iit Jee 2007 Paper 2 Offline $30 Questions$

Question 001 MCQ

QUESTION

Consider a titration of potassium dichromate solution with acidified Mohr’s salt solution using diphenylamine as indicator. The number of moles of Mohr’s salt required per mole of dichromate is

A 3

B 4

C 5

D 6

CORRECT OPTION

D 6

SOURCE

Chemistry • some-basic-concepts-of-chemistry

EXPLANATION

The formula of Mohr's salt is

$$FeSO_4(NH_4)_2SO_4$$

. It is a mixture of ferrous sulfate and ammonium sulfate. Ferrous sulfate is oxidized by potassium dichromate to ferric sulphate.

Reaction is as follows:

$$K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 + 7H$$

1 mole of potassium dichromate reacts with 6 moles of ferrous sulphate. Thus, number of moles of Mohr's salt required per mole of dichromate is 6.

Question 002 MCQ

QUESTION

STATEMENT-1 : Band gap in germanium is small.

STATEMENT-2 : The energy gap of each germanium atomic energy level is infinitesimally small.

A. Statement - 1 is True, Statement - 2 is True; Statement - 2 is a correct explanation for Statement - 1

B. Statement - 1 is True, Statement - 2 is True; Statement - 2 is not a correct explanation for Statement - 1

C. Statement - 1 is True, Statement - 2 is False

D. Statement - 1 is False, Statement - 2 is True

CORRECT OPTION

C Statement - 1 is True, Statement - 2 is False

SOURCE

Chemistry • p-block-elements

EXPLANATION

Statement-1:

“Band gap in germanium is small.”

✅ **True.**

Germanium is a semiconductor with an energy band gap of about **0.66 eV at 300 K**, which is much smaller than that of silicon $1.1 eV$.

Statement-2:

“The energy gap of each germanium atomic energy level is infinitesimally small.”

❌ **False.**

In a single germanium atom, the energy levels are **discrete** with **finite energy differences** between them — not infinitesimally small.

In a solid, when many atoms come together, each discrete atomic level splits into closely spaced energy states due to interactions between atoms, forming continuous **bands**; the gap between valence and conduction bands (the **band gap**) is small but **finite**.

So, the “infinitesimally small” part is **incorrect**.

✅ **Correct Option: C**

Statement-1 is True, Statement-2 is False.

Question 003 MCQ

QUESTION

Consider a reaction aG + bH

$$\rightarrow$$

Products. When concentration of both the reactants G and H is doubled, the rate increases by eight times. However, when concentration of G is doubled keeping the concentration of H fixed, the rate is doubled. The overall order of the reaction is

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

CORRECT OPTION

D 3

SOURCE

Chemistry • chemical-kinetics-and-nuclear-chemistry

EXPLANATION

The rate law expression is

$$\mathrm{R} = k[\mathrm{G}]^a[\mathrm{H}]^b$$

...... i

The rate of reaction increases by a factor of 2 on doubling the concentration of '

$$\mathrm{G}$$

'.

The rate law expression becomes

$$\mathrm{R}' = 2\mathrm{R} = k2^a[\mathrm{G}]^a[\mathrm{H}]^b$$

..... ii

Divided equation ii with eqn. i

$$\begin{aligned}\frac{\mathrm{R}'}{\mathrm{R}} &= \frac{2\mathrm{R}}{\mathrm{R}} = \frac{k2^a[\mathrm{G}]^a[\mathrm{H}]^b}{k2[\mathrm{G}]^a[\mathrm{H}]^b} \\ 2 &= 2^a \\ a &= 1\end{aligned}$$

The rate of reaction increases by a factor of 8 on doubling the concentration of

$$\mathrm{G}$$

and '

$$\mathrm{H}$$

'.

The rate law expression becomes

Rate

$$= \mathrm{R}'' k2^a[\mathrm{G}]^a 2^b[\mathrm{H}]^b$$

..... iii

Divide equation iii with equation i

$$\frac{8\mathrm{R}}{\mathrm{R}} = \frac{k2^a[\mathrm{G}]^a 2^b[\mathrm{H}]^b}{k[\mathrm{G}]^a[\mathrm{H}]^b}$$

$$8 = 2^a 2^b$$

or

$$b = 2$$

The overall order of reaction is

$$a + b = 1 + 2 = 3$$

Question 004 MCQ

QUESTION

Among the following metal carbonyl, the C-O bond order is lowest in

A $[Mn(CO)_6]^+$

B $[Fe(CO)_5]$

C $[Cr(CO)_6]$

D $[V(CO)_6]^-$

CORRECT OPTION

B $[Fe(CO)_5]$

SOURCE

EXPLANATION

A

$$\mathrm{Mn}^{+}=3d^{5}4s^{1}$$

; in presence of CO, effective configuration =

$$3d^{6}4s^{0}$$

Three lone pair of electrons in metal 3d orbitals for back bonding with vacant $$\pi$$ pi* orbital of C in CO.

B

$$\mathrm{Fe}^{0}=3d^{6}4s^{2}$$

; in presence of CO, effective configuration =

$$3d^{8}$$

Four lone pair for back bonding with CO.

C

$$\mathrm{Cr}^{0}=3d^{5}4s^{1}$$

; effective configuration =

$$3d^{6}$$

Three lone pair for back bonding with CO.

D

$$\mathrm{V}^{-}=3d^{4}4s^{2}$$

; effective configuration =

$$3d^{6}$$

Three lone pair for back bonding with CO.

Since, Vanadium has a negative charge, it is present in lower oxidation state and can easily back donate the electrons from metal

$$d$$

orbitals to $\$\$\pi\$\$$ pi* orbital of carbonyl ligand. Hence, it forms a much stronger bond with carbon or carbonyl thereby weakening the carbon oxygen bond.

Question 005 MCQ

QUESTION

A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless solution. Moreover, the solution of metal ion treatment with a solution of cobalt II thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is:

A. Pb

$$2+$$

B. Hg

$$2+$$

C. Cu

$$2+$$

D. Co

$$2+$$

CORRECT OPTION

B Hg

$2+$

SOURCE

Chemistry • salt-analysis

EXPLANATION

A solution of metal ion $Hg$$$^{2+}$$ when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt II thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is Hg

$2+$

.

$$\mathrm{Hg_2 + KI \rightarrow Hg\ I_2}$$

$redppt$

$$\mathrm{HgI_2 + KI \rightarrow K_2HgI_4}$$

$$\mathrm{Co(SCN)_2 + K_2HgI_4 = Co[Hg(SCN)_4]}$$

$bluecrystallineprecipitates$

Question 006 MCQ

QUESTION

Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound E. Compound E on further treatment with aqueous KOH yields compound F. Compound F is :

A

B

C

D

CORRECT OPTION

A

SOURCE

Chemistry • aldehydes-ketones-and-carboxylic-acids

EXPLANATION

Its open structure is

Question 007 MCQ

QUESTION

The number of stereoisomers obtained by bromination of

$$trans$$

-2-butene is :

A 1

B 2

C 3

D 4

CORRECT OPTION

A 1

SOURCE

Chemistry • basics-of-organic-chemistry

EXPLANATION

If we add halogens on alkenes it is mostly anti addition. Anti addition of

$$\mathrm{Br_2}$$

on

$$trans$$

alkene gives meso compound.

So, here only 1 stereoisomer is formed.

$$trans$$

-2-butene is

Image

Bromination of

$$trans$$

-2-butene

Image

Question 008 MCQ

QUESTION

Let

$$E^c$$

denote the complement of an event

$$E.$$

Let

$$E, F, G$$

be pairwise independent events with

$$P(G) > 0$$

and

$$P(E \cap F \cap G) = 0.$$

Then

$$P(E^c \cap F^c | G)$$

equals

A $$P(E^c) + P(F^c)$$

B $P\left(E^{c}\right)-P\left(F^{c}\right)$

C $P\left(E^{c}\right)-P(F)$

D $P(E)-P\left(F^{c}\right)$

CORRECT OPTION

C $P\left(E^{c}\right)-P(F)$

SOURCE

Mathematics • probability

EXPLANATION

$\mathrm{E}_1 f_1 G$ are pairwise independent events.

$$\therefore \quad \mathrm{P}(\mathrm{E} \cap \mathrm{F}) = \mathrm{P}(\mathrm{E}) \cdot \mathrm{P}(\mathrm{F})$$

$$\mathrm{P}(\mathrm{F} \cap \mathrm{G}) = \mathrm{P}(\mathrm{F}) \cdot \mathrm{P}(\mathrm{G})$$

$$\mathrm{P}(\mathrm{G} \cap \mathrm{E}) = \mathrm{P}(\mathrm{G}) \cdot \mathrm{P}(\mathrm{E})$$

$$\mathrm{P}\left(\frac{\mathrm{E}^c \cap \mathrm{F}^c}{\mathrm{G}}\right) = \mathrm{P}\left(\frac{(E^c \cap \mathrm{F}^c) \cap G}{\mathrm{P}(\mathrm{G})}\right)$$

$$= \frac{\mathrm{P}(\mathrm{G}) - \mathrm{P}(\mathrm{G} \cap \mathrm{E}) - \mathrm{P}(\mathrm{G} \cap \mathrm{F})}{\mathrm{P}(\mathrm{G})}$$

$$= 1 - \mathrm{P}(\mathrm{E}) - \mathrm{P}(\mathrm{F})$$

$$= \mathrm{P}\left(\mathrm{E}^c\right) - \mathrm{P}(\mathrm{F}).$$

Question 009 MCQ

QUESTION

A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of

$$\pm 0.05 \mathrm{~mm}$$

at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of

$$\pm 0.01 \mathrm{~mm}$$

. Take g = 9.8 m/s^2 $exact$. The Young's modulus obtained from the reading is

A

$$(2.0 \pm 0.3) \times 10^{11}\ \mathrm{N/m^2}$$

B

$$(2.0 \pm 0.2) \times 10^{11}\ \mathrm{N/m^2}$$

C

$$(2.0 \pm 0.1) \times 10^{11}\ \mathrm{N/m^2}$$

D

$$(2.0 \pm 0.05) \times 10^{11}\ \mathrm{N/m^2}$$

CORRECT OPTION

B

$$(2.0 \pm 0.2) \times 10^{11}\ \mathrm{N/m^2}$$

SOURCE

Physics • units-and-measurements

EXPLANATION

Young's modulus

$$(Y) = \frac{\text{Stress}}{\text{Strain}} = \frac{4mgl}{\pi d^2 \Delta l}$$

$$\mathrm{Y} = \frac{4mgl}{\pi d^2 l}$$

$$= \frac{4 \times 1 \times 9.8 \times 2}{3.14 \times (0.4)^2 \times (0.8) \times 10^{-6} \times 10^{-3}}$$

$$= 2 \times 10^{11}\ \mathrm{N/m^2}$$

Where,

Mass

$$(m) = 1 \text{ kg}$$

$$g = 9.8 \text{ m/s}^2$$

$$\text{Length of wire } = 2 \text{ m}$$

$$\pi = 3.14$$

$$\text{Diameter } (d) = 0.4 \text{ mm} \times 10^{-3} \text{ m}$$

Extension in the length of wire

$$(\Delta l) = 0.8 \text{ mm}$$

$$= 0.8 \times 10^{-3} \text{ m}$$

$$\frac{\Delta y}{y} = \frac{2\Delta d}{d} + \frac{\Delta l}{l}$$

$$= \frac{2 \times (0.01)}{0.4} + \frac{(0.05)}{0.8}$$

$$= 0.1125$$

$$\Rightarrow \Delta \text{Y} = (\text{Y}) \times 0.1125$$

$$= 2 \times 10^{11} \times 0.1125$$

$$= 0.225 \times 10^{11}$$

$$\simeq 0.2 \times 10^{11}$$

$$\text{(b) } \left(2 \pm 0.2 \times 10^{11} \text{ N/m}^2\right)$$

Question 010 MCQ

QUESTION

A particle moves in the X - Y plane under the influence of a force such that its linear momentum is

$$\overrightarrow{p}(t) = A\left[\hat{i}\cos(kt) - \hat{j}\sin(kt)\right]$$

, where A and k are constants. The angle between the force and the momentum is

A 0°

B 30°

C 45°

D 90°

CORRECT OPTION

D 90°

SOURCE

Physics • laws-of-motion

EXPLANATION

Given that,

$$\overrightarrow{\mathrm{P}}(t)=\mathrm{A}[\hat{i}\cos(kt)-\hat{j}\sin(kt)]$$

where,

$$\mathrm{A}$$

and

$$k=$$

constant

$$\text{Force }\overrightarrow{\mathrm{F}})=\frac{d\overrightarrow{\mathrm{P}}}{dt}(\text{ from Newton's }2^{\text{nd}}\text{ law})$$

$$\Rightarrow\quad\overrightarrow{\mathrm{F}}=\frac{d}{dt}[\mathrm{A}(\hat{i}\cos(kt)-\hat{j}\sin(kt))]$$

$$=\mathrm{A}k[\hat{i}\cos(kt)-\hat{j}\sin(kt)]$$

By applying dot product between

$$\vec{F}\&\vec{P}$$

we have

$$\overrightarrow{\mathrm{F}}\cdot\overrightarrow{\mathrm{P}}=0$$

$$\Rightarrow|\vec{F}||\vec{P}|\cos\theta=0$$

$$\Rightarrow\quad\cos\theta=0$$

$$\text{Hence,}\theta=90^{\circ}$$

Question 011 MCQ

QUESTION

In the experiment to determine the speed of sound using a resonance column,

A prongs of the tuning fork are kept in a vertical plane

B prongs of the tuning fork are kept in a horizontal plane

C in one of the two resonances observed, the length of the resonating air column is close to the wavelength of sound in air

D in one of the two resonances observed, the length of the resonating air column is close to half of the wavelength of sound in air

CORRECT OPTION

A prongs of the tuning fork are kept in a vertical plane

SOURCE

Physics • waves

EXPLANATION

Wave produced by tuning Fork in a vertical plane as shown in above figure.

Therefore, fringes of tuning Fork is kept in vertical plane.

Question 012 MCQ

QUESTION

A small object of uniform density rolls up a curved surface with an initial velocity

$$v$$

. It reaches up to a maximum height of

$$\frac{3v^2}{4g}$$

with respect to the initial position. The object is

A ring

B solid sphere

C hollow sphere

D disc

CORRECT OPTION

D disc

SOURCE

Physics • rotational-motion

EXPLANATION

By applying conservation of Energy, we have,

$$\frac{1}{2}mv^2 + \frac{1}{2}\mathrm{I}\omega^2 = mgh_{\max}$$

..... i

For pure rolling,

$$v = R\omega$$

$$\Rightarrow \quad \omega = v/\mathrm{R}$$

..... ii

Putting eq. ii in eq. i, we get

$$\Rightarrow \frac{1}{2}mv^2 + \frac{1}{2}\mathrm{I}\left(\frac{v^2}{R^2}\right) = mg \times \frac{3v^2}{4g}$$

$$\left(\because h_{\max} \times \frac{3v^2}{4g}\right)$$

$$\Rightarrow \quad \mathrm{I} = \frac{1}{2}\mathrm{MR}^2$$

Hence, this is a required formula of moment of Inertia of Disc. Therefore, the object a disc.

$$2^{\mathrm{nd}}$$

Method : For pure rolling, the velocity of point of contact is zero i.e.,

$$v = 0$$

, So,

$$\Delta x$$

$displacement$ is zero. Then work done by the frictional force should be

$$W = f_0\Delta x = 0$$

If work is done by dissipative force, work done should be zero. It means that work done of system is zero. So energy should be conserved. Initially, the object has both translation as well as rotational motion. If it attains '

$$h_{\max}$$

' kinetic energy changes into potential energy.

From energy conservation principle,

$$\mathrm{K.E}_{\text{translational}} + \mathrm{K.E}_{\text{rotational}} =$$

Potential Energy

$$\Rightarrow \quad \frac{1}{2}mv^2 + \frac{1}{2}\mathrm{I}\omega^2 = mg \times \frac{3v^2}{4g}$$

$$\Rightarrow \quad mv^2 + \mathrm{I}\omega_2 = \frac{3v^2}{2}m$$

$$\Rightarrow \quad \mathrm{I}\omega^2 = \frac{1}{2}mv^2$$

$$\Rightarrow \quad \mathrm{I} = \frac{1}{2}\frac{mv^2}{\omega^2}$$

..... i

For No slipping,

$$\Rightarrow$$

$$v = \omega R$$
$$\omega = \frac{v}{R}$$

..... ii

Put eq ii in eq i

Hence,

$$\mathrm{I} = \frac{1}{2}\mathrm{MR}^2$$

$$\mathrm{I} = \frac{1}{2}\mathrm{M}\frac{v^2}{v^2} \times \mathrm{R}^2$$

this is moment of inertia of disc.

So, object is a Disc.

Question 013 MCQ

QUESTION

Water is filled up to a height

$$h$$

in a beaker of radius

$$R$$

as shown in the figure. The density of water is

$$\rho$$

, the surface tension of water is

$$T$$

and the atmospheric pressure is P. Consider a vertical section

$$ABCD$$

of the water column through a diameter of the beaker. The force on water on one side of this section by water on the other side of this section has magnitude

A

$$\left|2\mathrm{P}_0\mathrm{Rh} + \pi\mathrm{R}^2\rho gh - 2\mathrm{RT}\right|$$

B

$$\left|2\mathrm{P}_0\mathrm{Rh} + \pi\mathrm{R}\rho\mathrm{gh}^2 - 2\mathrm{RT}\right|$$

C

$$\left|P_0\pi R^2 + R\rho gh^2 - 2RT\right|$$

D

$$\left|\mathrm{P}_0\mathrm{R}^2 + \mathrm{R}\rho g\,\mathrm{h}^2 + 2\mathrm{RT}\right|$$

CORRECT OPTION

B $$\left|2\mathrm{P}_0\mathrm{Rh}+\pi\mathrm{R}\rho\mathrm{gh}^2-2\mathrm{RT}\right|$$

SOURCE

Physics • properties-of-matter

EXPLANATION

Pressure is acting on area

$$ABCD$$

, we have

Pressure Force

$$=\int_0^h\left(\mathrm{P}_0+\rho g x\right)\times dx\times 2\mathrm{R}$$

Force due to pressure $push$

$$=\left[\left(\mathrm{P}_0+\rho g\frac{x^2}{2}\right)2\mathrm{R}\right]_0^h$$

$$=\left(\mathrm{P}_0 h+\rho g h^2/2\right)2\mathrm{R}$$

$$=2\mathrm{P}_0 h\mathrm{R}+\rho g h^2\mathrm{R}$$

Surface tension force $push$

$$=T\times 2R$$

$$\therefore$$

Net Force

$$= 2P_0hR + \rho gh^2R - 2TR$$

Question 014 MCQ

QUESTION

A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in the figure. The electric field inside the emptied space is

- **A** zero everywhere
- **B** non-zero and uniform
- **C** non-uniform
- **D** zero only at its center

CORRECT OPTION

B non-zero and uniform

SOURCE

Physics • electrostatics

EXPLANATION

When cavity is not present:

Electric field inside the solid sphere

$$\overrightarrow{\mathrm{E}_1}=\frac{\rho}{3\varepsilon_0}\overrightarrow{r_1}$$

..... i

Solid sphere after making cavity inside solid sphere,

$$\overrightarrow{\mathrm{E}_2}=\frac{\rho}{3\varepsilon_0}\overrightarrow{r_2}$$

...... ii

$$\begin{aligned}\overrightarrow{E}_{net}=\overrightarrow{E_1}-\overrightarrow{E_2}&=\frac{\rho}{3\varepsilon_0}\overrightarrow{r_1}-\frac{\rho}{3\varepsilon_0}\overrightarrow{r_2}\\&=\frac{\rho}{3\varepsilon_0}\left(\overrightarrow{r_1}-\overrightarrow{r_2}\right)\end{aligned}$$

...... iii

From eq iii, we get

$$\therefore\quad \mathrm{E}_{\mathrm{net}}=\frac{\rho}{3\varepsilon_0}(\vec{r})$$

Hence, electric field inside the emptied space $cavity$ is non-zero and uniform.

Question 015 MCQ

QUESTION

Positive and negative point charges of equal magnitude are kept at

$$\left(0,0,\frac{a}{2}\right)$$

and

$$\left(0, 0, \frac{-a}{2}\right)$$

, respectively. The work done by the electric field when another positive point charge is moved from

$$(-a, 0, 0)$$

to

$$(0, a, 0)$$

is

A positive

B negative

C zero

D depends on the path connecting the initial and final positions

CORRECT OPTION

C zero

SOURCE

Physics • electrostatics

EXPLANATION

Consider that,

$$\mathrm{P} = (-a, 0, 0)$$

and

$$Q = (0, a, 0)$$

points lie on the equatorial plane of dipole.

The charges makes an electric dipole.

Therefore, potential at

$$P =$$

Potential at

$$Q = 0$$

Work done

$$(W) = q\left(V_P - V_Q\right) = 0$$

Question 016 MCQ

QUESTION

A magnetic field

$$\vec{B} = B_0 \hat{j}$$

exists in the region

$$a < x < 2a$$

and

$$\vec{B} = -B_0 \hat{j}$$

, in the region

$$2a < x < 3a$$

, where

$$B_0$$

is a positive constant. A positive point charge moving with a velocity

$$\vec{v} = v_0\hat{i}$$

, where

$$v_0$$

is a positive constant, enters the magnetic field at

$$x = a$$

. The trajectory of the charge in this region can be like,

A

B

C

D

CORRECT OPTION

A

SOURCE

Physics • magnetism

EXPLANATION

For

$$a < x < 2a$$

$$\overrightarrow{\mathrm{B}} = \mathrm{B}_0\hat{j}$$

The initial velocity is

$$\vec{v} = v \cdot \hat{j}$$

From the above diagram it is clear that force on the particle is toward

$$+z$$

-axis $byapplyingFleming's lefthandrule$ at

$$x = a$$

, which shifts the particle as shown in the x-z plane

For

$$2a < x < 3a$$

$$\overrightarrow{\mathrm{B}} = -\mathrm{B}_0\hat{j}$$

The direction of velocity is shown at

$$x = 2a$$

.

Again by using Fleming's left hand rule, we get direction of force.

Question 017 MCQ

QUESTION

Electrons with de-Broglie wavelength

$$\lambda$$

fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-rays is

A

$$\lambda_0 = \frac{2mc\lambda^2}{h}$$

B

$$\lambda_0 = \frac{2h}{mc}$$

C

$$\lambda_0 = \frac{2m^2c^2\lambda^3}{h^2}$$

D

$$\lambda_0 = \lambda$$

CORRECT OPTION

A

$$\lambda_0 = \frac{2mc\lambda^2}{h}$$

SOURCE

Physics • dual-nature-of-radiation

EXPLANATION

The cut off wavelength is given by

$$\lambda_0 = \frac{hc}{ev}$$

..... i

According to de-Broglie equation

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2me\,\mathrm{V}}}$$

$$\Rightarrow \quad \lambda^2 = \frac{h^2}{2me\,\mathrm{V}}$$

$$\Rightarrow \quad \mathrm{V} = \frac{h^2}{2me\lambda^2}$$

..... ii

From i and ii

$$\lambda_0 = \frac{hc \times 2me\lambda^2}{eh^2} = 2mc\lambda^2$$

Question 018 MCQ

QUESTION

STATEMENT 1

If there is no external torque on a body about its center of mass, then the velocity of the center of mass remains constant.

Because

STATEMENT 2

The linear momentum of an isolated system remains constant.

A. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

C Statement-1 is True, Statement-2 is False.

D Statement-1 is False, Statement-2 is True.

CORRECT OPTION

D Statement-1 is False, Statement-2 is True.

SOURCE

Physics • rotational-motion

EXPLANATION

Statement 1 : For velocity of centre of mass remains constant, net force acting on body must be zero. Therefore the statement 1 is false.

Statement 2 : The linear momentum of an isolated system remains constant. The statement is true.

Question 019 MCQ

QUESTION

STATEMENT 1

A cloth covers a table. Some dishes are kept on it. The cloth can be pulled out without dislodging the dishes from the table.

STATEMENT 2

For every action there is an equal and opposite reaction.

A. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1s.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

CORRECT OPTION

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1s.

SOURCE

Physics • laws-of-motion

EXPLANATION

Statement 1 : Cloth can be pulled out without dislodging the dishes from the table because of inertia. Therefore, statement 1 true.

Statement 2 : This is Newton's third law and hence true. But statement 2 is not a correct explanation of statement 1 .

Question 020 MCQ

QUESTION

STATEMENT 1

A vertical iron rod has a coil of wire wound over it at the bottom end. An alternating current flows in the coil. The rod goes through a conducting ring as shown in the figure. The ring can float at a certain height above the coil.

Because

STATEMENT 2

In the above situation, a current is induced in the ring which interacts with the horizontal component of the magnetic field to produce an average force in the upward direction.

A. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

CORRECT OPTION

A. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

SOURCE

Physics • alternating-current

EXPLANATION

As shown in the figure, the horizontal component of the magnetic field interacts with the current in the conducting ring, which produces an average force in the upwards direction $by using Fleming's left hand rule$.

Question 021 MCQ

QUESTION

STATEMENT 1

The total translational kinetic energy of all the molecules of a given mass of an ideal gas is 1.5 times the product of its pressure and its volume.

Because

STATEMENT 2

The molecules of a gas collide with each other and the velocities of the molecules change due to the collision.

A. Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

CORRECT OPTION

B. Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct for Statement-1.

SOURCE

Physics • heat-and-thermodynamics

EXPLANATION

Statement 1 :

Total translational kinetic energy

$$= \frac{3}{2} n\mathrm{RT}$$

where,

n = no. of moles

R = gas constant

T = Temperature

but, PV = nRT

$$\therefore$$

K.E. = 1.5 PV

Statement 2 : Molecules of a gas collide with each other and the velocities of the molecules change due to collision.

But statement 2 is not a correct explanation of statement 1 .

Question 022 MCQ

QUESTION

The speed of sound of the whistle is

$340 \mathrm{~m/s}$

for passengers in

A

A and

$310 \mathrm{~m/s}$

for passengers in

B

$360 \mathrm{~m/s}$

for passengers in

A

B and

$310 \mathrm{~m/s}$

for passengers in

B

$310 \mathrm{~m/s}$

for passengers in

A

C and

$360 \mathrm{~m/s}$

for passengers in

B

D

$$340 \mathrm{~m/s}$$

for passengers in both the trains

CORRECT OPTION

B

$$360 \mathrm{~m/s}$$

for passengers in

$$\mathrm{A}$$

and

$$310 \mathrm{~m/s}$$

for passengers in

$$\mathrm{B}$$

SOURCE

Physics • waves

EXPLANATION

$$v_{\mathrm{SA}}=(340+20) \mathrm{m/s}=360 \mathrm{~m/s}$$
$$v_{\mathrm{SB}}=(340-30) \mathrm{m/s}=310 \mathrm{~m/s}$$

where, speed of sound in air = 340 m/s

Hence, the speed of sound depends on the frame of reference of observer.

Question 023 MCQ

QUESTION

The distribution of the sound intensity of the whistle as observed by the passengers in train

$$\mathrm{A}$$

is best represented by

A

B

C

D

CORRECT OPTION

A

SOURCE

Physics • waves

EXPLANATION

Since all the passengers in train A are moving with a velocity of

$$20\ \mathrm{m/s}$$

therefore the distribution of sound intensity of the whistle by the passengers in the train

$$A$$

is uniform.

Trick : Total frequency

$$= (1120 - 800)\text{Hz} = 320 \text{ Hz}$$

There is no relative motion between source and observer.

Therefore, all the passengers will hear the sound of same intensity.

Question 024 MCQ

QUESTION

The spread of frequency as observed by the passengers in train B is

A 310 Hz

B 330 Hz

C 350 Hz

D 290 Hz

CORRECT OPTION

A 310 Hz

SOURCE

Physics • waves

EXPLANATION

Frequency

$$(f') = f_1\left(\frac{v - v_0}{v - v_s}\right) = 800\left[\frac{340 - 30}{340 - 20}\right]$$

$$= 800 \times \frac{31}{32}$$

..... i

where,

$$\left(\frac{v - v_0}{v - v_S}\right) = \frac{31}{32}$$

..... ii

Frequency

$$(f') = f_2\left(\frac{v - v_0}{v - v_S}\right) = 1120 \times \frac{31}{32}$$

..... iii

$$\therefore \quad f' - f' = (1120 - 800)\frac{31}{32} = 320 \times \frac{31}{32}$$

$$= 310 \text{ Hz}$$

Question 025 MCQ

QUESTION

Light travels as a

A parallel beam in each medium

B convergent beam in each medium

C divergent beam in each medium

D divergent beam in one medium and convergent beam in the other medium.

CORRECT OPTION

A parallel beam in each medium

SOURCE

Physics • geometrical-optics

EXPLANATION

Since the wave fronts are parallel in each medium, the beam is also a parallel beam travelling in the direction perpendicular to the wave fronts. Since the beam would bend inside medium 2 when travelling from medium 1 , the second medium has the higher refractive index.

Trick : For plane wave fronts the beam of light is parallel.

Question 026 MCQ

QUESTION

The phases of the light wave at

$$c, d, e$$

and

$$f$$

are

$$\phi_c, \phi_d, \phi_e$$

and

$$\phi_f$$

respectively.

It is given that

$$\phi_c \neq \phi_f$$

.

A cannot be equal to

$$\phi_c$$

$$\phi_d$$

B can be equal to

$$\phi_d$$

$$\phi_c$$

C is equal to

$$(\phi_d - \phi_f)$$

$$(\phi_c - \phi_e)$$

$$(\phi_d - \phi_c)$$

D is not equal to

$$(\phi_f - \phi_e)$$

CORRECT OPTION

$$(\phi_d - \phi_f)$$

C is equal to

$$(\phi_c - \phi_e)$$

SOURCE

Physics • geometrical-optics

EXPLANATION

Since point c and d are on same wave front.

Therefore,

$$\phi_d = \phi_c$$

Similarly,

$$\phi_e = \phi_f$$

$$\therefore\ \phi_d - \phi_f = \phi_c - \phi_f$$

Question 027 MCQ

QUESTION

Speed of the light is

A the same in medium-1 and medium-2

B larger in medium-1 than in medium-2

C larger in medium-2 than in medium-1

D different at b and d

CORRECT OPTION

B larger in medium-1 than in medium-2

SOURCE

Physics • wave-optics

EXPLANATION

The gap between consecutive wave fronts in medium 2 is less than that in medium 1. Therefore, wavelength of light in medium 2 in less than that in medium 1. Therefore, speed of light is more in medium 1 and less in medium 2.

Question 028 MCQ

QUESTION

Column I describe some situations in which a small object moves. Column II describes some characteristics of these motions. Match the situation in Column I with the characteristics in Column II and indicate your answer by darkening appropriate bubbles in the

$$4 \times 4$$

matrix given in the ORS.

	Column I		Column II
A	The object moves on the x-axis under a conservative force in such a way that its "speed" and "position" satisfy $$v = c_1\sqrt{c_2 - x^2}$$, where $$c_1$$ and $$c_2$$ are positive constants.	P	The object executes a simple harmonic motion.
B	The object moves on the x-axis in such a way that its velocity and its displacement from the origin satisfy $$v = -kx$$, where $$k$$ is a positive constant.	Q	The object does not change its direction.
C	The object is attached to one end of a massless spring of a given spring constant. The other end of the spring is attached to the ceiling of an elevator. Initially everything is at rest. The elevator starts going upwards with a constant acceleration a. The	R	The kinetic energy of the object keeps on decreasing

	Column I		Column II
	motion of the object is observed from the elevator during the period it maintains this acceleration.		
D	The object is projected from the earth's surface vertically upwards with a speed $$2\sqrt{GMe/\mathrm{Re}}$$, where, M e is the mass of the earth and R e is the radius of the earth. Neglect forces from objects other than the earth.	S	The object can change its direction only once.

A $$[\mathrm{A} \rightarrow (\mathrm{P}); \mathrm{B} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{Q}, \mathrm{R})]$$

B $$[\mathrm{A} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{S}, \mathrm{R})]$$

C $$[\mathrm{A} \rightarrow (\mathrm{P}, \mathrm{S}); \mathrm{B} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R})]$$

D $$[\mathrm{A} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{S})]$$

CORRECT OPTION

A $[\mathrm{A} \rightarrow (\mathrm{P}); \mathrm{B} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{Q}, \mathrm{R})]$

SOURCE

Physics • waves

EXPLANATION

Reason:

In above figure shown that S.H.M

Therefore,

$$f_s = Kx$$

Given,

$$v = c_1\sqrt{c_2 - x^2}$$

..... i

For a simple harmonic motion,

$$v = \omega\sqrt{A^2 - x^2}$$

..... ii

On comparing eq. i & ii therefore it shows the S.H.M of particle.

A

$$\rightarrow$$

P

b Given,

$$v = -kx$$

At

$$x = 0, v = 0$$

$$x = 2, v = -2k$$

$$x = -5, v = +5k$$

The above consideration show that particle is coming from minus x-axis.

Velocity is decreasing with time.

Graph:

Therefore, no change in direction, velocity keeps on decreasing. So that kinetic energy is decreasing with time.

B

$$\rightarrow q_1 r$$

C From the reference frame of the observer in the elevator a constant force acts on the object. Hence the motion of the object will remain simple harmonic.

Therefore, option 1 is correct.

Velocity of object

$$v = 2\sqrt{G\frac{M_e}{R_e}} = \sqrt{2}\sqrt{2G\frac{M_e}{R_e}} = \sqrt{2}v_e$$

Since,

$$v > v_e$$

$where\$\$v_e\$\$isescapevelocity$ object will move out of earth.

Hence, option Q and R are correct.

Question 029 MCQ

QUESTION

Two wires each carrying a steady current I are shown in four configurations in Column I. Some of the resulting effects are described in Column II. Match the statements in Column I with the statements in Column II and indicate your answer by darkening appropriate bubbles in the

$$4 \times 4$$

matrix given in the ORS.

	Column I		Column II
A	Point P is situated midway between the wires.	P	The magnetic fields B at P due to the currents in the wire are in same direction.
B	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii.	Q	The magnetic fields B at P due to the currents in the wires are in opposite directions.
C	Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii.	R	There is no magnetic field at P.
D	Point P is situated at the common center of the wires.	S	The wires repel each other.

A

$$[\mathrm{A} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{P}); \mathrm{C} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{D} \rightarrow (\mathrm{Q}, \mathrm{R})]$$

B

$$[\mathrm{A} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{P}); \mathrm{C} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{D} \rightarrow (\mathrm{Q})]$$

C

$$[\mathrm{A} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{P}); \mathrm{C} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{D} \rightarrow (\mathrm{Q})]$$

D

$$[\mathrm{A} \rightarrow (\mathrm{S}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{P}); \mathrm{C} \rightarrow (\mathrm{P}, \mathrm{R}); \mathrm{D} \rightarrow (\mathrm{Q})]$$

CORRECT OPTION

B

$$[\mathrm{A} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{B} \rightarrow (\mathrm{P}); \mathrm{C} \rightarrow (\mathrm{Q}, \mathrm{R}); \mathrm{D} \rightarrow (\mathrm{Q})]$$

SOURCE

Physics • magnetism

EXPLANATION

We can find the direction of magnetic field at

$$P$$

due to a wire by using thumb rule, and the direction of force on a wire due to other is calculated by the direction of cross product of direction of current and direction of magnetic field,

$$\vec{f} = q(\vec{l} \times \vec{B})$$

A From thumb rule, the magnetic field at point

$$\mathrm{P}$$

due to both wires is in opposite direction. Since

$$\mathrm{P}$$

is at midpoint, net magnetic field at

$$P$$

is zero. The direction of force on one wire is towards another $from above equation$, hence they attract each other. Thus, option

$$(\mathrm{Q})$$

are

$$(\mathrm{R})$$

are correct.

B Direction of magnetic field at

$$\mathrm{P}$$

is same due to both the loop. Hence option

$$(\mathrm{P})$$

is correct. If both the loop is very close they might act as single $likesolenoid$, so we cannot predict loop will attract nor repel.

C Similar to case

$$A$$

, net

$$B$$

at point

$$\mathrm{P}$$

is zero. And direction of force is towards another wire which means attraction. Hence, option Q and R are correct.

D Magnetic field at the center of current carrying loop is given by

$$\mathrm{B} = \frac{\propto_0 i}{2R}$$

Current in the two loop is in opposite direction so magnetic field is in opposite direction due to both the loops. Radius of two loops is different, so it will have non zero field at point

$$P$$

.

Question 030 MCQ

QUESTION

Column I gives some devices and Column II gives some process on which the functioning of these devices depend. Match the devices in Column I with the processes in Column II and indicate your answer by darkening appropriate bubbles in the

$$4 \times 4$$

matrix given in the ORS.

	Column I		Column II
A	Bimetallic strip	P	Radiation from a hot body
B	Steam engine	Q	Energy conversion
C	Incandescent lamp	R	Melting
D	Electric fuse	S	Thermal expansion

A. $[\mathrm{A} \rightarrow (\mathrm{Q}, \mathrm{S}); \mathrm{B} \rightarrow (\mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R})]$

B. $[\mathrm{A} \rightarrow (\mathrm{R}, \mathrm{S}); \mathrm{B} \rightarrow (\mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R}, \mathbf{S})]$

C. $[\mathrm{A} \rightarrow (\mathrm{S}); \mathrm{B} \rightarrow (\mathrm{Q}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R})]$

D. $[\mathrm{A} \rightarrow (\mathrm{P}, \mathrm{S}); \mathrm{B} \rightarrow (\mathrm{R}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R})]$

CORRECT OPTION

C

$$[\mathrm{A} \rightarrow (\mathrm{S}); \mathrm{B} \rightarrow (\mathrm{Q}); \mathrm{C} \rightarrow (\mathrm{P}); \mathrm{D} \rightarrow (\mathbf{R})]$$

SOURCE

Physics • properties-of-matter

EXPLANATION

A A bimetallic strip is used to convert a temperature change into mechanical displacement. The strip consists of two strips of different metals having different thermal coefficients.

B Steam engine is a device which converts heat energy into mechanical energy and heat is supplied into the engine through the medium of steam. Thus energy conversion is right answer here.

C The incandescent light bulb works on incandescence, which is the emission of light radiations caused by heating the filament.

D Fuse wire works on the principle of heat and melting, when excess current passes in the circuit, due to heat produced by the excess current fuse melts and prevent the damage.