times 10 = 40 \text{ cm}$$

5. For a given gas at 1 atm pressure, rms speed of the molecules is 200 m/s at 127°C . At 2 atm pressure and at 22 the rms speed of the molecules will be:

(A) 100 m/s
(B) $80\sqrt{5}$ m/s
(C) $100\sqrt{5}$ m/s
(D) 80 m/s

Correct Option: C

Solution:

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} = \frac{(273 + 127)}{(273 + 237)} = \sqrt{\frac{400}{500}} = \sqrt{\frac{4}{5}} = \frac{2}{\sqrt{5}}$$

$$\therefore v_2 = \frac{\sqrt{5}}{2} v_1 = \frac{\sqrt{5}}{2} \times 200 = 100\sqrt{5} \text{ m/s.}$$

6. The magnitude of the magnetic field at the center of an equilateral triangular loop of side 1 m which is carrying current of 10 A is : [Take $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$]

(A) $18\mu T$ (B) $3\mu T$ (C) $1\mu T$ (D) $9\mu T$

Correct Option: A

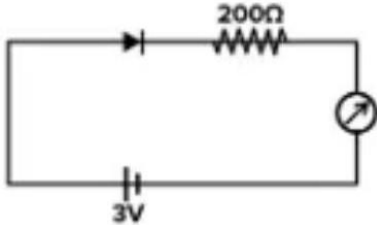
Solution:

$$B = 3 \left[\frac{\mu_0 i}{4\pi r} (\sin 60^\circ + \sin 60^\circ) \right] \text{ Here, } r = \frac{a}{2\sqrt{3}} = \frac{1}{2\sqrt{3}}$$

$$B = 3 \left[\frac{4\pi \times 10^{-7} \times 10 \times 2\sqrt{3}}{4\pi \times 1} \left[\frac{\sqrt{3}}{2} + \frac{\sqrt{3}}{2} \right] \right]$$

$$B = 18 \times 10^{-6} = 18\mu T$$

7. The reading of the ammeter for a silicon diode in the given circuit is



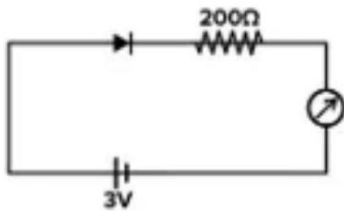
- (A) 15 mA (B) 11.5 mA (C) 13.5 mA (D) 0

Correct Option: B

Solution:

Silicon diode is in forward bias.

Hence across diode potential barrier



$$\Delta V = 0.7 \text{ volts}$$

$$I = \frac{V - \Delta V}{R} = \frac{3 - 0.7}{200} = \frac{2.3}{200} = 11.5 \text{ mA.}$$

8. Energy required to move a body of mass m from an orbit of radius $2R$ to $3R$ is

- (A) $\frac{GMm}{12R^2}$ (B) $\frac{GMm}{3R^2}$
(C) $\frac{GMm}{8R}$ (D) $\frac{GMm}{6R}$

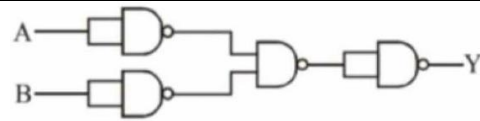
Correct Option: D

Solution:

Change in potential energy in displacing a body from r_1 to r_2 is given by

$$\Delta U = GMm \left[\frac{1}{r_1} - \frac{1}{r_2} \right] = GMm \left(\frac{1}{2R} - \frac{1}{3R} \right) = \frac{GMm}{6R}$$

9. The following logic gate is equivalent to :



- (A) NOR Gate (B) OR Gate (C) AND Gate (D) NAND Gate

Correct Option: A

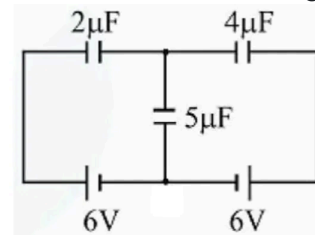
Solution:

Truth table for the given logic gate :

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

The truth table is similar to that of a NOR gate.

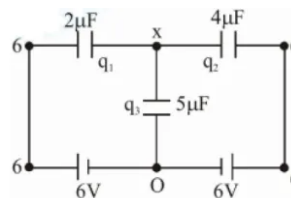
10. In the circuit shown, charge on the $5\mu F$ capacitor is :



- (A) $5.45\mu C$ (B) $16.36\mu C$
(C) $10.90\mu C$ (D) $18.00\mu C$

Correct Option: B

Solution:



Let potential of point O $V_0 = 0$

Now, using junction analysis

We can say, $q_1 + q_2 + q_3 = 0$

$$2(x - 6) + 4(x - 6) + 5(x) = 0$$

$$x = \frac{36}{11} \quad q_3 = \frac{36(5)}{11} = \frac{180}{11}$$

$$q_3 = 16.36 \mu\text{C}$$

11. The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation
- (A) Phase (B) Amplitude (C) Intensity (D) Frequency

Correct Option: D

Solution:

The stopping potential (V_s) depends upon the frequency of the incident electromagnetic radiation.

12. A paramagnetic material has 10^{28} atoms / m^3 . Its magnetic susceptibility at temperature 350 K is 2.8×10^{-4} . Its magnetic susceptibility at 300 K is :-
- (A) 3.672×10^{-4} (B) 3.726×10^{-4}
(C) 3.267×10^{-4} (D) 2.672×10^{-4}

Correct Option: C

Solution:

$$\chi_m \propto \frac{1}{T}$$

$$\frac{\chi m_1}{\chi m_2} = \frac{T_2}{T_1}$$

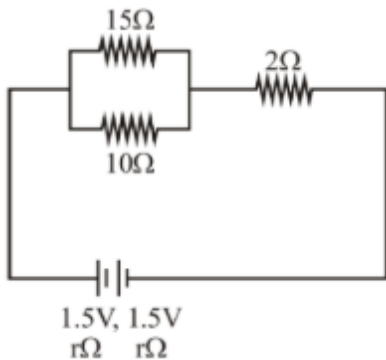
$$\frac{\chi m_1}{\chi m_2} = \frac{350}{300}$$

$$\chi m_1 = \frac{350}{300} \chi m_2$$

$$= \frac{350}{300} \times 2.8 \times 10^{-4}$$

$$= 3.267 \times 10^{-4}$$

13. In the given circuit, an ideal voltmeter connected across the 10Ω resistance reads 2 V. The internal resistance r of each cell is:



- (A) 1Ω (B) 1.5Ω (C) 0Ω (D) 0.5Ω

Correct Option: D

Solution:

$$R_{eq} = \frac{15 \times 10}{25} + 2 + 2r = 8 + 2r$$

$$i = \frac{3}{8 + 2r}$$

$$2 = iR_{eq} = \frac{3}{8 + 2r} \times 6$$

$$16 + 4r = 18 \Rightarrow r = 0.5\Omega$$

14. An electric dipole of moment $\vec{p} = (-\hat{i} - 3\hat{j} + 2\hat{k}) \times 10^{-29} \text{C} \cdot \text{m}$ is at the origin $(0, 0, 0)$. The electric field due to this dipole at $\vec{r} = +\hat{i} + 3\hat{j} + 5\hat{k}$ (note that $\vec{r} \cdot \vec{p} = 0$) is parallel to:

- (A) $(-\hat{i} + 3\hat{j} - 2\hat{k})$
(B) $(+\hat{i} - 3\hat{j} - 2\hat{k})$
(C) $(+\hat{i} + 3\hat{j} - 2\hat{k})$
(D) $(-\hat{i} - 3\hat{j} + 2\hat{k})$

Correct Option: C

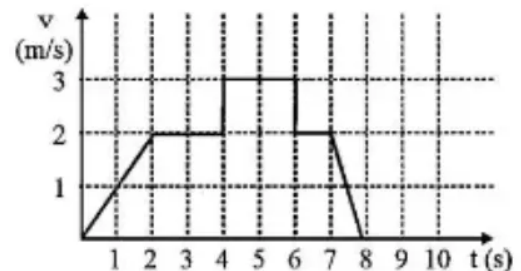
Solution:

Since $\vec{r}$ and $\vec{p}$ are perpendicular to each other therefore point lies on the equatorial plane. Therefore electric field at the point will be antiparallel to the dipole moment.

$$\text{i.e. } \vec{E} \parallel -\vec{p}$$

$$\vec{E} \parallel (\hat{i} + 3\hat{j} - 2\hat{k})$$

15. A particle starts from the origin at time $t = 0$ and moves along the positive X-axis. The graph of velocity with respect to time is shown in figure. What is the position of the particle at time $t = 5\text{s}$?



- (A) 6 m (B) 3 m (C) 10 m (D) 9 m

JM 20

Correct Option: D

Solution:

Position at $t = 5\text{s}$ = area under $v - t$ graph from 0 to 5s

From 0 to 2s :

$$\text{Area} = \frac{1}{2} \times 2 \times 2 = 2 \text{ m}$$

From 2 to 5 s :

$$Area = 3 \times 2 = 6 \text{ m}$$

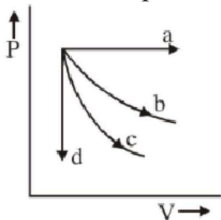
Total displacement:

$$x = 2 + 6 = 8 \text{ m}$$

But according to the given graph/options, accepted answer is:

$$= 9 \text{ m}$$

16. The given diagram shows four processes i.e. isochoric, isobaric, isothermal and adiabatic. The correct assignment of the processes, in the same order is given by :-



- (A) d a c b (B) a d c b
(C) a d b c (D) d a b c

Correct Option: D

Solution:

isochoric → Process d

isobaric → Process a

Adiabatic slope will be more than isothermal so

Isothermal → Process b

Adiabatic → Process c

order → dabc

17. The height of Victoria Falls is 63 m. What is the difference in temperature of water at the top and at the bottom of the fall?

Given $1 \text{ cal} = 4.2 \text{ J}$ and specific heat of water = $1 \text{ cal g}^{-1} \text{ C}^{-1}$

- (A) 0.147°C (B) 14.76°C (C) 1.476° (D) 0.014°C

JM 2021

Correct Option: A

Solution:

Change in P.E. = Heat energy

$$mgh = mS\Delta T$$

$$\Delta T = \frac{gh}{S}$$

$$= \frac{10 \times 63}{4200 \text{ J/kg } ^\circ \text{C}}$$

$$= 0.147^\circ \text{C}$$

18. Electric field in a plane electromagnetic wave is given by $E = 50 \sin(500x - 10 \times 10^{10}t) \text{ V/m}$. The velocity of electromagnetic wave in this medium is :
(Given C = speed of light in vacuum)

- (A) $\frac{3}{2}C$ (B) C
(C) $\frac{2}{3}C$ (D) $\frac{C}{2}$

JM 20

Correct Option: C

Solution:

$$V = \frac{\omega}{K} = \frac{10 \times 10^{10}}{500} = 2 \times 10^8 \text{ m/s}$$

$$V = \frac{2C}{3}$$

19. The elastic limit of brass is 379 MPa. What should be the minimum diameter of a brass rod if it is to support a N load without exceeding its elastic limit?
[2019 : 10 April Shift 2]

- (A) 1.16 mm (B) 0.90 mm
(C) 1.36 mm (D) 1.00 mm

Correct Option: A

Solution:

$$\frac{F}{A} = \text{stress} \quad \frac{400 \times 4}{\pi d^2} = 379 \times 10^6 \text{ d}^2 = \frac{1600}{\pi \times 379 \times 10^6} = 1.34 \times 10^{-6} \text{ d} = \sqrt{1.34} \times 10^{-3} = 1.15 \times 10^{-3} \text{ m}$$

20. The trajectory of a projectile near the surface of the earth is given as $y = 2x - 9x^2$. If it were launched at an angle θ_0 with speed v_0 then ($g = 10 \text{ ms}^{-2}$) :
[2019 : 12 April Shift 1]

- (A) $\theta_0 = \cos^{-1}(\frac{1}{\sqrt{5}})$ and $v_0 = \frac{5}{3} \text{ ms}^{-1}$
(B) $\theta_0 = \sin^{-1}(\frac{1}{\sqrt{5}})$ and $v_0 = \frac{5}{3} \text{ ms}^{-1}$
(C) $\theta_0 = \sin^{-1}(\frac{2}{\sqrt{5}})$ and $v_0 = \frac{3}{5} \text{ ms}^{-1}$
(D) $\theta_0 = \cos^{-1}(\frac{2}{\sqrt{5}})$ and $v_0 = \frac{3}{5} \text{ ms}^{-1}$

Correct Option: A

Solution:

Equation of trajectory is given as $y = 2x - 9x^2$

(1) Comparing with the equation $y = x \tan \theta - \frac{g}{2 \cos^2 \theta} x^2$
 $\frac{g}{2 \cos^2 \theta} = 9 \Rightarrow \cos^2 \theta = \frac{g}{18}$
 $\cos \theta = \frac{1}{\sqrt{5}}$
 $\theta = \cos^{-1} \left(\frac{1}{\sqrt{5}} \right)$
 $\tan \theta = 2$
 $\theta = \tan^{-1} 2$
 $\theta = 63.4^\circ$

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

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

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

$$dz = a \omega t$$

The speed of the particle is :

[2019 : 9 Jan Shift 2]

- (A) $a\omega$ (B) $\sqrt{3}a\omega$
 (C) $\sqrt{2}a\omega$ (D) $2a\omega$

Correct Option: C**Solution:**

$$v_x = -a\omega \sin \omega t \Rightarrow v_y = a\omega \cos \omega t \quad v_z = a\omega \Rightarrow v = \sqrt{v_x^2 + v_y^2 + v_z^2} = \sqrt{2}a\omega$$

22. Two identical strings X and Z made of same material have tension T_X and T_Z in them. If their fundamental frequencies are 450 Hz and 300 Hz, respectively, then the ratio T_X/T_Z is :

- (A) 0.44 (B) 1.5 (C) 2.25 (D) 1.25

Correct Option: C**Solution:**

Solution:

$$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}}$$

For identical string l and μ will be same

$$f \propto \sqrt{T}$$

$$\frac{450}{300} = \sqrt{\frac{T_X}{T_Z}}$$

$$\frac{T_X}{T_Z} = \frac{9}{4} = 2.25$$

23. A He^+ ion is in its first excited state. Its ionization energy is :-

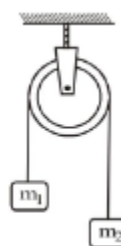
[2019 : 9 April Shift 2]

- (A) 6.04 eV (B) 13.60 eV
 (C) 54.40 eV (D) 48.36 eV

Correct Option: B**Solution:**

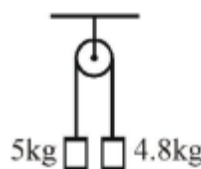
Energy levels in Hydrogen like atom is given by $E = -13.6 \frac{Z^2}{n^2} \text{ eV}$. As He^+ is 1st excited state $E = -13.6 \text{ eV}$. Total energy of He^+ in 1st excited state is -13.6 eV , ionisation energy should be $+13.6 \text{ eV}$.

24. Two masses $m_1 = 5 \text{ kg}$ and $m_2 = 4.8 \text{ kg}$ tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when they are free to move? ($g = 9.8 \text{ m/s}^2$)



[AIEEE - 2004]

- (A) 4.8 m/s^2 (B) 5 m/s^2
 (C) 0.2 m/s^2 (D) 9.8 m/s^2

Correct Option: C**Solution:**

$$5g - T = 5a \quad \dots(i)$$

$$T - 4.8g = 4.8a \quad \dots(ii)$$

Adding equation (i) and (ii)

$$0.2g = 9.8a$$

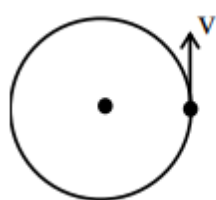
$$a = 0.2 \text{ m/s}^2$$

25. Angular momentum of a single particle moving with constant speed along circular path :

[31 August 2021, Time 9AM to 12PM (Shift 1)]

- (A) remains same in magnitude and direction
 (B) changes in magnitude but remains same in the direction
 (C) remains same in magnitude but changes in the direction
 (D) is zero

JM 2021

Correct Option: A**Solution:**

$$|\vec{L}| = mVr$$

And direction will be upward & remain constant
 Option (2)

26. If the source of light used in a Young's double slit experiment is changed from red to violet :
 [24 February 2021 (Shift 2)]
- (A) consecutive fringe lines will come closer.
 (B) the central bright fringe will become a dark fringe.
 (C) the fringes will become brighter.
 (D) the intensity of minima will increase.

JM 2021

Correct Option: A**Solution:**

$$\beta = \frac{\lambda \cdot D}{d}$$

$$\lambda_R > \lambda_V$$

$$\beta_R = \frac{\lambda_R D}{d} \text{ and } \beta_V = \frac{\lambda_V D}{d}$$

$$\beta_R > \beta_V$$

Fringe pattern will shrink.

Option (A) is correct.

27. If the length of the pendulum in pendulum clock increases by 0.1%, then the error in time per day is:
 [2021 : 26 August, Shift-2]

- (A) 86.4 s (B) 4.32 s
 (C) 43.2 s (D) 8.64 s

JM 2021

Correct Option: C**Solution:**

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

$$\frac{\Delta T}{T} = \frac{1}{2} \frac{\Delta \ell}{\ell}$$

$$\Delta T = \frac{1}{2} \times \frac{0.1}{100} \times 24 \times 3600$$

$$\Delta T = 43.2$$

Ans. 3

28. An AC circuit has $R = 100\Omega$, $C = 2\mu F$ and $L = 80mH$ connected in series. The quality factor of the circuit is:
 [6 September 2020 (Shift 1)]

- (A) 400 (B) 0.5 (C) 2 (D) 20

Correct Option: C**Solution:**

$$Q = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{1}{100} \sqrt{\frac{80 \times 10^{-3}}{2 \times 10^{-6}}}$$

$$= \frac{1}{100} \sqrt{40 \times 10^3}$$

$$= \frac{200}{100} = 2$$

29. If radius of the ${}^{27}_{13}\text{Al}$ nucleus is estimated to be 3.6 fm then the radius of ${}^{125}_{52}\text{Te}$ nucleus be nearly-

- (A) 6 fermi (B) 8 fermi (C) 4 fermi (D) 5 fermi

Correct Option: A**Solution:**

Radius of a nuclei $\propto (\text{Mass Number})^{1/3}$

$$\frac{R_{Te}}{R_{Al}} = \left(\frac{125}{27}\right)^{1/3} = \frac{5}{3}$$

$$\Rightarrow R_{Te} = R_{Al} \times \frac{5}{3} = 6 \text{ fermi}$$

30. The flux linked with a coil at any instant 't' is given by $\phi = 10t^2 - 50t + 250$. The induced emf at $t = 3$ s is

(A) 10 V (B) 190 V
(C) -190 V (D) -10 V

Correct Option: D

Solution:

$$e = \left(-\frac{d\phi}{dt}\right)_{t=3\text{sec}}$$

$$\begin{aligned} &= -\left(\frac{d}{dt}(10t^2 - 50t + 250)\right)_{t=3} \\ &= -(20t - 50)_{t=3} = -10 \text{ V} \end{aligned}$$

31. Which one of the following compounds would have the highest heat of hydrogenation?

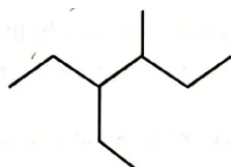
(A) $\text{CH}_2 = \text{CH}_2$
(B) $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$
(C) $\text{CH}_3\text{CH} = \text{CHCH}_3$
(D) $(\text{CH}_3)_2\text{C} = \text{C}(\text{CH}_3)_2$

Correct Option: A

Solution:

The heat of hydrogenation of an alkene depends upon its stability. Higher the stability, lower the heat of hydrogenation. Since $\text{CH}_2 = \text{CH}_2$ has no substituent, it is the least stable alkene and hence has the highest heat of hydrogenation.

32. The correct IUPAC name of the following compound

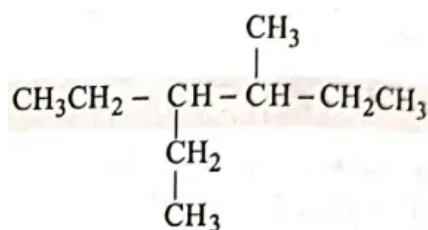


is:

(A) 4-methyl-3-ethylhexane (B) 3-ethyl-4-methylhexane
(C) 3,4-ethylmethylhexane (D) 4-ethyl-3-methylhexane

Correct Option: B

Solution:



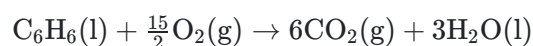
3-Ethyl-4-methyl hexane

33. What is Δn_{gns} for the combustion of 1 mole of benzene when both the reactants and the products are at 298 K

(A) 0 (B) 1/2 (C) 3/2 (D) -3/2

Correct Option: D

Solution:



$$\Delta n = 6 - \frac{15}{2} = -\frac{3}{2}$$

34. Excited hydrogen atom emits light in the ultraviolet region at 2.47×10^{15} Hz. With this frequency, the energy of a single photon is:

$$(h = 6.63 \times 10^{-34} \text{ Js})$$

(A) 8.041×10^{-40} J
(B) 2.680×10^{-19} J
(C) 1.640×10^{-18} J
(D) 6.111×10^{-17} J

Correct Option: C

Solution:

$$\begin{aligned} E &= h\nu \\ &= 6.63 \times 10^{-34} \times 2.47 \times 10^{15} \\ &= 1.640 \times 10^{-18} \text{ J} \end{aligned}$$

35. Night blindness is caused by deficiency of

(A) vitamin B₁₂ (B) vitamin A
(C) vitamin C (D) vitamin E

Correct Option: B

Solution:

Vitamin A.

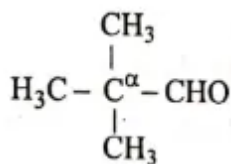
36. Which of the following will respond to Cannizzaro's reaction?

(A) 2,2-Dimethylpropanal (B) Acetaldehyde
(C) Propionaldehyde (D) Cinnamaldehyde

Correct Option: A

Solution:

(a)



2,2-dimethylpropanal (no $\alpha - H$)

(b) $H_3C^{\alpha} - CHO$

acetaldehyde ($\alpha - H$)

(c) $CH_3 \overset{\alpha}{C} H_2CHO$

propionaldehyde ($\alpha - H$)

(d) $C_6H_5CH = \overset{\alpha}{C} HCHO$

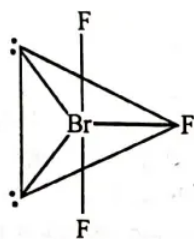
cinnamaldehyde ($\alpha - H$)

37. In BrF_3 molecule, the lone pairs occupy equatorial positions to minimize

- (A) lone pair - bond pair repulsion only
- (B) bond pair - bond pair repulsion only
- (C) lone pair - lone pair repulsion and lone pair - bond pair repulsion
- (D) lone pair - lone pair repulsion only

Correct Option: C

Solution:



In BrF_3 , both bond pairs as well as lone pairs of electrons are present. Due to the presence of lone pairs of electrons (lp) in the valence shell, the bond angle is contracted and the molecule takes the T-shape. This is due to greater repulsion between two lone pairs or between a lone pair and a bond pair than between the two bond pairs.

38. $CH_3 - CH_2C \equiv N \xrightarrow{X} CH_3CH_2CHO$.

The compound X is

- (A) $SnCl_2/HCl/H_2O$, boil
- (B) $H_2/Pd - BaSO_4$

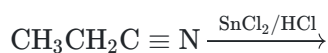
(C) $LiAlH_4$ / ether

(D) $NaBH_4$ / ether / H_3O^+

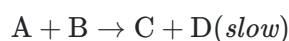
Correct Option: A

Solution:

It is Stephen's reaction.



39. A following mechanism has been proposed for a reaction
 $2A + B \rightarrow D + E$



The rate law expression for the reaction is:

- (A) $r = k[A]^2[B]$
- (B) $r = k[A][B]$
- (C) $r = k[A]^2$
- (D) $r = k[A][C]$

Correct Option: B

Solution:

From slow reaction

$$Rate = k[A][B]$$

40. The reaction, $SO_2 + Cl_2 \rightarrow SO_2Cl_2$ is exothermic reversible. A mixture of $SO_2(g)$, $Cl_2(g)$ and SO_2Cl_2 at equilibrium in a closed container. Now a certain quantity of extra SO_2 is introduced into the container, the volume remaining the same. Which of the following is/are true?

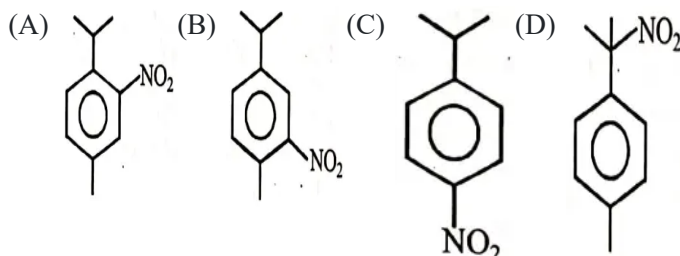
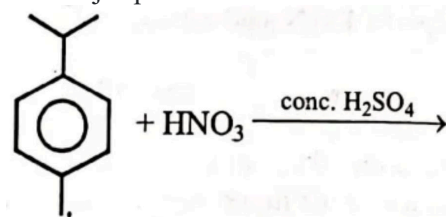
- (A) The pressure inside the container will not change
- (B) The temperature will not change.
- (C) The temperature will increase.
- (D) The temperature will decrease.

Correct Option: C

Solution:

By addition of SO_2 equilibrium will shift to RHS which is exothermic. Hence temperature will increase.

41. The major product formed in the reaction is:



Correct Option: B

Solution:

Hyperconjugation $\rightarrow$ more α H, more reactive o,p site w.r.t $-\text{CH}_3$ group.

42. In the reaction $3\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2$

- (A) magnesium is reduced (B) magnesium is oxidized
(C) nitrogen is oxidized (D) None of these

Correct Option: B

Solution:

In the given reaction, oxidation state of Mg is changing from 0 to +2, while in nitrogen it is changing from 0 to -3. So oxidation of Mg and reduction of nitrogen takes place.

43. What is the e.m.f for the given cell?



(E° for $\text{Cr}^{3+}/\text{Cr} = -0.74$ volt and E° for $\text{Co}^{2+}/\text{Co} = -0.28$ volt)

- (A) -0.46 volt (B) -1.02 volt
(C) +0.46 volt (D) 1.66 volt

Correct Option: C

Solution:

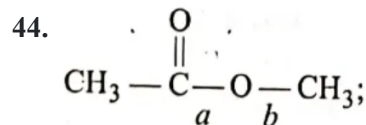
$$E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}, E^\circ_{\text{Co}^{2+}/\text{Co}} = -0.28 \text{ V}$$

The given cell reaction is



$\therefore$ Cr is anode and Co is cathode

$$E^\circ_{\text{cell}} = E^\circ_{\text{C}} - E^\circ_{\text{A}} = -0.28 - (-0.74) = -0.28 + 0.74 + 0.46 \text{ V}$$

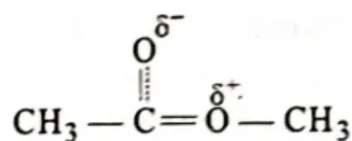


The correct relation between the bond lengths a and

- (A) $a = b$ (B) $b > a$
(C) $b < a$ (D) Impossible to predict

Correct Option: B

Solution:



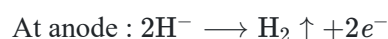
due to resonance this bond has partial double bond characters.

45. When electric current is passed through an ionic hydride in molten state:

- (A) hydrogen is liberated at anode
(B) hydrogen is liberated at cathode
(C) hydride ion migrates towards cathode
(D) hydride ion remains in solution

Correct Option: A

Solution:

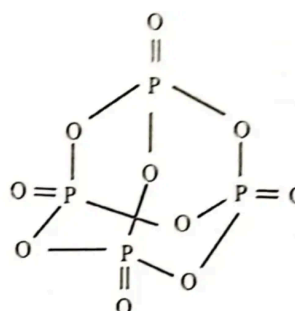


46. Number of sigma bonds in P_4O_{10} is

- (A) 6 (B) 7 (C) 17 (D) 16

Correct Option: D

Solution:





47. The correct order of ligands in the spectrochemical series is

- (A) $\text{Cl}^- > \text{en} > \text{CN}^- > \text{NCS}^-$
 (B) $\text{CN}^- > \text{en} > \text{NCS}^- > \text{Cl}^-$
 (C) $\text{NCS}^- > \text{CN}^- > \text{Cl}^- > \text{en}$
 (D) $\text{en} > \text{CN}^- > \text{Cl}^- > \text{NCS}^-$

Correct Option: B

Solution:

Correct order is: $\text{CN}^- > \text{en} > \text{NCS}^- > \text{Cl}^-$

48. The electronegativity follows the order

- (A) $\text{F} > \text{O} > \text{Cl} > \text{Br}$
 (B) $\text{F} > \text{Cl} > \text{Br} > \text{O}$
 (C) $\text{O} > \text{F} > \text{Cl} > \text{Br}$
 (D) $\text{Cl} > \text{F} > \text{O} > \text{Br}$

Correct Option: A

Solution:

F and O belong to 2nd period whereas Cl and Br belong to 3rd and 4th periods respectively. Hence the sequence of the E.N. is $\text{F} > \text{O} > \text{Cl} > \text{Br}$.

49. Which of the following metal is leached by cyanide process?

- (A) Ag (B) Na (C) Al (D) Cu

Correct Option: A

Solution:

Ag is leached by cyanide process.

50. At 298 K a 0.1M CH_3COOH solution is 1.34% ionized. The ionization constant K_a for acetic acid will be

- (A) 1.82×10^{-5} (B) 18.2×10^{-5}
 (C) 0.182×10^{-5} (D) None of these

Correct Option: A

Solution:

$$K_a = c\alpha^2 = 0.1 \times \left(\frac{1.34}{100}\right)^2 = 1.8 \times 10^{-5}$$

51. Specific conductance of 0.1 M sodium chloride solution is $1.06 \times 10^{-2} \text{ohm}^{-1} \text{cm}^{-1}$. Its molar conductance in $\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ is

- (A) 1.06×10^2 (B) 1.06×10^3
 (C) 1.06×10^4 (D) 5.3×10^2

Correct Option: A

Solution:

$$\Lambda_m = \frac{\kappa \times 1000}{M} = \frac{1.06 \times 10^{-2} \times 1000}{0.1} = 1.06 \times 10^2$$

52. The amount of zinc required to produce 224 mL of STP on treatment with dil. H_2SO_4 will be

- (A) 6.5 g (B) 0.65 g (C) 65 g (D) 0.06 g

Correct Option: B

Solution:



65 g Zn gives 1 mole of $\text{H}_2 = 22400 \text{ mL}$ of H_2 224 mL H_2 will be obtained from 0.65 g Zn.

53. Which of the following is not an example of addition polymer?

- (A) Polystyrene (B) Nylon
 (C) PVC (D) Polypropylene

Correct Option: B

Solution:

Nylon is a condensation polymer

54. Magnetic moment of Gd^{3+} ion ($Z = 64$) is

- (A) 3.62 BM (B) 9.72 BM (C) 7.9 BM (D) 10.6 BM

Correct Option: C

Solution:

$$\text{Gd}(64) = [\text{Xe}]4f^7 5d^1 6s^2$$

$$\text{Gd}^{3+} = [\text{Xe}]4f^7 5d^0 6s^0$$

i.e. no. of unpaired electrons = 7

$$\mu = \sqrt{n(n+2)} = \sqrt{7(7+2)} = \sqrt{63} = 7.93 \text{ BM}$$

55. Boric acid is a weak monobasic acid and acts as I acid

- (A) By donating H^+
 (B) By accepting $\text{O}^- \text{H}$
 (C) By donating lone pair of electrons

(D) By accepting lone pair of electrons.

Correct Option: B

Solution:



56. Which of the following has the square planar structure?

- (A) XeF_4 (B) NH_4^+
(C) BF_4^- (D) CCl_4

Correct Option: A

Solution:

XeF_4 has square planar structure, while NH_4^+ , BF_4^- and CCl_4 have tetrahedral structure.

57. A binary liquid solution is prepared by mixing *n*-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution?

- (A) The solution is non-ideal, showing - ve deviation from Raoult's Law.
(B) The solution is non-ideal, showing + ve deviation from Raoult's Law.
(C) *n*-Heptane shows + ve deviation while ethanol shows - ve deviation from Raoult's Law.
(D) The solution formed is an ideal solution.

Correct Option: B

Solution:

For this solution, intermolecular interactions between *n*-heptane and ethanol are weaker than *n*-heptane - *n*-heptane and ethanol-ethanol interactions. Hence, the solution of *n*-heptane and ethanol is non-ideal and shows positive deviation from Raoult's law.

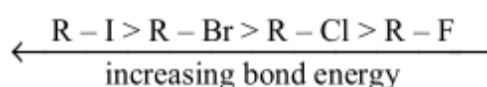
58. The order of reactivity of the given haloalkanes towards nucleophile is :

- (A) $\text{RI} > \text{RBr} > \text{RCl}$
(B) $\text{RCl} > \text{RBr} > \text{RI}$
(C) $\text{RBr} > \text{RCl} > \text{RI}$
(D) $\text{RBr} > \text{RI} > \text{RCl}$

Correct Option: A

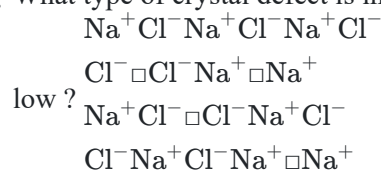
Solution:

For a given alkyl group, the order of reactivity



decreasing halogen reactivity. This order depends on the carbon-halogen bond energy; the carbon-fluorine bond energy is maximum and thus fluorides are least reactive while carbon-iodine bond energy is minimum hence iodides are most reactive.

59. What type of crystal defect is indicated in the diagram



- (A) Frenkel defect (B) Schottky defect
(C) Interstitial defect (D) Frenkel and Schottky defects

Correct Option: B

Solution:

As equal number of Na^+ and Cl^- ions are missing from their lattice site so it is Schottky defect.

60. The brown ring test for NO_2^- and NO_3^- is due to the formation of complex ion with formula-

- (A) $[\text{Fe}(\text{H}_2\text{O})(\text{NO})_5]^{2+}$
(B) $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
(C) $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$
(D) $[\text{Fe}(\text{NO})(\text{CN})_5]^{2-}$

Correct Option: C

Solution:

Complex formed in ring test is $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$

61. Read the following passages carefully and choose most appropriate answer to the questions out of the alternatives.



True, It is the function of the army to maintain law and order in abnormal times. But in normal times there is another force that compels citizens to obey the laws and to act with due regard to the rights of others. The force also protects the lives and the properties of law abiding men. Laws are made to secure the personal safety of its subjects and to prevent murder and crimes of violence. They are made to secure the property of the citizens against theft and damage to protect the rights of communities and castes to carry out their customs and ceremonies, so long as they do not conflict with the rights of others. Now the good citizen, of his own free will obey these laws and he takes care that everything he does is done with due regard to the rights and wellbeing of others. But the bad citizen is only restrained from breaking these laws by fear of the consequence of his actions. And the necessary steps to compel the bad citizen to act as a good citizen are taken by this force. The supreme control of law and order in a State is in the hands of a Minister who is responsible to the State Assembly and acts through the Inspector General of Police.

Which of the following is not implied in the passage?

- (A) Laws protect those who respect it.
- (B) Laws ensure people's religious and social rights absolutely and unconditionally.
- (C) A criminal is deterred from committing crimes for fear of the law.
- (D) The forces of law help to transform irresponsible citizens into responsible ones.

Correct Option: B

Solution:

Option (b) is not implied in the passage, as 'unconditionally' means "without any condition"; whereas in the passage it is given that these rights should not conflict with the rights of others. In that case, the law can't ensure that people enjoy that right.

62. Read the following passages carefully and choose the most appropriate answer to the questions out of the four alternatives.

True, It is the function of the army to maintain law order in abnormal times. But in normal times there is other force that compels citizens to obey the laws and act with due regard to the rights of others. The force protects the lives and the properties of law abiding. Laws are made to secure the personal safety of its subjects and to prevent murder and crimes of violence. are made to secure the property of the citizens against theft and damage to protect the rights of communities and castes to carry out their customs and ceremonies, so as they do not conflict with the rights of others. Now good citizen, of his own free will obey these laws and takes care that everything he does is done with due regard to the rights and wellbeing of others. But the bad citizen is only restrained from breaking these laws by fear of consequence of his actions. And the necessary steps to compel the bad citizen to act as a good citizen are taken by this force. The supreme control of law and order in State is in the hands of a Minister who is responsible to the State Assembly and acts through the Inspector General of Police.

The expression "customs and ceremonies" means

- (A) fairs and festivals.
- (B) habits and traditions.
- (C) usual practices and religious rites.
- (D) superstitions and formalities.

Correct Option: C

Solution:

The expression 'customs and ceremonies' means "usual practices and religious rites".

63. Read the following passages carefully and choose the most appropriate answer to the questions out of the alternatives.



True, It is the function of the army to maintain law and order in abnormal times. But in normal times there is another force that compels citizens to obey the laws and to act with due regard to the rights of others. The force also protects the lives and the properties of law abiding men. Laws are made to secure the personal safety of its subjects and to prevent murder and crimes of violence. They are made to secure the property of the citizens against theft and damage to protect the rights of communities and castes to carry out their customs and ceremonies, so long as they do not conflict with the rights of others. Now the good citizen, of his own free will obey these laws and he takes care that everything he does is done with due regard to the rights and wellbeing of others. But the bad citizen is only restrained from breaking these laws by fear of the consequence of his actions. And the necessary steps to compel the bad citizen to act as a good citizen are taken by this force. The supreme control of law and order in a State is in the hands of a Minister who is responsible to the State Assembly and acts through the Inspector General of Police.

"They are made to secure the property of citizens against theft and damage" means that the law

- (A) helps in recovering the stolen property of the citizens.
- (B) assists citizens whose property has been stolen or destroyed.
- (C) initiate process against offenders of law.
- (D) safeguards people's possessions against being stolen or lost.

Correct Option: D

Solution:

The correct answer is 'Safeguards people's possessions against being stolen or lost'. The passage clearly describes that force secures the property of the citizens against theft and damage

64. In the following questions, out of the four alternatives, choose the one which best expresses the meaning of the given word.

FRAUDULENT

- (A) Candid
- (B) Direct
- (C) Forthright
- (D) Genuine

Correct Option: D

Solution:

'Fraudulent' means "dishonest and illegal". Its antonym will be 'genuine'.

65. In the following questions, out of the four alternatives choose the one which best expresses the meaning of the given word.

TRYST

- (A) severance
- (B) rendezvous
- (C) annul
- (D) disparate

Correct Option: B

Solution:

'Tryst' means "a meeting between two people at an agreed time and place especially those who are in a romantic relationship". Its synonym will be rendezvous which means "a meeting at an agreed time and place".

66. In the following questions, out of the four alternatives choose the one which best expresses the meaning of the given word.

DISCERNING

- (A) naive
- (B) asinine
- (C) inept
- (D) astute

Correct Option: D

Solution:

'Discerning' means "to be able to see, recognize, understand, or decide something". Its synonym will be astute which means "having or showing shrewdness and ability to notice and understand things clearly".

67. Choose an appropriate word from the options to suitably fill the blank in the sentence below so that the sentence makes sense, both grammatically and contextually.

There will be a rush for seats when the train _____

- (A) Will arrive
- (B) Arrives
- (C) Arrived
- (D) Had arrived

Correct Option: B

Solution:

In Conditional Sentences, if the Main Clause is in Simple Future Tense, the Conditional Clause will be in Simple Present Tense. Here, 'arrives' is the right usage.

68. Choose an appropriate word from the options to suitably fill the blank in the sentence below so that the sentence makes sense, both grammatically and contextually.

I _____ reading for two hours tomorrow before going to school.

- (A) Will have been
- (B) Had been
- (C) Will be
- (D) Am

Correct Option: A

Solution:

As the sentence is referring to the future and the time expression "for two hours" has been used which suggests that the most appropriate tense to be used here is future perfect continuous tense. The syntax for the future perfect continuous tense- Sub+will have been/ shall have been + verb(+ing form) + other words.

69. Read the following group of sentences. The 1st and the last sentences are numbered 1 and 6, the rest are numbered *P, Q, R, S*. Arrange these four sentences in proper order to form a meaningful paragraph/sentence.

1. Human behaviours are regulated by their
- P*. A person's working pattern as well as living style.
- Q*. Between these selves has an adverse effect upon
- R*. Work done is the self portrait
- S*. Real self and social self. Conflict
6. of the person who did it.

- (A) RPQS (B) SQPR (C) QRSP (D) PQRS

Correct Option: B

Solution:

What are human behaviours regulated by? They are regulated by real self and social self. Hence, *S* follows 1. We see that *S* ends in 'conflict'. Out of the remaining options only, *Q* fits in appropriately. Conflict between these selves has an adverse effect upon... On what does this conflict has an adverse effect upon? On a person's working pattern and living style. Hence *P* comes next in the sequence. *P* also marks the end of a sentence. Hence, the next part should also be a new sentence. *R* is the last remaining part and also fits well in between *P* and 6. Thus the sequence is SQPR.

70. Read the following group of sentences. The 1st and the last sentences are numbered 1 and 6, the rest are numbered *P, Q, R, S*. Arrange these four sentences in proper order to form a meaningful paragraph/sentence.

1. Optimism is not a deep complicated philosophy.
- P*. In some persons it is an inborn trait.
- Q*. In fact, it is always taking a positive and bright view of life.
- R*. It is more of a general attitude of life.
- S*. They are tuned that way by nature and temperament.
6. However, in most cases it is an acquired and nurtured habit.

- (A) SPRQ (B) RPQS (C) RQPS (D) QPSR

Correct Option: C

Solution:

The second sentence should have a direct reference to the 1st sentence and most certainly it should start with a pronoun referring to optimism. Hence, *R* follows 1. The author continues to define optimism. Hence *Q* is next. If we now read the two sentences that are left, we see that the one that starts with 'they' hence it can't come next. So the next sentence is *P* followed by *S*. Thus the sequence is RQP

71. Arrange the following words in a logical and meaningful order:

1. Micron
2. Metre
3. Mile
4. Millimetre
5. Kilometre
6. Centimetre

- (A) 4-6-2-5-3-1 (B) 4-6-2-5-1-3
(C) 1-4-6-2-5-3 (D) 1-4-6-2-3-5

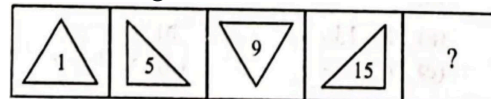
Correct Option: C

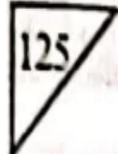
Solution:

The correct logical and meaningful order :

Micron → Millimetre → Centimetre →
(1) (4) (6)
Metre → Kilometre → Mile
(2) (5) (3)

72. Select the figure that can replace the question mark in the following series.



- (A)  (B)  (C)  (D) 

Correct Option: D

Solution:

$$\text{As, } 1 + 4 = 5, 5 + 4 = 9$$

$$\text{Similarly, } 9 + 6 = 15, 15 + 6 = 21$$

73. Select the letter-cluster that can replace the question mark (?) in the following series.
AOS, CQU, ?, GUY, IWA

(A) FSX (B) DRV (C) ESW (D) GSW

Correct Option: C**Solution:**

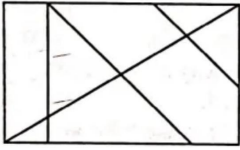
The pattern is :

$$A \xrightarrow{+2} C \xrightarrow{+2} E \xrightarrow{+2} G \xrightarrow{+2} I$$

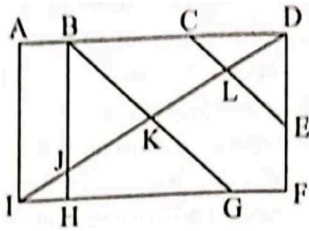
$$O \xrightarrow{+2} Q \xrightarrow{+2} S \xrightarrow{+2} U \xrightarrow{+2} W$$

$$S \xrightarrow{+2} U \xrightarrow{+2} W \xrightarrow{+2} Y \xrightarrow{+2} A$$

74. How many triangles are there in the given figure ?



(A) 9 (B) 10 (C) 11 (D) 12

Correct Option: C**Solution:**Total triangles are $\Rightarrow$ CDL, DLE, HJI, BJK, CDE, IKG, BHG, BJD, BKD, DFI, AID.

Total triangles = 11

75. Which two digits should be interchanged to make the given equation correct ?

$$32 \div 6 + 26 - 13 \times 6 = 54$$

(A) 2 and 3 (B) 6 and 2 (C) 3 and 1 (D) 3 and 6

Correct Option: B**Solution:**

From option (b)

$$32 \div 6 + 26 - 13 \times 6 = 54$$

$$\Rightarrow 32 \div 2 + 62 - 13 \times 2 = 54$$

$$\Rightarrow 18 + 62 - 26 = 54$$

$$\Rightarrow 54 = 54 (L.H.S. = R.H.S.)$$

So, option (b) is correct.

76. Four letter-clusters have been given, out of which three are alike in some manner and one is different. Select the odd letter-cluster.

(A) HFE (B) GMF (C) DVR (D) OVC

Correct Option: A**Solution:**

As,

$$\begin{array}{ccc} G & M & F, \\ \uparrow & \uparrow & \\ -6 & +7 & \end{array}$$

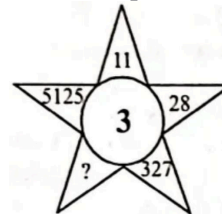
$$\begin{array}{ccc} D & V & R, \\ \uparrow & \uparrow & \\ -17 & +4 & \end{array}$$

$$\begin{array}{ccc} O & V & G, \\ \uparrow & \uparrow & \\ -7 & +15 & \end{array}$$

But

$$\begin{array}{ccc} H & F & E \\ \uparrow & \uparrow & \\ +2 & +1 & \end{array}$$

77. Study the given pattern carefully and select the number that can replace the question mark (?) in it.



(A) 446 (B) 464 (C) 4126 (D) 444

Correct Option: B**Solution:**

$$11 \Rightarrow 1 \times 1^3 \Rightarrow 11$$

$$28 \Rightarrow 2 \times 2^3 \Rightarrow 28$$

$$327 \Rightarrow 3 \times 3^3 \Rightarrow 327$$

$$464 \Rightarrow 4 \times 4^3 \Rightarrow 464$$

$$5125 \Rightarrow 5 \times 5^3 \Rightarrow 5125$$

78. Select the option that is related to the third number in the same way as the second number is related to the first number.

$$6 : 252 :: 5 : ?$$

(A) 175 (B) 150 (C) 125 (D) 225

Correct Option: B

Solution:

$$\text{As, } 6 \times 6 \times 7 = 252$$

$$\text{Formula} = n^2 \times (n + 1)$$

$$\text{Similarly, } 5 \times 5 \times 6 = 150$$

79. Four number-pairs have been given, out of which three are alike in some manner and one is different. Select the number-pair that is different from the rest.

(A) 8-138 (B) 11-143 (C) 6-174 (D) 5-155

Correct Option: A

Solution:

According to question,

As, 143 is divided by 11

174 is divided by 6

155 is divided by 5

But, 138 is not divided by 8.

80. 'Grapes' is related to 'Fruit' in the same way as 'Pepper' is related to '_____'.
 (A) Pulses (B) Dry Fruits
 (C) Spices (D) Cereals

Correct Option: C

Solution:

As, Grapes is a type of fruit. Similarly, Pepper is a type of spices.

81. Select the option that is related to the third word in the same way as the second word is related to the first word.
 Medicine : Disease :: Food : ?

(A) Hunger (B) Energy (C) Nutrition (D) Thirst

Correct Option: A

Solution:

As, medicine is used by disease person. Similarly, food is used by hunger person.

82. Select the option in which the numbers are related in the same way as are the numbers in the given set.
 (269,278,296)

(A) 313, 322, 340

(B) 109, 118, 128

(C) 419, 430, 448

(D) 577, 586, 598

Correct Option: A

Solution:

$$\text{As, } (269, 278, 296)$$

$$269 \Rightarrow 2 + 6 + 9 = 17$$

$$278 \Rightarrow 2 + 7 + 8 = 17$$

$$296 \Rightarrow 2 + 9 + 6 = 17$$

Similarly (313, 322, 340)

$$313 \Rightarrow 3 + 1 + 3 = 7$$

$$322 \Rightarrow 3 + 2 + 2 = 7$$

$$340 \Rightarrow 3 + 4 + 0 = 7$$

83. Read the given statements and conclusions care
 Assuming that the information given in the statement is true, even if it appears to be at variance with commonly known facts, decide which of the given conclusions logically follow(s) from the statements.

Statements :

1. Some animals are elephants.
2. Some elephants are tigers.

Conclusions :

- I. Some animals are tigers.
- II. No tiger is an animal.

- (A) Only conclusion I follows.
 (B) Either conclusion I or II follows.
 (C) Neither conclusion I nor II follows.
 (D) Only conclusion II follows.

Correct Option: B

Solution:



So, Either I or II conclusion follows.

84. Arrange the following words in the order in which they appear in an English dictionary.

1. Rightly
2. Rigidly
3. Righteous
4. Rigour
5. Rights

(A) 3, 1, 5, 2, 4

(B) 3, 1, 5, 4, 2

(C) 1, 3, 5, 2, 4

(D) 3, 5, 1, 4, 2

Correct Option: A**Solution:**

Righteous → Rightly → Rights → Rigidly
 (3) (1) (5) (2)
 → Rigour
 (4)

85. Study the given carefully and select the number that can replace the question mark (?) in it.

6	21	14
40	500	?
8	25	7

(A) 78

(B) 98

(C) 91

(D) 84

Correct Option: C**Solution:**

$$\text{As, } 8 \times (6 - 1) \Rightarrow 8 \times 5 = 40$$

$$25 \times (21 - 1) \Rightarrow 25 \times 20 = 500$$

$$\text{Similarly, } 7 \times (14 - 1) \Rightarrow 7 \times 13 = 91$$

86. Amit is the brother of Sonia, Jyoti is the sister of Nikita, Sonia is the daughter of Satish's father. Nikita is the daughter of Kavinder. Jyoti is the mother of Amit, Mukesh is Nikita's only sister's husband. How is Satish related to Kavinder?

(A) Son

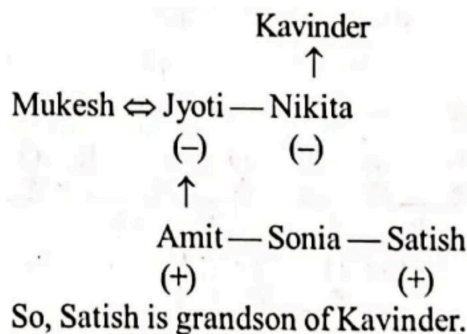
(B) Brother

(C) Son-in-law

(D) Grandson

Correct Option: D**Solution:**

According to question,



87. Four words have been given out of which three are alike in some manner, while one is different. Select the odd word.

(A) Ferry

(B) Submarine

(C) Ship

(D) Yacht

Correct Option: B**Solution:**

Except submarine, all others can travel on the surface of water, but submarine is a type of ship that can travel under the water as well as on the surface of water.

88. In a certain code language, COUNTRY is written as BOWKXLF. How will DESPAIR be written in that language?

(A) GBVMDR

(B) ULDSVH

(C) GBSPSXI

(D) UFD

Correct Option: D**Solution:**

As,

C O U N T R Y
 ↓+3 ↓-3 ↓+3 ↓-3 ↓+3 ↓-3 ↓+3
 F L X K W O B

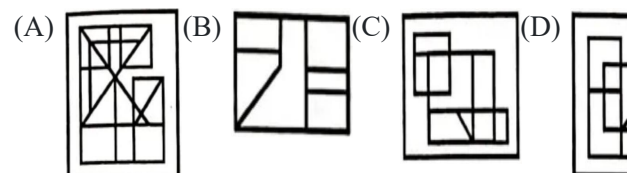
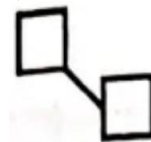
After reversing, BOWKXLF

Similarly,

D E S P A I R
 ↓+3 ↓-3 ↓+3 ↓-3 ↓+3 ↓-3 ↓+3
 G B V M D F U

After reversing, UFDMBVG

89. Select the option in which the given figure is embedded (rotation is NOT allowed).

**Correct Option: A****Solution:**

90. Select the letter-cluster from among the given options that can replace the question mark (?) in the following series.
 UTMD, QXIH, MBEL, IFAP, ?



(A) EKXT (B) EKWU (C) EJWT (D) DJVT

Correct Option: C**Solution:**

U	T	M	D
↓ -4	↓ +4	↓ -4	↓ +4
Q	X	I	H
↓ -4	↓ +4	↓ -4	↓ +4
M	B	E	L
↓ -4	↓ +4	↓ -4	↓ +4
I	F	A	P
↓ -4	↓ +4	↓ -4	↓ +4
E	J	W	T

91. For any two independent events E_1 and E_2 ,
 $P\{(E_1 \cup E_2) \cap (\bar{E}_1 \cap \bar{E}_2)\}$ is equal to

- (A) $< \frac{1}{4}$ (B) $> \frac{1}{4}$
 (C) $\geq \frac{1}{2}$ (D) None of these

Correct Option: A**Solution:**Let E_1 and E_2 be two independent events.Now, $\bar{E}_1 \cap \bar{E}_2 = \overline{E_1 \cup E_2}$ and $(E_1 \cup E_2) \cap (\bar{E}_1 \cap \bar{E}_2) = \phi$

$$(\overline{E_1 \cup E_2}) = \phi$$

Therefore, $P\{(E_1 \cup E_2) \cap (\bar{E}_1 \cap \bar{E}_2)\}$

$$= P\{(E_1 \cup E_2) \cap (\overline{E_1 \cup E_2})\} = P(\phi) = 0 < \frac{1}{4}$$

92. If the lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar, then k can have

- (A) any value (B) exactly one value
 (C) exactly two values (D) exactly three values

Correct Option: C**Solution:**

Given lines will be coplanar

$$\text{If } \begin{vmatrix} -1 & 1 & 1 \\ 1 & 1 & -k \\ k & 2 & 1 \end{vmatrix} = 0$$

$$\Rightarrow -1(1+2k) - (1+k^2) + 1(2-k) = 0$$

$$\Rightarrow k = 0, -3$$

93. If $\vec{a}, \vec{b}, \vec{c}$ are vectors such that $[\vec{a} \vec{b} \vec{c}] = 4$, then

$$[\vec{a} \times \vec{b} \quad \vec{b} \times \vec{c} \quad \vec{c} \times \vec{a}] =$$

- (A) 16 (B) 64 (C) 4 (D) 8

Correct Option: A**Solution:**

$$\text{We have, } [\vec{a} \times \vec{b} \quad \vec{b} \times \vec{c} \quad \vec{c} \times \vec{a}]$$

$$= (\vec{a} \times \vec{b}) \cdot \{(\vec{b} \times \vec{c}) \times (\vec{c} \times \vec{a})\}$$

$$= (\vec{a} \times \vec{b}) \cdot \{(\vec{m} \cdot \vec{a})\vec{c} - (\vec{m} \cdot \vec{c})\vec{a}\}$$

(where $\vec{m} = \vec{b} \times \vec{c}$)

$$= \{(\vec{a} \times \vec{b}) \cdot \vec{c}\} \cdot \{(\vec{a} \cdot (\vec{b} \times \vec{c}))\}$$

$$= [\vec{a} \vec{b} \vec{c}]^2 = 4^2 = 16.$$

94. Solution of the differential equation
 $x dy = y dx = \sqrt{x^2 + y^2} dx$ is

- (A) $y = cx^2$
 (B) $y = cx^2 + \sqrt{x^2 + y^2}$
 (C) $y + \sqrt{x^2 + y^2} = cx^2$
 (D) $y - \sqrt{x^2 - y^2} = c$

Correct Option: C**Solution:**

Given equation can be written as

$$x dy = (\sqrt{x^2 + y^2} + y) dx, \text{ i.e.,}$$

$$\frac{dy}{dx} = \frac{\sqrt{x^2 + y^2} + y}{x} \dots (i)$$

Substituting $y = vx$, we get from (i)

$$v + x \frac{dv}{dx} = \frac{\sqrt{x^2 + v^2 x^2} + vx}{x}$$

$$v + x \frac{dv}{dx} = \sqrt{1 + v^2} + v$$

$$x \frac{dv}{dx} = \sqrt{1 + v^2} \Rightarrow \frac{dv}{\sqrt{1 + v^2}} = \frac{dx}{x} \dots (ii)$$

Integrating both sides of (ii), we get

$$\log(v + \sqrt{1 + v^2}) = \log x + \log c$$

$$\Rightarrow v + \sqrt{1 + v^2} = cx \Rightarrow \frac{y}{x} + \sqrt{1 + \frac{y^2}{x^2}} = cx$$

$$\Rightarrow y + \sqrt{x^2 + y^2} = cx^2$$

95. The area included between the parabolas $y^2 = 4a(x + a)$ and $y^2 = 4b(x - a)$, $b > a > 0$, is

(A) $\frac{4\sqrt{2}}{3} b^2 \sqrt{\frac{a}{b-a}}$ sq. units

(B) $\frac{8\sqrt{8}}{3} a^2 \sqrt{\frac{b}{b-a}}$ sq. units

(C) $\frac{4\sqrt{2}}{3} a^2 \sqrt{\frac{b}{b-a}}$ sq. units

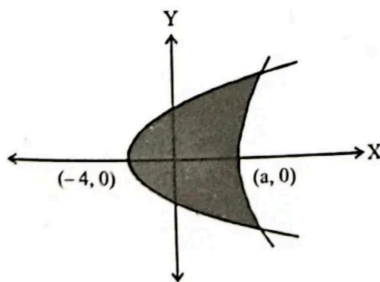
(D) $\frac{8\sqrt{8}}{3} b^2 \sqrt{\frac{a}{b-a}}$ sq. units

Correct Option: B

Solution:

We have $y^2 = 4a(x + a) \dots (i)$, a parabola with vertex $(-a, 0)$ and $y^2 = 4b(x - a) \dots (ii)$, a parabola with vertex $(a, 0)$

Solving (i) and (ii), we get $y = \pm a\sqrt{\frac{8b}{b-a}}$



$$\begin{aligned} A &= 2 \int_0^{\frac{a\sqrt{8b}}{\sqrt{b-a}}} \left(\left(\frac{y^2}{4b} + a \right) - \left(\frac{y^2}{4b} - a \right) \right) dy \\ &= 2 \int_0^{\frac{a\sqrt{8b}}{\sqrt{b-a}}} \left(2a - \frac{(b-a)y^2}{4ab} \right) dy \\ &= 2 \left[2ay - \frac{b-a}{12ab} y^3 \right]_0^{\frac{a\sqrt{8b}}{\sqrt{b-a}}} \\ &= 2 \left[2a \times \frac{a\sqrt{8b}}{\sqrt{b-a}} - \frac{b-a}{12ab} \left(\frac{a\sqrt{8b}}{\sqrt{b-a}} \right)^3 \right] \\ &= \frac{8a^2}{3} \sqrt{\frac{8b}{b-a}} \text{ sq. units} \end{aligned}$$

96. $\int_0^{1000} e^{x-[x]} dx$ is

(A) $e^{1000} - 1$

(B) $\frac{e^{1000}-1}{e-1}$

(C) $1000(e-1)$

(D) $\frac{e-1}{1000}$

Correct Option: C

Solution:

We know, $e^{x-[x]}$ is periodic function with period 1.

$$\begin{aligned} \therefore I &= \int_0^{1000} e^{x-[x]} dx; \\ \int_0^{1000} e^{x-[x]} dx &= \int_0^{1000} e^{\{x\}} dx \\ &= \int_0^1 e^x dx + \int_1^2 e^x dx + \int_2^3 e^x dx + \dots + \int_{999}^{1000} e^x dx \\ &= \int_0^1 e^x dx + \int_1^2 e^x dx + \int_2^3 e^x dx + \dots 1000 \text{ terms} \\ &= 1000 \int_0^1 e^x dx = 1000 [e^x]_0^1 = 1000 [e^1 - e^0] \\ &= 1000[e - 1]. \end{aligned}$$

97. The derivative of $\sin^{-1} \left(\frac{2x}{1+x^2} \right)$ with respect to $\cos^{-1} \left[\frac{1-x^2}{1+x^2} \right]$ is equal to :

(A) 1

(B) -1

(C) 2

(D) None of these

Correct Option: A

Solution:

Let $s = \sin^{-1} \left(\frac{2x}{1+x^2} \right)$ and

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

We have to find out $\frac{ds}{dt}$.

Putting $x = \tan \theta$, we get

$$\begin{aligned} s &= \sin^{-1} \left[\frac{2 \tan \theta}{1 + \tan^2 \theta} \right] = \sin^{-1}(\sin 2\theta) = 2\theta \\ &= 2 \tan^{-1} x \\ \therefore \frac{ds}{dx} &= \frac{2}{1+x^2} \end{aligned}$$

$$\text{and } t = \cos^{-1} \left(\frac{1-x^2}{1+x^2} \right) = \cos^{-1} \left(\frac{1-\tan^2 \theta}{1+\tan^2 \theta} \right)$$

$$= \cos^{-1}(\cos 2\theta) = 2\theta = 2 \tan^{-1} x$$

$$\therefore \frac{dt}{dx} = \frac{2}{1+x^2}$$

$$\therefore \frac{ds}{dt} = \frac{ds/dx}{dt/dx} = \frac{2}{1+x^2} \times \frac{1+x^2}{2} = 1$$



98. The point(s), at which the function f given by $f(x) =$

$$\begin{cases} \frac{x}{|x|}, & x < 0 \\ -1, & x \geq 0 \end{cases} \text{ is continuous, is/are :}$$

- (A) $x \in \mathbb{R}$ (B) $x = 0$
 (C) $x \in \mathbb{R} - \{0\}$ (D) $x = -1$ and 1

Correct Option: A

Solution:

$$f(x) = \begin{cases} \frac{x}{|x|} = -1, & x < 0 \\ -1, & x \geq 0 \end{cases}$$

$$\Rightarrow f(x) = -1 \forall x \in \mathbb{R}$$

$$\Rightarrow f(x) \text{ is continuous } \forall x \in \mathbb{R}$$

as it is a constant function.

99. If x, y, z are all distinct and $\begin{vmatrix} x & x^2 & 1+x^3 \\ y & y^2 & 1+y^3 \\ z & z^2 & 1+z^3 \end{vmatrix} = 0$, then

the value of xyz is

- (A) -2 (B) -1
 (C) -3 (D) None of these

Correct Option: B

Solution:

$$\text{We have } \begin{vmatrix} x & x^2 & 1+x^3 \\ y & y^2 & 1+y^3 \\ z & z^2 & 1+z^3 \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} + \begin{vmatrix} x & x^2 & x^3 \\ y & y^2 & y^3 \\ z & z^2 & z^3 \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} + xyz \begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} x & x^2 & 1 \\ y & y^2 & 1 \\ z & z^2 & 1 \end{vmatrix} (1 + xyz) = 0$$

$$\Rightarrow (x - y)(y - z)(z - x)(1 + xyz) = 0$$

$$[\because x \neq y \neq z]$$

$$\Rightarrow xyz + 1 = 0 \Rightarrow xyz = -1$$

100. If A is a square matrix, then $A + A^T$ is

- (A) Non-singular matrix (B) Symmetric matrix
 (C) Skew-symmetric matrix (D) Unit matrix

Correct Option: B

Solution:

$A + A^T$ is a square matrix.

$$(A + A^T)^T = A^T + (A^T)^T = A^T + A$$

Hence, A is a symmetric matrix.

101. Let $A = \begin{bmatrix} \cos^2 \theta & \sin \theta \cos \theta \\ \cos \theta \sin \theta & \sin^2 \theta \end{bmatrix}$ and $B = \begin{bmatrix} \cos^2 \phi & \sin \phi \cos \phi \\ \cos \phi \sin \phi & \sin^2 \phi \end{bmatrix}$, then $AB = 0$, if

- (A) $\theta = n\phi, \quad n = 0, 1, 2, \dots$
 (B) $\theta + \phi = n\pi, \quad n = 0, 1, 2, \dots$
 (C) $\theta = \phi + (2n + 1)\frac{\pi}{2}, \quad n = 0, 1, 2, \dots$
 (D) $\theta = \phi + \frac{n\pi}{2}, \quad n = 0, 1, 2, \dots$

Correct Option: C

Solution:

$$AB = \begin{bmatrix} \cos^2 \theta & \sin \theta \cos \theta \\ \cos \theta \sin \theta & \sin^2 \theta \end{bmatrix} \begin{bmatrix} \cos^2 \phi & \sin \phi \cos \phi \\ \cos \phi \sin \phi & \sin^2 \phi \end{bmatrix}$$

$$= \begin{bmatrix} \cos^2 \theta \cos^2 \phi + \sin \theta \cos \phi \cos \phi \sin \phi \\ \cos^2 \phi \cos \theta \sin \theta + \sin^2 \theta \sin \phi \cos \phi \end{bmatrix}$$

$$\begin{bmatrix} \cos^2 \theta \sin \phi \cos \phi + \sin^2 \theta \sin \theta \cos \theta \\ \cos \theta \sin \theta \sin \phi \cos \phi + \sin^2 \theta \sin^2 \phi \end{bmatrix}$$

$$= \begin{bmatrix} \cos \theta \cos \phi \cos(\theta - \phi) & \sin \phi \cos \theta \cos(\theta - \phi) \\ \sin \theta \cos \phi \cos(\theta - \phi) & \sin \theta \sin \phi \cos(\theta - \phi) \end{bmatrix}$$

$$\therefore AB = 0$$

$$\Rightarrow \cos(\theta - \phi) = 0 \Rightarrow \cos(\theta - \phi) = \cos(2n + 1)\frac{\pi}{2}$$

$$\Rightarrow \theta = (2n + 1)\frac{\pi}{2} + \phi, \text{ where } n = 0, 1, 2, \dots$$

102. $\cot^{-1}(\frac{ab+1}{a-b}) + \cot^{-1}(\frac{bc+1}{b-c}) + \cot^{-1}(\frac{ca+1}{c-a})$ is equal to

- (A) 0 (B) $\frac{\pi}{4}$
 (C) 1 (D) 5

Correct Option: A

Solution:



$$\begin{aligned} & \cot^{-1}\left(\frac{ab+1}{a-b}\right) + \cot^{-1}\left(\frac{bc+1}{b-c}\right) + \cot^{-1}\left(\frac{ac+1}{c-a}\right) \\ &= \cot^{-1} a - \cot^{-1} b + \cot^{-1} b - \cot^{-1} c + \\ & \cot^{-1} c - \cot^{-1} a = 0 \end{aligned}$$

103. The number of surjection from

$A = \{1, 2, \dots, n\}, n \geq 2$ onto $B = \{a, b\}$ is

- (A) ${}^n P_2$ (B) $2^n - 2$
(C) $2^n - 1$ (D) None of these

Correct Option: B

Solution:

We know that, if X and Y are any two finite sets having m and n elements respectively, where $1 \leq n \leq m$, then the number of onto functions from X to Y is given by $\sum_{r=1}^n (-1)^{n-r} C_r r^m \cdot r = 1$. Thus, the number of surjective mappings is

$$\sum_{r=1}^2 (-1)^{2-r} C_r r^2 = (2^2 - 2)$$

104. If p : It is raining today, q : I go to school, r : I shall meet any friends and s : I shall go for a movie, then which of the following is the proposition: 'If it does not rain or if I do not go to school, then I shall meet my friend and go for a movie'?

- (A) $\sim (p \wedge q) \Rightarrow (r \wedge s)$
(B) $\sim (p \wedge \sim q) \Rightarrow (r \wedge s)$
(C) $\sim (p \wedge q) \Rightarrow (r \vee s)$
(D) None of these

Correct Option: A

Solution:

Correct result is $(\sim p \vee \sim q) \Rightarrow (r \wedge s)$

So, $\sim (p \wedge q) \Rightarrow (r \wedge s)$

105. If $f(x) = |\cos x - \sin x|$, then $f'(\frac{\pi}{4})$ is equal to

- (A) $\sqrt{2}$ (B) $-\sqrt{2}$
(C) 0 (D) None of these

Correct Option: D

Solution:

We have, $f(x) = |\cos x - \sin x|$

$$\Rightarrow f(x) = \begin{cases} \cos x - \sin x, \text{ for } 0 < x \leq \frac{\pi}{4} \\ \sin x - \cos x, \text{ for } \frac{\pi}{4} < x < \frac{\pi}{2} \end{cases}$$

Clearly, $Lf'(\frac{\pi}{4}) = \left\{ \frac{d}{dx}(\cos x - \sin x) \right\}_{at x=\frac{\pi}{4}}$

$$= (-\sin x - \cos x)_{x=\frac{\pi}{4}} = -\sqrt{2}$$

and $Rf'(\frac{\pi}{4}) = \left\{ \frac{d}{dx}(\sin x - \cos x) \right\}_{at x=\frac{\pi}{4}}$

$$= (\cos x + \sin x)_{x=\frac{\pi}{4}} = \sqrt{2}$$

$\therefore Lf'(\frac{\pi}{4}) \neq Rf'(\frac{\pi}{4}) \therefore f'(\frac{\pi}{4})$ doesn't exist.

106. The foci of an ellipse are $(\pm 2, 0)$ and its eccentric $\frac{1}{2}$ then the equation of ellipse is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. The of 'a' is

- (A) 3 (B) 4 (C) 6 (D) 2

Correct Option: B

Solution:

Coordinates of foci are $(\pm ae, 0)$

$$\therefore ae = 2 \Rightarrow a \cdot \frac{1}{2} = 2 \Rightarrow a = 4$$

107. The equation of an ellipse with one vertex at the point $(3, 1)$, the nearer focus at the point $(1, 1)$ and $e = \frac{2}{3}$

- (A) $\frac{(x+3)^2}{36} + \frac{(y-1)^2}{20} = 1$
(B) $\frac{(x-3)^2}{20} + \frac{(y+1)^2}{36} = 1$
(C) $\frac{(x-3)^2}{36} + \frac{(y+1)^2}{20} = 1$
(D) $\frac{(x-3)^2}{36} + \frac{(y-1)^2}{20} = 1$

Correct Option: D

Solution:

Given, $e = \frac{2}{3}$, So, $a = \frac{3}{2}$

$$(\because ae = 1)$$

$$\text{We know, } b^2 = a^2(1 - e^2) \Rightarrow b^2 = \frac{9}{4} \left[1 - \frac{4}{9} \right] = \frac{5}{4}$$

So equation of the ellipse with vertex $(3, 1)$ is

$$\frac{(x-3)^2}{36} + \frac{(y-1)^2}{20} = 1.$$

108. The focus of the curve $y^2 + 4x - 6y + 13 = 0$ is

- (A) $(2, 3)$ (B) $(-2, 3)$ (C) $(2, -3)$ (D) $(-2,$

Correct Option: B

**Solution:**

The given equation of curve is:

$$y^2 + 4x - 6y + 13 = 0$$

which can be written as: $y^2 - 6y + 9 + 4x + 4 = 0$

$$\Rightarrow (y^2 - 6y + 9) = -4(x + 1)$$

$$\Rightarrow (y - 3)^2 = -4(x + 1)$$

Put $Y = y - 3$ and $X = x + 1$

On comparing $Y^2 = 4aX$

Length of focus from vertex, $a = -1$

At focus $X = a$ and $Y = 0 \Rightarrow x + 1 = -1$

$$\Rightarrow x = -2$$

$y - 3 = 0 \Rightarrow y = 3 \therefore$ Focus is $(-2, 3)$.

- 109.** Four distinct points $(2k, 3k)$, $(1, 0)$, $(0, 1)$ and $(0, 0)$ lie on a circle for

- (A) only one value of k (B) $0 < k < 1$
(C) $k < 0$ (D) all integral values of k

Correct Option: A

Solution:

The equation of the circle through $(1, 0)$, $(0, 1)$ and $(0, 0)$ is $x^2 + y^2 - x - y = 0$. It passes through $(2k, 3k)$

$$\text{So, } 4k^2 + 9k^2 - 2k - 3k = 0 \text{ or } 13k^2 - 5k = 0$$

$$\Rightarrow k(13k - 5) = 0 \Rightarrow k = 0 \text{ or } k = \frac{5}{13}$$

But $k \neq 0$ [$\because$ all the four points are distinct]

$$\therefore k = \frac{5}{13}.$$

- 110.** The equation of straight line through the intersection of the lines $x - 2y = 1$ and $x + 3y = 2$ and parallel to $3x + 4y = 0$ is

- (A) $3x + 4y + 5 = 0$ (B) $3x + 4y - 10 = 0$
(C) $3x + 4y - 5 = 0$ (D) $3x + 4y + 6 = 0$

Correct Option: C

Solution:

The line is passing through the intersection of lines $x - 2y = 1$ and $x + 3y = 2$. This line is parallel to the line $3x + 4y = 0$.

Let the equation of the line be $y = mx + c$.

Since this is parallel to the line $3x + 4y = 0$

$$\therefore m = -\frac{3}{4}.$$

Putting this value in $y = mx + c$,

$$\text{We get, } y = -\frac{3}{4}x + c \dots(i).$$

Since this passes through the point which is intersection of $x - 2y = 1$ and $x + 3y = 2$, we solve for the values of x and y :

$$x - 2y = 1$$

$$x + 3y = 2$$

$$\frac{-\frac{-1}{-5}}{-5y-1} \Rightarrow y = \frac{1}{5}$$

Putting value of y in the equation of any of the two line say $x - 2y = 1$

$$x - 2 \times \frac{1}{5} = 1 \Rightarrow x = 1 + \frac{2}{5} = \frac{7}{5}$$

So, point of intersection is $(\frac{7}{5}, \frac{1}{5})$ and putting these values in equation (i) we get

$$\frac{1}{5} = -\frac{3}{4} \times \frac{7}{5} + c$$

$$\Rightarrow c = \frac{1}{5} + \frac{21}{20} = \frac{4+21}{20} \Rightarrow c = \frac{25}{20} = \frac{5}{4}$$

Hence equation of the line is

$$y = -\frac{3}{4}x + \frac{5}{4}$$

$$\text{or } 4y = -3x + 5 \text{ or } 3x + 4y - 5 = 0$$

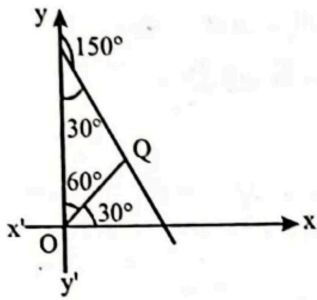
- 111.** The length of the perpendicular from the origin to a line is 7 and the line makes an angle of 150° with the positive direction of y-axis then the equation of the line is

- (A) $4x + 5y = 7$ (B) $-x + 3y = 2$
(C) $\sqrt{3}x - y = 10\sqrt{2}$ (D) $\sqrt{3}x + y = 14$

Correct Option: D

Solution:

Here $p = 7$ and $\alpha = 30^\circ$



$\therefore$ Equation of the required line is $x \cos 30^\circ + y \sin 30^\circ = 7$

$$\text{or } x \frac{\sqrt{3}}{2} + y \times \frac{1}{2} = 7 \text{ or } \sqrt{3}x + y = 14$$

112. Let $a_1, a_2, a_3, \dots$ be a G.P. such that $a_1 < 0$, $a_1 + a_2 = 4$ and $a_3 + a_4 = 16$. If $\sum_{i=1}^9 a_i = 4\lambda$, then λ is equal to:

- (A) -513 (B) -171
(C) 171 (D) $\frac{511}{3}$

Correct Option: B

Solution:

$$\text{Since, } a_1 + a_2 = 4 \Rightarrow a_1 + a_1 r = 4 \dots (i)$$

$$a_3 + a_4 = 16 \Rightarrow a_1 r^2 + a_1 r^3 = 16 \dots (ii)$$

From eqn. (i), $a_1 = \frac{4}{1+r}$ and substituting the value of a_1 , in eqn (ii),

$$\left(\frac{4}{1+r}\right) r^2 + \left(\frac{4}{1+r}\right) r^3 = 16$$

$$\Rightarrow 4r^2(1+r) = 16(1+r) \Rightarrow r^2 = 4$$

$$\therefore r = \pm 2$$

$$r = 2, a_1(1+2) = 4 \Rightarrow a_1 = \frac{4}{3}$$

$$r = -2, a_1(1-2) = 4 \Rightarrow a_1 = -4$$

$$\sum_{i=1}^9 a_i = \frac{a_1(r^9 - 1)}{r - 1} = \frac{(-4)((-2)^9 - 1)}{-2 - 1}$$

$$= \frac{4}{3}(-513) = 4\lambda \Rightarrow \lambda = -171$$

113. The sum $\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \dots$ upto 11 terms is:

- (A) $\frac{7}{2}$ (B) $\frac{11}{4}$
(C) $\frac{11}{2}$ (D) $\frac{60}{11}$

Correct Option: C

Solution:

Given sum is

$$\frac{3}{1^2} + \frac{5}{1^2+2^2} + \frac{7}{1^2+2^2+3^2} + \dots$$

$$nth \text{ term} = T_n = \frac{2n+1}{\frac{n(n+1)(2n+1)}{6}} = \frac{6}{n(n+1)}$$

$$\text{or } T_n = 6 \left[\frac{1}{n} - \frac{1}{n+1} \right]$$

$$\begin{aligned} \therefore S_n &= \sum T_n = 6 \sum \frac{1}{n} - 6 \sum \frac{1}{n+1} \\ &= \frac{6n}{n} - \frac{6}{n+1} = 6 - \frac{6}{n+1} = \frac{6n}{n+1} \end{aligned}$$

$$\text{So, } S_{11} = \frac{6 \times 11}{11+1} = \frac{66}{12} = \frac{33}{6} = \frac{11}{2}$$

114. The number of zero terms in the expansion of $(1 + 3\sqrt{2}x)^9 + (1 - 3\sqrt{2}x)^9$ is

- (A) 2 (B) 3 (C) 4 (D) 5

Correct Option: D

Solution:

Given expression

$$= 2 [1 + {}^9C_2(3\sqrt{2}x)^2 + {}^9C_4(3\sqrt{2}x)^4$$

$$+ {}^9C_6(3\sqrt{2}x)^6 + {}^9C_8(3\sqrt{2}x)^8]$$

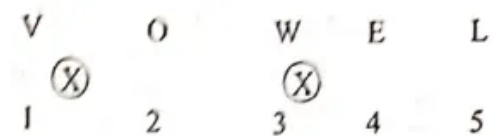
$\therefore$ the number of non-zero terms is 5.

115. The numbers of ways in which the letters of the word 'VOWEL' can be arranged so that the letters O, E occupy only even places is

- (A) 12 (B) 24 (C) 18 (D) 36

Correct Option: A

Solution:



O and E occupying only even places



marked

places] can be arranged in 2P_2 ways = 2

Remaining letters can be arranged in $(3!)$ ways = 6

Required number of words = $2 \times 6 = 12$



116. The set of real x satisfying the inequality $\frac{5-2x}{3} \leq \frac{x}{6} - 5$ is $[a, \infty)$. The value of 'a' is
 (A) 2 (B) 4 (C) 6 (D) 8

Correct Option: D

Solution:

$$\begin{aligned}\frac{5-2x}{3} \leq \frac{x}{6} - 5 &\Rightarrow \frac{5-2x}{3} \leq \frac{x-30}{6} \\ \Rightarrow 5 - 2x \leq \frac{x-30}{2} &\Rightarrow 10 - 4x \leq x - 30 \\ \Rightarrow 40 \leq 5x & \\ \Rightarrow 8 \leq x &\Rightarrow x \in [8, \infty)\end{aligned}$$

117. Product of real roots of the equation $t^2 x^2 + |x| + 9 = 0$
 (A) is always positive (B) is always negative
 (C) does not exist (D) None of these

Correct Option: A

Solution:

$$\text{Product of real roots} = \frac{9}{t^2} > 0, \forall t \in \mathbb{R}$$

$\therefore$ Product of real roots is always positive.

118. The amplitude of $\sin \frac{\pi}{5} + i(1 - \cos \frac{\pi}{5})$ is
 (A) $\frac{\pi}{5}$ (B) $\frac{2\pi}{5}$
 (C) $\frac{\pi}{10}$ (D) $\frac{\pi}{15}$

Correct Option: C

Solution:

$$\begin{aligned}\sin \frac{\pi}{5} + i(1 - \cos \frac{\pi}{5}) &= 2 \sin \frac{\pi}{10} \cos \frac{\pi}{10} + i2 \sin^2 \frac{\pi}{10} \\ &= 2 \sin \frac{\pi}{10} (\cos \frac{\pi}{10} + i \sin \frac{\pi}{10}) \\ \text{For amplitude, } \tan \theta &= \frac{\sin \frac{\pi}{10}}{\cos \frac{\pi}{10}} = \tan \frac{\pi}{10} \\ \Rightarrow \theta &= \frac{\pi}{10}\end{aligned}$$

119. The domain of ; $f(x) = \sqrt{\cos(\sin x)} + \sqrt{\log_x \{x\}}$; $\{.\}$ denote the fractional part, is
 (A) $[1, \pi)$ (B) $(0, 2\pi) - [1, \pi)$
 (C) $(0, \frac{\pi}{2}) - \{1\}$ (D) $(0, 1)$

Correct Option: D

Solution:

$$f(x) = \sqrt{\cos(\sin x)} + \sqrt{\log_x \{x\}}$$

Domain $\cos(\sin x) \geq 0$ $\{x\} > 0, x > 0, x \neq 1, \log_x$,
 $|x| \geq 0$

(i) $\cos(\sin x) \geq 0$ for all $x, x \in \mathbb{R}[-1, 1]$

(ii) $|x| > 0, x \notin \text{Int.}$

(iii) $x > 0, x \in (0, \infty)$

(iv) $x \neq 1$

(v) $\log_x \{x\} \geq 0 \Rightarrow 1 > f(x) \geq 0$,

so $1 > x \geq 0$ $\log_x f(x)$ is positive $x \in [0, 1)$

$\Rightarrow x \in (0, 1)$

120. The value of the function $f(x) = \frac{x^2-3x+2}{x^2+x-6}$ lies in the interval

(A) $(-\infty, \infty) - \{\frac{1}{5}, 1\}$

(B) $(-\infty, \infty)$

(C) $(-\infty, \infty) - \{1\}$

(D) None of these

Correct Option: B

Solution:

$f(x)$ is defined if $x^2 + x - 6 \neq 0$

i.e. $(x+3)(x-2) \neq 0$ i.e. $x \neq -3, 2$

$\therefore$ Domain $(f) = (-\infty, \infty) - \{-3, 2\}$

$$\text{Let } y = \frac{x^2-3x+2}{x^2+x-6}$$

$$\Rightarrow x^2 y + xy - 6y = x^2 - 3x + 2$$

$$\Rightarrow x^2(y-1) + x(y+3) - (6y+2) = 0$$

For x to be real, $(y+3)^2 + 4(y-1)(6y+2) \geq 0$

$$\Rightarrow 25y^2 - 10y + 1 \geq 0 \text{ i.e. } (5y-1)^2 \geq 0$$

Which is true for all real y . Range of $f = (-\infty, \infty)$

121. If A, B and C are any three sets, then $A \times (B \cup C)$ is equal to

(A) $(A \times B) \cup (A \times C)$

(B) $(A \cup B) \times (A \cup C)$

(C) $(A \times B) \cap (A \times C)$

(D) None of these

Correct Option: A**Solution:**

It is distributive law.

122. If $n(A) = 8$ and $n(A \cap B) = 2$, then $n[(A \cap B)' \cap A]$ is equal to

(A) 8 (B) 6 (C) 4 (D) 2

Correct Option: B**Solution:**

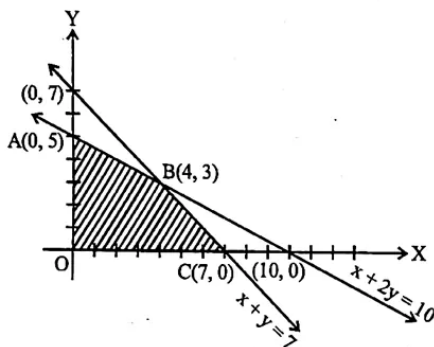
$$\begin{aligned} n[(A \cap B)' \cap A] &= n[(A' \cup B') \cap A] \\ &= n[(A' \cap A) \cup (B' \cap A)] \quad (\text{Distributive Law}) \\ &= n[\emptyset \cup (B' \cap A)] = n(A \cap B') = n(A) - n(A \cap B) \end{aligned}$$

123. The maximum value of $z = 5x + 2y$ subject to constraints $x + y \leq 7$, $x + 2y \leq 10$, $x, y \geq 0$

(A) 10 (B) 26 (C) 35 (D) 70

Correct Option: C**Solution:**

Change the inequalities into equations and draw the graph of lines, thus we get the required feasible region as shown below.



The region bounded by the vertices

 $A(0, 5), B(4, 3), C(7, 0)$.The objective function is maximum at $C(7, 0)$ and

$$\text{Max } z = 5 \times 7 + 2 \times 0 = 35.$$

124. The standard deviation of 5 scores 1, 2, 3, 4, 5 is $\sqrt{a}$. The value of 'a' is

(A) 2 (B) 3 (C) 5 (D) 1

Correct Option: A**Solution:**

$$\text{Mean } (\bar{x}) = \frac{1+2+3+4+5}{5} = 3$$

$$\begin{aligned} S.D = \sigma &= \sqrt{\frac{1}{5}(1+4+9+16+25) - 9} = \sqrt{11 - 9} \\ &= \sqrt{2} \end{aligned}$$

125. The function $f(x) = \log(1+x) - \frac{2x}{2+x}$ is increasing

(A) $(0, \infty)$ (B) $(-\infty, 0)$
(C) $(-\infty, 0)$ (D) None of these**Correct Option: A****Solution:**

$$\text{Given } f(x) = \log(1+x) - \frac{2x}{2+x}$$

$$\begin{aligned} f'(x) &= \frac{1}{1+x} - \frac{(2+x)(2) - 2x}{(2+x)^2} \\ &= \frac{1}{1+x} - \frac{4}{(2+x)^2} \\ &= \frac{(2+x)^2 - 4 - 4x}{(1+x)(2+x)^2} = \frac{x^2}{(1+x)(2+x)^2} > 0 \text{ for } \end{aligned}$$

Thus, given function $f(x)$ is increasing on $(0, \infty)$.

126. $10^n + 3(4^{n+2}) + 5$ is divisible by which of the following for $n \in \mathbb{N}$?

(A) 7 (B) 5 (C) 9 (D) 17

Correct Option: C**Solution:**

We have

$$10^n + 3 \cdot 4^n + 5$$

Check divisibility by 9.

Since,

$$10 \equiv 1 \pmod{9}$$

$$\Rightarrow 10^n \equiv 1$$

Also,

$$4^3 = 64 \equiv 1 \pmod{9}$$

Thus the powers of 4 repeat every 3 terms. For every n ,

$$10^n + 3 \cdot 4^n + 5 \equiv 1 + 3 \cdot 4^n + 5$$

When evaluated modulo 9, the expression is always congruent to 0.

Hence it is divisible by 9.

127. The number of 3 digit numbers having at least one of their digit as 5 are

(A) 250 (B) 251 (C) 252 (D) 253

Correct Option: C

Solution:

Total number of 3-digit numbers having at least one of their digits as 5 = Total number of 3-digit numbers - (Total number of 3-digit numbers in which 5 does not appear at all)

$$= 9 \times 10 \times 10 - 8 \times 9 \times 9$$

$$= 900 - 648 = 252$$

128. If A and B are two events, such that $P(A \cup B) = \frac{3}{4}$, $P(A \cap B) = \frac{1}{4}$, $P(A^c) = \frac{2}{3}$ where A^c stands for the complementary event of A, then $P(B)$ is given by:

(A) $\frac{1}{3}$ (B) $\frac{2}{3}$
(C) $\frac{1}{9}$ (D) $\frac{2}{9}$

Correct Option: B

Solution:

From the given problem: $P(A \cup B) = \frac{3}{4}$,

$$P(A \cap B) = \frac{1}{4}$$

$$P(A^c) = \frac{2}{3} = 1 - P(A) \Rightarrow P(A) = 1 - \frac{2}{3} = \frac{1}{3}$$

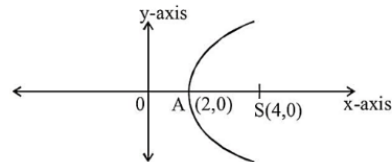
$$\begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\ \Rightarrow P(B) &= P(A \cup B) + P(A \cap B) - P(A) \\ &= \frac{3}{4} + \frac{1}{4} - \frac{1}{3} = 1 - \frac{1}{3} = \frac{2}{3} \end{aligned}$$

129. Axis of a parabola lies along x-axis. If its vertex and focus are at distances 2 and 4 respectively from the origin on the positive x-axis then which of the following points does not lie on it?

(A) (4, -4) (B) (5, $2\sqrt{6}$)
(C) (8, 6) (D) (6, $4\sqrt{2}$)

Correct Option: C

Solution:



equation of parabola is $y^2 = 8(x - 2)$

(8, 6) does not lie on parabola.

130. Equation of a common tangent to the circle, $x^2 + y^2 - 6x = 0$ and the parabola, $y^2 = 4x$, is :

(A) $2\sqrt{3}y = 12x + 1$ (B) $2\sqrt{3}y = -x - 12$
(C) $\sqrt{3}y = x + 3$ (D) $\sqrt{3}y = 3x + 1$

Correct Option: C

Solution:

Let equation of tangent to the parabola

$$y^2 = 4x \Rightarrow y = mx + \frac{1}{m}$$

$$\Rightarrow m^2x - ym + 1 = 0 \text{ is tangent}$$

$$x^2 + y^2 - 6x = 0$$

$$\Rightarrow \frac{|3m^2 + 1|}{\sqrt{m^4 + m^2}} = 3$$

$$m = \pm \frac{1}{\sqrt{3}}$$

$$\Rightarrow \text{tangent are } x + \sqrt{3}y + 3 = 0$$

$$\text{and } x - \sqrt{3}y + 3 = 0$$

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	A	D	A	C	A	B	D	A	B
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	C	D	C	D	D	A	C	A	A
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	C	C	B	C	A	A	C	C	A	D
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	D	C	B	A	C	A	B	C
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	B	B	C	B	A	D	B	A	A	A
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	A	B	B	C	B	A	B	A	B	C
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	B	C	D	D	B	D	B	A	B	C
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	C	D	C	C	B	A	B	B	A	C
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	A	A	B	A	C	D	B	D	A	C
Que.	91	92	93	94	95	96	97	98	99	100
Ans.	A	C	A	C	B	C	A	A	B	B
Que.	101	102	103	104	105	106	107	108	109	110
Ans.	C	A	B	A	D	B	D	B	A	C
Que.	111	112	113	114	115	116	117	118	119	120
Ans.	D	B	C	D	A	D	A	C	D	B
Que.	121	122	123	124	125	126	127	128	129	130

Ans.	A	B	C	A	A	C	C	B	C	C
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