MitoPrep Premium Test 1 Answer Key

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Q1) **Explanation:**

Hint: Reading = main scale reading (MSR) + (Vernier scale reading (VSR) × least count).

Step: Find the reading of the meter.
Reading of the meter is given as;
Reading = main scale reading (MSR) + (Vernier scale reading (VSR) × least count).
Vernier scale reading is given when the Vernier scale matches with any division of the main scale which is 6 in this case.
Reading of the meter is given as $= 3.7 + (6 \times 0.01) = 3.76$ cm.
Hence, option **(4)** is the correct answer.

Q2) **Explanation:**

Hint: $F = \frac{GM_1M_2}{r^2}$

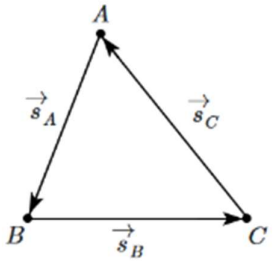
Step 1: Find the dimensions of E and G.
The dimensions of energy $E = Fd = \left[ML^2T^{-2}\right]$
The dimensions of G is given by;
$G = Fr^2m^{-2} = \left[MLT^{-2}\right]\left[L^2\right]\left[M^{-2}\right]$
$\Rightarrow [G] = \left[M^{-1}L^3T^{-2}\right]$

Step 2: Find the dimensions of $\frac{E}{G}$.
$\left[\frac{E}{G}\right] = \frac{[ML^2T^{-2}]}{[M^{-1}L^3T^{-2}]} = \left[M^2L^{-1}T^0\right]$
Hence, option **(3)** is the correct answer.

Q3) **Explanation:**

Hint: The vector sum of the displacement of all particles is zero.

Step: Find the relationship between the velocities of the given particles.
The vector sum of the displacement of all particles is zero.



$\vec{s}_A + \vec{s}_B + \vec{s}_C = 0$
$\Rightarrow \vec{v}_At + \vec{v}_Bt + \vec{v}_Ct = 0$
$\Rightarrow \vec{v}_A + \vec{v}_B + \vec{v}_C = 0$
Hence, option **(4)** is the correct answer.

Q4) **Explanation:**

Hint: The dot product of two orthogonal vectors is equal to zero.

Step 1: Find the dot product of two vectors.

For perpendicular vector, we have $\overrightarrow{\mathrm{A}} . \overrightarrow{\mathrm{B}}=0$

$\left[\cos \omega t \hat{\mathrm{i}}+\sin \omega t \hat{\mathrm{j}}\right] .\left[\cos \frac{\omega t}{2} \hat{\mathrm{i}}+\sin \frac{\omega t}{2} \hat{\mathrm{j}}\right]=0$

$\Rightarrow \cos \omega t . \cos \frac{\omega t}{2}+\sin \omega t . \sin \frac{\omega t}{2}=0$

[cos (A-B) = cosAcosB + sinAsinB]

Step 2: Find the value of t.

$\Rightarrow \cos \left(\omega t-\frac{\omega t}{2}\right)=0$

$\Rightarrow \cos \frac{\omega t}{2}=0 \Rightarrow \frac{\omega t}{2}=\frac{\pi}{2} \Rightarrow \mathrm{t}=\frac{\pi}{\omega}$

Q5) **Explanation:**

Hint: $\vec{B} \times \vec{C}$ is $\perp$ to both $\vec{B}$ and $\vec{C}$.

Step: Find the vector parallel to $\vec{A}$.

Given: $\vec{\mathrm{A}} \cdot \vec{\mathrm{B}}=0$ and $\vec{\mathrm{A}} \cdot \vec{\mathrm{C}}=0$

These conditions indicate that vectors $\vec{B}$ and $\vec{C}$ are both perpendicular to vector $\vec{A}$. This means that $\vec{A}$ lies in a direction that is perpendicular to both $\vec{B}$ and $\vec{C}$.

The cross product $\vec{B} \times \vec{C}$ gives a vector that is perpendicular to both $\vec{B}$ and $\vec{C}$. Since $\vec{B}$ and $\vec{C}$ are both perpendicular to $\vec{A}$, their cross product will produce a vector parallel to $\vec{A}$. This satisfies the condition of a vector parallel to $\vec{A}$.

Hence, option **(3)** is the correct answer.

Q6) **Explanation:**

The integrand $(K-U)$ has units of energy (joules), and integrating over time multiplies by time, resulting in units of energy × time. This is the unit of action, which is the same as the unit of angular momentum (e.g., Planck's constant h has units of action: J·s = kg·m²/s).

Thus, the proper unit is $\mathrm{kg} \cdot \mathrm{m}^2 / \mathrm{s}$.

Hence, option **(4)** is the correct answer.

Q7) **Explanation:**

Hint: Momentum per unit time = force.

Step: Find the dimensions momentum per unit time.

The dimensions of momentum per unit time = $|MLT^{-2}|$

Step 2: Check the dimensions of the given physical quantities in the options.

[Torque/Mass] = $|L^2T^{-2}|$

[Energy/Length] = $|MLT^{-2}|$

[Acceleration/Mass] = $|M^{-1}LT^{-2}|$

[Power/Acceleration] = $|MLT^{-1}|$

Therefore, the dimensions of Energy/Length are the same as that of momentum per unit time.

Hence, option (2) is the correct answer.

Q8) **Explanation:**

Hint: Rounding off to significant figures is done after the entire calculation is completed.

Step: Find the result of the calculation to 3 significant figures.
The given calculation is:
$2 \times 0.536 + 0.0050 + 2.100 = 3.177$
Rounding off 3.177 to three significant figures gives 3.18.
Hence, option **(2)** is the correct answer.

Q9) **Explanation:**

Hint: $\cos\theta = \dfrac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|}$

Step: Find the angle between force and displacement.

$$\cos\theta = \frac{\vec{F}.\vec{d}}{|\vec{F}||\vec{d}|}$$
$$\Rightarrow \cos\theta = \frac{(6\hat{i} + 2\hat{j}).(2\hat{i} + 6\hat{j})}{\sqrt{6^2 + 2^2} \times \sqrt{2^2 + 6^2}}$$
$$\Rightarrow \cos\theta = \frac{6 \times 2 + 2 \times 6}{\sqrt{40} \times \sqrt{40}}$$
$$\Rightarrow \cos\theta = \frac{24}{40}$$
$$\Rightarrow \theta = \cos^{-1}(0.6)$$

Hence, option **(4)** is the correct answer.

Q10) **Explanation:**

$$\begin{aligned} \text{Work done} &= \int_a^b F(x)dx \\ &= \int_a^b +mg \quad dx \\ &= +mg\int_a^b dx = +mg\,[x]_a^b \\ &= +mg \quad [b-a] \\ &= 10 \times 10 \times [5-0] \\ &= +500 \quad J \end{aligned}$$

Q11) **Explanation:**

Hint: Henry is the SI unit of inductance.

Step: Convert given quantities in list-I into appropriate units.

(a) $\left[\frac{H}{s}\right] = \left[\frac{L}{R} \times \frac{R}{s}\right] = [R] = \Omega$

(b) $[H \times A] = [LI] = [\phi] = Wb$

(c) $[H \times F] = \left[\frac{L}{R} \times RC\right] = s^2$

(d) $[\Omega \times F] = [RC] = s$

Here, H is Henry (SI unit of electrical inductance), F is Farad (SI unit of electrical capacitance), A is Ampere (SI unit of electric current)
Therefore, the correct match is (a) – (iv), (b) – (ii), (c) – (i), (d) – (iii).
Hence, option **(2)** is the correct answer.

Q12) **Explanation:**

Hint: The absolute error is always added.

Step: Find the error in the measurement of time difference Δt.

The absolute error in the measurement of time t is given by;

$\Delta t = \Delta t_1 + \Delta t_2$

$\Rightarrow \Delta t = 10^{-2} + 10^{-2} = 2 \times 10^{-2}$ s

Therefore, the error in the measurement of time Δt is 2×10^{-2} s.

Hence, option (2) is the correct answer.

Q13) **Explanation:**

$C = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

$Therefore\ dimension\ \ LT^{-1}$

Q14) **Explanation:**

(C)

Triangle law of vector addition

Q15) **Explanation:**

Hint: The relative error is the ratio of the mean error to the mean value.

Step 1: Find the mean value of the observations.

The mean value of observations is given by;

$\Rightarrow \frac{1.25\text{ s} + 1.24\text{ s} + 1.27\text{ s} + 1.21\text{ s} + 1.28\text{ s}}{5}$

$\Rightarrow 1.25$ s

Step 2: Find the mean error.

The mean of errors is given by;

$\Rightarrow \frac{0+0.01+0.02+0.04+0.03}{5}$

$\Rightarrow \frac{0.1}{5}$

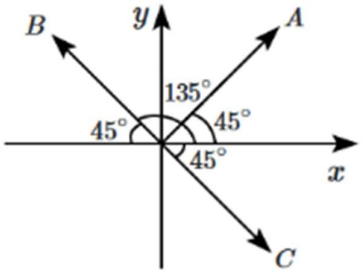
Percentage error is; $\frac{0.1 \times 100}{5 \times 1.25} = 1.6\%$

Hence, option **(4)** is the correct answer.

Q16) **Explanation:**

Hint: Resolve the three vectors in the x and y-direction.

Step 1: Draw a diagram.



Step 2: Find the magnitude of $\vec{R}$.

From the diagram, it is clear, B & C will get cancelled to each other.

Hence, $\vec{R} = \vec{A} = 200$ unit.

Hence, option **(2)** is the correct answer.

Q17) **Explanation:**

Hint: $V\sqrt{x} + VB = Ax^2$

Step: Find the dimensions of $\frac{\mathrm{A}^2}{\mathrm{B}}$.

Given: $\mathrm{V} = \frac{\mathrm{A}x^2}{\sqrt{x} + \mathrm{B}}$

According to the principle of homogeneity, only the physical quantities having the same dimensional formula only can be added or subtracted.

$\Rightarrow [B] = [\sqrt{X}] = [L^{\frac{1}{2}}]$

$\Rightarrow \mathrm{V} = \frac{\mathrm{A}x^2}{\sqrt{x} + \mathrm{B}} = \frac{[\mathrm{A}][x^2]}{[\sqrt{x}]}$

$\Rightarrow [ML^2T^{-2}] = \frac{[\mathrm{A}][L^2]}{[L^{\frac{1}{2}}]} = [A][L^{\frac{3}{2}}]$

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

$\Rightarrow \frac{A^2}{B} = \frac{[M^2L^1T^{-4}]}{[L^{\frac{1}{2}}]} = [M^2L^{1/2}T^{-4}]$

Hence, option **(3)** is the correct answer.

Q18) **Explanation:**

Hint: Use the dot and cross product of vectors.

Step 1: Find the dot product of given vectors.

The dot product of the given vectors is given by;

$\vec{F} \cdot \vec{r} = (2\hat{i} + \hat{j} - \hat{k}).(3\hat{i} + 2\hat{j} - 2\hat{k})$

$\Rightarrow \vec{F} \cdot \vec{r} = 6 + 2 + 2 = 10$

Step 2: Find the cross product of given vectors.

The cross-product of the given vectors is given by;

$$\vec{F} \times \vec{r} = \begin{vmatrix} i & j & k \\ 2 & 1 & -1 \\ 3 & 2 & -2 \end{vmatrix}$$

$\Rightarrow \vec{F} \times \vec{r} = i(-2+2) - j(-4+3) + k(4-3) = j + k$

$\Rightarrow |\vec{F} \times \vec{r}| = |\hat{j} + \hat{k}| = \sqrt{2}$

Therefore, the scalar and vector products of $\vec{F}$ and $\vec{r}$ have the magnitudes respectively as $10,\ \sqrt{2}$.

Hence, option **(3)** is the correct answer.

Q19) **Explanation:**

Hint: The dimensional formula of pressure is $\left[ML^{-1}T^{-2}\right]$.

Step: Find the system of the unit of pressure.

The dimensions of pressure are given by; $[P] = \frac{[\text{Force}]}{[\text{Area}]} = \left[ML^{-1}T^{-2}\right]$

$\Rightarrow [P] = (1\text{ kg})(1\text{ m})^{-2}(1\text{ min})^{-2}$

$\Rightarrow [P] = (1\text{ kg})(1\text{ m})^{-2}(60\text{ sec})^{-2}$

$\Rightarrow [P] = \frac{1}{3600}\text{ Nm}^{-2}$

Hence, option **(3)** is the correct answer.

Q20) **Explanation:**

Hint: Apply the principle of homogeneity.

Step: Find the dimensions of a, b and c.

The velocity of the particle is given by; $v = at + \frac{b}{t+c}$

By using the principle of homogeneity we get;

$[v] = \left[LT^{-1}\right] = [a][t] = \frac{[b]}{[t+c]} = \frac{[b]}{[T]}$

$\Rightarrow \left[LT^{-1}\right] = [a][T] \Rightarrow [a] = \left[LT^{-2}\right]$

$\Rightarrow [c] = [T]$

$\Rightarrow [LT^{-1}] = \frac{[b]}{[T]} \Rightarrow [b] = [L]$

Therefore, the dimensions of a, b and c are $\left[LT^{-2}\right], [L], [T]$ respectively.

Hence, option (1) is the correct answer.

Q21) **Explanation:**

Hint: $U = \frac{1}{2}Li^2$

Step: Find the dimensions of the electric inductance.

Energy stored, in an inductor, $U = \frac{1}{2}Li^2$

Energy stored, in a capacitor, $U = \frac{1}{2}CV^2$

Now, use dimensional analysis:

$\left[\frac{1}{2}Li^2\right] = \left[\frac{1}{2}CV^2\right]$

$\Rightarrow [L] = \left[C\frac{V^2}{i^2}\right]$

$\Rightarrow [L]$ =(Resistance)^2 × Capacitance

Hence, option (4) is the correct answer.

Q22) **Explanation:**

Hint: $\left(\vec{A} \times \vec{B}\right)$ is perpendicular on both $\vec{A}$ and $\vec{B}$.

Explanation: In the question, $\vec{C}$ is given as $\vec{C} = \vec{A} \times \vec{B}$ which means $\vec{C} \perp \vec{A}$ and $\vec{C} \perp \vec{B}$ i.e., $\left(\vec{A} \times \vec{B}\right)$ is perpendicular to both $\vec{A}$ and $\vec{B}$. The dot product of two perpendicular vectors is zero.

Therefore, $\vec{A} \cdot (\vec{A} \times \vec{B})$ is equal to zero.

Hence, option (4) is the correct answer.

Q23) **Explanation:**

Hint: $\vec{\tau} = \vec{r} \times \vec{F}$

Step: Find the dimensions of each quantity.

Acceleration = $\frac{\Delta v}{\Delta t} = \frac{\text{m}}{\text{s}^2} = [LT^{-2}]$

Torque = Force × distance $= [ML^2T^{-2}]$

Absorptive Power = $\frac{\text{Energy absorbed by the body}}{\text{Energy absorbed by the black body}} = [M^0L^0T^0]$

Pressure = $\frac{F}{A} = [ML^{-1}T^{-2}]$

Therefore, the correct match is **(a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)**.

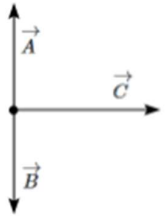
Hence, option **(1)** is the correct answer.

Q24) **Explanation:**

Hint: The resultant of two equal and opposite direction vectors is zero.

Step: Find the direction of the sum.

The vectors A and B have equal magnitude but are opposite in direction, so they will cancel each other. The direction of the sum is given by the direction of the vector C.



Therefore, the direction of the sum is shown as arrow →.

Hence, option **(1)** is the correct answer.

25) **Explanation:**

Position vectors of the particles are:
$\vec{r_1}$ = (-2î+ 5ĵ) and $\vec{r_2}$= (4ĵ + 3$\hat{k}$)
∴ Displacement of the particle,
$\vec{\Delta s} = \vec{r_2} - \vec{r_1}$
$= 4\hat{j} + 3\hat{k} - (-2\hat{i} + 5\hat{j})$
$= 2\hat{i} - \hat{j} + 3\hat{k}$
Force on the particle, $\vec{F} = \left(4\hat{i} + 3\hat{j}\right) N$
∴ Work done, $W = \vec{F}.\Delta\vec{s}$
$=(4\hat{i} + 3\hat{j}).(2\hat{i} - \hat{j} + 3\hat{k})$
=8-3=5 J.

Q26) **Explanation:**

Hint: Vector quantity has both magnitude and direction.

Explanation: Velocity is a vector quantity because it has both magnitude (speed) and direction. Weight is a vector quantity because it represents the force due to gravity, which has both magnitude and direction (downward). Electric charge is a scalar quantity because it only has magnitude and no direction.
Electric field is a vector quantity because it has both magnitude and direction, describing the force per unit charge at any point in space.
Electric charge has only magnitude. It does not require any direction. Therefore, electric charge is a scalar quantity.
Hence, option **(3)** is the correct answer.

Q27) **Explanation:**

Hint: L.C.=Pitch/(Number of circular scale divisions)

Step: Find the correct diameter of the ball.

The reading of the screw gauge is given by;
$= \text{MSR} + \text{CSR-Zero Error} = 0.5 \text{ cm} + 0.001 \times 25 \text{ cm} - (-0.004 \text{ cm})$
$= 0.529 \text{ cm}$
Therefore, the correct diameter of the ball is 0.529 cm.
Hence, option **(4)** is the correct answer.

Q28) **Explanation:**

Hint: $|\vec{P} \times \vec{Q}| = PQ \sin\theta$

Step: Find the angle between the given vectors.
$\vec{P} \times \vec{Q} = \vec{Q} \times \vec{P}$
$\vec{P} \times \vec{Q} = -(\vec{P} \times \vec{Q}) \quad (\vec{Q} \times \vec{P} = -(\vec{P} \times \vec{Q}))$
$2\vec{P} \times \vec{Q} = 0$
$\Rightarrow |\vec{P}||\vec{Q}| \sin(\theta) = 0$
$\Rightarrow \sin\theta = 0$
$\Rightarrow \theta = 180^\circ$
Hence, option (4) is the correct answer.

Q29) **Explanation:**

Hint: $\left|\vec{A} \times \vec{B}\right| = AB\sin\theta$

Step: Identify the correct match.

(A) $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$

$\Rightarrow \sqrt{A^2 + B^2 + 2AB\cos\theta} = \sqrt{A^2 + B^2 - 2AB\cos\theta}$

$\Rightarrow 4AB\cos\theta = 0$

$\Rightarrow \theta = 90^\circ$

Hence, $\mathrm{A} \rightarrow \mathrm{R}$.

(B) $|\vec{A} \times \vec{B}| = \vec{A} \cdot \vec{B}$

$\Rightarrow AB\cos\theta = AB\sin\theta$

$\Rightarrow \tan\theta = 1$

$\Rightarrow \theta = 45^\circ$

Hence, $\mathrm{B} \rightarrow \mathrm{P}$.

(C) $\vec{A} \cdot \vec{B} = \dfrac{AB}{2}$

$\Rightarrow AB\cos\theta = \dfrac{AB}{2}$

$\Rightarrow \cos\theta = \dfrac{1}{2}$

$\Rightarrow \theta = 60^\circ$

Hence, $\mathrm{C} \rightarrow \mathrm{S}$.

(D) $|\vec{A} \times \vec{B}| = \dfrac{AB}{2}$

$\Rightarrow AB\sin\theta = \dfrac{AB}{2}$

$\Rightarrow \sin\theta = \dfrac{1}{2}$

$\Rightarrow \theta = 30^\circ$

Hence, $\mathrm{D} \rightarrow \mathrm{Q}$.

Therefore, the correct match is; $\mathrm{A} \rightarrow \mathrm{R}, \mathrm{B} \rightarrow \mathrm{P}, \mathrm{C} \rightarrow \mathrm{S}, \mathrm{D} \rightarrow \mathrm{Q}$

Hence, option **(3)** is the correct answer.

30) **Explanation:**

Let there be two vectors P and Q. As mentioned, the magnitude of the sum of P and Q is equal to the magnitude of the difference of these two vectors which can be represented as follows:

Suppose two vectors are P and Q. It is given that: $|\mathrm{P} + \mathrm{Q}| = |\mathrm{P} - \mathrm{Q}|$

Let the angle between P and Q is θ.

$\Rightarrow \mathrm{P}^2 + \mathrm{Q}^2 + 2\mathrm{PQ}\cos\theta = \mathrm{P}^2 + \mathrm{Q}^2 - 2\mathrm{PQ}\cos\theta$

$\Rightarrow \cos\theta = 0 = \cos 90^0$

$\Rightarrow \theta = 90^0$

Q31)

Q32) **Explanation:**

$$\text{Change in velocity,}$$
$$\Delta v = \sqrt{v^2 + v^2 - 2v^2\cos\theta}$$
$$\Delta v = v\sqrt{2(1-\cos\theta)}$$
$$\Delta v = v\sqrt{2\left(1 - 1 + 2\sin^2\frac{\theta}{2}\right)}$$
$$\Delta v = 2v\sin\left(\frac{\theta}{2}\right)$$
$$= 2 \times v \times \sin 90^\circ$$
$$= 2 \times 100 \times 1$$
$$= 200 \quad \text{km/hr}$$

Q33) **Explanation:**

Hint: $\left|\vec{A} \times \vec{B}\right| = AB\sin\theta$

Step: Find the angle between two vectors.

Given: $|\vec{A} \times \vec{B}| = \sqrt{3}|\vec{A} \cdot \vec{B}|$

$|\vec{A} \times \vec{B}| = \sqrt{3}|\vec{A} \cdot \vec{B}|$

$\Rightarrow AB\sin\theta = \sqrt{3}AB\cos\theta \quad \left[\vec{A} \times \vec{B} = AB\sin\theta, \vec{A} \cdot \vec{B} = AB\cos\theta\right]$

$\Rightarrow \tan\theta = \sqrt{3}$

$\Rightarrow \theta = 60^\circ$

Therefore, the angle between two vectors is 60°.

Hence, option **(3)** is the correct answer.

Q34) **Explanation:**

Hint: Use the concept of vector resolution.

Step 1: Find the magnitude of the force.

The y-component of the force is given by;

$F_y = F\cos 30^\circ = 2\sqrt{3}$ N

$\Rightarrow F = 4$ N

Step 2: Find the x-component of the force.

The x-component of the force is given by;

$F_x = F\sin 30^\circ$

$\Rightarrow F_x = 4 \times \frac{1}{2} = 2$ N

Hence, option **(2)** is the correct answer.

35) **Explanation:**

Hint: Recall the dimensions of the given quantities.

Step: Find the quantities which have the same dimensions as those of solid angles.

The expression of the solid angle is given by; $\Omega = \frac{\text{Area}}{r^2} = \frac{[L^2]}{[L^2]} = \left[M^0L^0T^0\right]$

Therefore, the solid angle is a dimensionless quantity.

The dimensions of strain are given by; $\frac{\Delta L}{L} = \left[M^0L^0T^0\right]$

The dimensions of the angle are given by; $\theta = \frac{l}{r} = \left[M^0L^0T^0\right]$

Therefore, strain and angle are both dimensionless quantities.

Hence, option **(4)** is the correct answer.

36) **Explanation:**

Hint: $\vec{a} \times \vec{b}$ is the vector product.

Explanation: The ratio $\frac{\vec{a} \times \vec{b}}{\vec{a} \cdot \vec{b}} = \tan\theta\,\hat{n}$, where θ is the angle between the vectors $\vec{a}, \vec{b}$ and $\hat{n}$ is the unit vector, perpendicular to both $\vec{a}$ and $\vec{b}$. The $\vec{a} \times \vec{b}$ has the magnitude: $ab\ \sin\theta$, and $\vec{a}.\vec{b}$ has the magnitude: $ab\ \cos\theta$, where θ is the angle between the vectors $\vec{a}, \vec{b}$.

Therefore, **(A)** is False but **(R)** is True.

Hence, option (4) is the correct answer.

Q37) **Explanation:**

Hint: $R = \sqrt{A^2 + B^2 + 2ABcos\theta}$

Step: Find the magnitude of the resultant force.

The resultant of the two vectors separated by angle θ is given by;

$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

Given: $A = A,\ B = \frac{A}{2}, \theta = 90^\circ$

The net force is given by;

$F_{\text{net}} = \sqrt{A^2 + \frac{A^2}{4}}$

$\Rightarrow F_{\text{net}} = \frac{\sqrt{5}A}{2}$

Hence, option (2) is the correct answer.

Q38) **Explanation:**

Hint: $W = \vec{F}.\vec{s}$

Step: Find different quantities having the same dimension.

Work and Torque have the same dimensions of force × distance (i.e., Newton-meters), but they represent different physical concepts.

Hence, option (3) is the correct answer.

Q39) **Explanation:**

Hint: $[v] = \left[\mathrm{M^0LT^{-1}}\right]$

Step 1: Use the principle of homogeneity

$v = \lambda^K a^L \rho^M$

$[LT^{-1}] = [L]^K[LT^{-2}]^L\ [ML^{-3}]^M$

0 = M

1 = K+L-3M

$-1 = -2L \Rightarrow L = \frac{1}{2}$

$and\ K = \frac{1}{2}$

Q40) **Explanation:**

percent error in P is the given by

Δ P/P =3 Δ A/A +2 Δ B/B + Δ C/C + Δ D/D

= 3X1% + 2X2% + 1X3% + 1X4% = 14%

Note: The video solution is for a similar question.

Q41) **Explanation:**

Hint: Density=mass/volume

Step: Use the concept of percentage error.

$\rho = \frac{M}{V} \Rightarrow \frac{\Delta\rho}{\rho} \times 100 = \frac{\Delta M}{M} \times 100 + \frac{\Delta V}{V} \times 100$

= 0.8%+0.4%

=1.2%

Q42) **Explanation:**

Hint: $|\vec{F}_1 + \vec{F}_2| = \sqrt{|\vec{F}_1|^2 + |\vec{F}_2|^2 + 2|\vec{F}_1||\vec{F}_2|\cos\theta}$

Step: Find the magnitude of the net force in each case.

In the first case, both forces are added in the same direction then the magnitude of the net force is given by;

$F_{net} = F_A + F_B = 400 + 300 = 700$ N

In the second case, both forces are acting in opposite directions then the magnitude of the net force is given by;

$F_{net} = F_A - F_B = 400 - 300 = 100$ N

In the third case, both forces are perpendicular to each other, then the magnitude of the net force is given by;

$F_{net} = \sqrt{F_A^2 + F_B^2} = \sqrt{(400)^2 + (300)^2} = 500$ N

Therefore, in Case 1, the net force is 700 N; Case 2, 100 N; and Case 3, 500 N.

Hence, option **(2)** is the correct answer.

Q43) **Explanation:**

Hint: $\left|\vec{A}+\vec{B}\right| = \sqrt{A^2+B^2+2AB\cos\theta}$

Step: Find the angle between the two vectors.

$|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}|$

$\Rightarrow \sqrt{A^2+B^2+2AB\cos\theta} = \sqrt{A^2+B^2-2AB\cos\theta}$

After squaring both sides, we get;

$\Rightarrow A^2+B^2+2AB\cos\theta = A^2+B^2-2AB\cos\theta$

$\Rightarrow 4AB\cos\theta = 0$

$\Rightarrow \cos\theta = 0$

$\Rightarrow \theta = 90^\circ$

Hence, option **(3)** is the correct answer.

Q44) **Explanation:**

Hint: Least count = pitch/(number of the divisions)

Step: Find the pitch of the screw gauge.

The least count of the screw gauge is given by;

Least count = pitch/(number of the divisions)

$\Rightarrow 0.01 = \frac{\text{Pitch}}{50}$

$\Rightarrow$ Pitch $= 50 \times 0.01 = 0.5$ mm

Hence, option **(2)** is the correct answer.

Q45) **Explanation:**

Hint: $d_{mean} = \frac{d_1+d_2+d_3+d_4+d_5}{5}$.

Step 1: Find the mean diameter.

$\frac{3.33+3.32+3.34+3.33+3.32}{5} = 3.328$

Step 2: Find the mean diameter to appropriate significant figures.

After rounding off the mean diameter to appropriate significant figures is 3.33 cm.

Q46) **Explanation:**

Hint: $CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$

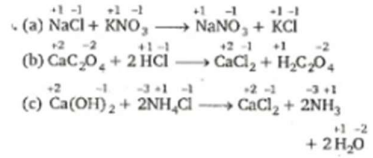
$n_{NaOH} = 1; \therefore (CO)_2 \ present \ in \ mixture = 0.5 \ and \ CO \ present = 0.3 \ mole$
$When \ more \ (CO)_2 \ produced = 0.3, more \ NaOH \ requried = 0.3 \times 2 = 0.6 \ mole$

Let's break this down step by step:

1. **Initial Reaction**: The mixture of CO and CO_2 requires 40 grams of NaOH for complete conversion of all the CO_2 into Na_2CO_3. Given that 40 grams of NaOH is equivalent to 1 mole of NaOH (since the molar mass of NaOH is 40 g/mol), this means 0.5 moles of CO_2 are present in the mixture (because 1 mole of NaOH reacts with 0.5 moles of CO_2).
2. **Oxidation of CO**: The remaining 0.3 moles in the mixture must be CO (since the total mixture is 0.8 moles). When CO is oxidized, it forms CO_2: [$2CO + O_2 \rightarrow 2CO_2$] This means 0.3 moles of CO will produce 0.3 moles of CO_2.
3. **Additional NaOH Required**: The newly formed 0.3 moles of CO_2 will require NaOH for conversion into Na_2CO_3. The reaction is: [$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$] Therefore, 0.3 moles of CO_2 will require 0.6

Q47) **Explanation:**

Hint: One involving oxidation and the other involving reduction.



in all these cases during the reaction, there is no change in the oxidation state of the ion or molecule, or constituent atom, these are simply ionic reactions.

(d) $2K[Ag(CN)_2] + Zn \rightarrow 2Ag + K_2[Zn(CN)_4]$

$Ag^+ \rightarrow Ag$ gaining of e^-, reduction

$Zn \rightarrow Zn^{2+}$ loss of e^-, reduction

Q48) **Explanation:**

Hint: Phosphorus undergo both reduction and oxidation reaction
Write the O.N. of each element above its symbol, then

$$\overset{0}{P_4} + 3\overset{-2\,+1}{OH^-} + 3\overset{+1\,-2}{H_2O} \rightarrow \overset{-3+1}{PH_3} + 3\overset{+1\ +1\ -2}{H_2PO_2^-}$$

In this reaction, the oxidation number of P increases from 0 in P_4 to +1 in $H_2PO_2^-$ and decreases to -3 in PH_3, therefore, P undergoes both oxidations as well as reduction. Thus, statements (a) and (b) are wrong and statement (c) is correct.
Further, the oxidation number of H remains +1 in all the compounds, i.e., H neither undergoes oxidation nor reduction. Thus,
option (d) is correct.

Q49) **Explanation:**

Step 1: The oxidation number, is the hypothetical charge of an atom if all of its bonds to other atoms were fully ionic.

Oxygen has -2 charge, and potassium has +1 charge. Let the oxidation number of potassium as "x".

Step 2: The oxidation number of Chromium in $K_2Cr_2O_7$ is calculated as follows:

$2(+1) + 2x + 7(-2) = 0$ or $x = +6$

The oxidation number of chromium in K_2CrO_4 is calculated as follows:

$2(+1) + x + 4(-2) = 0$ or $x = +6$

Step 3: In both the molecules, the oxidation state of chromium is +6. So, the change in the oxidation state of conversion in $K_2Cr_2O_7 \rightarrow K_2CrO_4$ is 0.

Option 1 is the correct choice.

Q50) **Explanation:**

Hint: Use molarity and volume to find the moles required.

Explanation:

Step 1: The initial molarity (M_1) is $0.6\ M$

Let the initial volume is V_1

The final molarity (M_2) is $0.4\ M$

and the final volume (V_2) is $30\ cm^3$

Step 2: By using the equation, $M_1V_1 = M_2V_2$

$(0.6\ M)\ V_1 = (0.4\ M) \times (30\ cm^3)$

or, V_1 = $20\ cm^3$

Hence, the correct answer is **option 2**.

Q51) **Explanation:**

Hint: Mole Concept

The reaction of KI with HgI_4 are as follows:

$2KI + HgI_2 \rightarrow K_2HgI_4$

Therefore, the number of moles of KI required to produce 0.4 moles of K_2HgI_4 will be 2 x 0.4 =0.8

Q52) Hint: $KMnO_4$ changes its colour as the pH of the solution changes

Because of the colour, the chromate ions C r + 3) give off at the end of the reaction, potassium dichromate cannot be used as a self-indicator. The dichromate solutions are usually orange, but they cannot be used as self-indicators.

1. When employed in redox titration, it is reduced to a brown-colored Mn2+ ion (in acidic solutions) near the endpoint, and the color transformation may be seen fast.
2. A separate indication for permanganate titration is not required because the indicator's function is to identify endpoints.

Q53) **Explanation:**

Step 1: The given mass of C_2H_4 is $1.0\ g$

The molar mass of C_2H_4 is $28\ g\ mol^{-1}$

So, the number of moles of C_2H_4 is $\frac{1.0\ g}{28\ g\ mol^{-1}} = 0.036\ mol$

The number of moles is the ratio of the given mass to the molar mass of the compound.

Step 2: In one mole of a compound, N_A or 6.023×10^{23} molecules of that compound are present.

So, the total number of molecules of C_2H_4 is $0.036\ mol \times 6.023\ \times 10^{23}\ \ molecules\ mol^{-1}$ of C_2H_4

or, the total number of molecules of C_2H_4 is $0.22\ \times 10^{23}$.

In one molecule of C_2H_4, 16 electrons are present.

Thus, the total number of electrons will be $16 \times 0.22\ \times 10^{23} = 3.46 \times 10^{23}$

The correct answer is **option 2**.

Q54) **Explanation:**

Hint: Balance the equation by ensuring equal atom counts for each element on both sides.

(1) $IO_3^- + aI^- + bH^+ \rightarrow cH_2O + dI_2$

Step 1 : $I^{-1} \rightarrow I_2$ (oxidation)

$IO_3^- \rightarrow I_2$ (reduction)

Step 2 : $2IO_3^- + 12H^+ \rightarrow I_2 + 6H_2O$

Step 3 : $2IO_3^- + 12H^+ + 10e \rightarrow I_2 + 6H_2O$

$2I^- \rightarrow I_2 + 2e$

Step 4 : $2IO_3^- + 12H^+ + 10e^- \rightarrow I_2 + 6H_2O$

$[2I^- \rightarrow I_2 + 2e]5$

Step 5 : $2IO_3^- + 10I^- + 12H^+ \rightarrow 6I_2 + 6H_2O$

$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$

On comparing, $a = 5$, $b = 6$, $c = 3$, $d = 3$

Q55) **Explanation:**

Hint: Number of moles = $\frac{amount\ of\ substance}{molar\ mass\ of\ substance}$

Explanation:

Step 1: The mass ratio of CO_2 and N_2O is $2:5$. The molar mass of both CO_2 and N_2O is $44\ g\ mol^{-1}$.

The ratio of number of molecules will be:

$$\frac{Number\ of\ molecules\ of\ CO_2}{Number\ of\ molecules\ of\ N_2O} = \frac{Number\ of\ moles\ of\ CO_2 \times N_A}{Number\ of\ moles\ of\ N_2O \times N_A}$$

where N_A is the Avogadro's number.

Step 2: The formula for the number of moles is: $\frac{amount\ of\ substance}{molar\ mass\ of\ substance}$

Since the molar mass is the same, the ratio of the number of molecules will be the same as the ratio of mass.

Thus, the ratio of the number of molecules is:

$$\frac{Number\ of\ molecules\ of\ CO_2}{Number\ of\ molecules\ of\ N_2O} = \frac{2}{5}$$

Hence, **option 2** is the correct choice.

Q56) The balanced equation is :

$\mathrm{Cr_2O_7^{2-} + 14H^+ + 3Ni \longrightarrow 2Cr^{3+} + 7H_2O + 3Ni^{2+}}$

To balance the given redox reaction $\mathrm{Cr_2O_7^{-2} + H^+ + Ni \rightarrow Cr^{3+} + Ni^{2+} + H_2O}$, we will use the ion-electon method. Here's a step-by-step breakdown of the balancing process:

Step 1: Identify oxidation and Reduction Half-Reactions

Oxidation Half-Reaction: Nickel (ni) is oxidized to Nickel ion (Ni^{2+})

$\mathrm{Ni \rightarrow Ni^{2+} + 2e^-}$

Reduction Half-Reaction: Dichromate ion $(Cr_2O_7^{2-})$ is reduced to Chromium ion (Cr^{3-})

$\mathrm{Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O}$

Step 2: Balance the Electrons

- The oxidation half-reaction produces 2 electrons per Ni atom. For the reduction half-reaction, we need to ensure that the number of electrons lost in oxidation matches the number gained in reduction.
- To balance the electrons, we need 3 Ni atoms to match the 6 electrons from the reduction half-reaction. Therefore, we multiply the oxidation half-reaction by 3 :

$\mathrm{3Ni \rightarrow 3Ni^{2+} + 6e^-}$

Step 3: Combine the Half-Reactions

Now we can combine the balanced half-reaction:

$\mathrm{3Ni + Cr_2O_7^{2-} + 14H^+ \rightarrow 3Ni^{2+} + 2Cr^{3+} + 7H_2O}$

Step 4: Write the final balanced equation

the final balanced equation is :

$\mathrm{3Ni + Cr_2O_7^{2-} + 14H^+ \rightarrow 3Ni^{2+} + 2Cr^{3+} + 7H_2O}$

Step 5 : Identify coefficient

The coefficients in the balanced reaction are:

- $\mathrm{Cr_2O_7^{2-}}$: 1
- Ni : 3
- $\mathrm{H^+}$: 14
- $\mathrm{Ni^2}$: 3
- $\mathrm{Cr^{3+}}$: 2
- $\mathrm{H_2O}$: 7

Q57) **Explanation:**

Hint: $molarity = \frac{number\ of\ mole\ of\ CaCl_2}{volume\ of\ solution(L)}$

Molarity of $CaCl_2$ can be calculated from the following formula:

$$m = \frac{n}{V}$$
$$= \frac{22.2}{111}$$
$$= 0.2\mathrm{M}$$

Q58) **Explanation:**

Hint: weight of $NaNO_3$ = number of moles × molar weight of $NaNO_3$

Step 1:

The amount of Na^+ ion in 50 mL is-

In 1 mL 70 mg Na^+ ion is present.

$$\mathbf{In \quad 50 \quad mL \quad = \frac{70 \ \ mg}{1 \ \ ml} \times 50 \quad ml}$$
$$\mathbf{In \quad 50 \quad mL \quad = 3500 \quad mg = 3.5 \quad gm}$$

Step 2:

Calculate the moles of Na^+ ion.

moles of $\mathbf{Na^+} = \frac{3.5}{23}$ mol

When 1 mole of $NaNO_3$ dissociates 1 mole of Na^+ ion. Hence, $\frac{3.5}{23}$ **mol** of Na^+ is generated by $\frac{3.5}{23}$ **mol** of $NaNO_3$.

Step 3:

Calculate the weight of $NaNO_3$ is as follows:

weight of $NaNO_3$ = number of moles × molar weight of $NaNO_3$

weight of $\mathbf{NaNO_3} = \frac{3.5}{23} \times 85 = 13 \quad \mathrm{g}$

Q59) **Explanation:**

Hint: KO_2 is a superoxide.

Explanation:

(i) The oxidation number of an atom is defined as the charge that an atom appears to have on forming ionic bonds with other heteroatoms.

The oxidation number of potassium remains the same in all the compounds, i.e., +1. The oxidation numbers of oxygen atoms in $\mathbf{K_2O}, \mathbf{K_2O_2}$ and $\mathbf{KO_2}$, are -2, -1, and -1/2 respectively.

(ii) $\mathbf{K_2O}$ is a basic oxide . This pale yellow solid is the simplest oxide of potassium. It is a highly reactive compound that is rarely encountered.

$\mathbf{K_2O_2}$ is a peroxide and $\mathbf{KO_2}$ is a superoxide, which forms along with $\mathbf{K_2O}$ when potassium reacts with oxygen.

So, the correct answer is **option 2**.

Q60) **Explanation:**

Hint: The molar ratio of C and H is 7:8.

The general equation of combustion is as follows:

$$\mathbf{C_xH_y + \left(x + y/4\right)O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O}$$

The mole of hydrogen and carbon remain conserved in the reaction.

Calculate the mole of hydrogen and carbon in the reaction as follows:

$\mathbf{H_2O = \frac{0.72}{18} = 0.04\,mol = 0.08\ mol\ ''H''}$

$\mathbf{CO_2 = \frac{3.08}{44} = 0.07\,mol = 0.07\ mol\ ''C''}$

$\mathbf{x : \frac{y}{2} = 7 : 4}$

$\mathbf{x : y = 7 : 8 \Rightarrow C_7H_8}$

Hence, option second is the correct answer.

Q61) **Explanation:**

HINT : More reduction potential, better oxidising agent .Less reduction potential , better reducing agent.

The oxidizing agent is a substance that causes oxidation by accepting electrons; therefore, its oxidation state decreases.
The reducing agent is a substance that causes reduction by losing electrons; therefore its oxidation state increases.

On the basis of reduction potential , the strength of oxidising and reducing nature can be understood.

More positive reduction potential means the substance will get reduce easily and will oxidise othe. So , it will be better oxidising agent and vice versa for reducing agent.

In the given data all are Standard reduction potentials (SRP) . So, best oxidising agent is F_2 and best reducing agent is I^-.

Q62) **Explanation:**

Hint: Femto is equal to 10^{-15}

Q63) **Explanation:**

Hint: Moles concept

Explanation:

Number of moles = (mass of the sample) / (molar mass)

The given reaction is a Haber's process $\mathbf{N_2(g) + 3H_2(g) \rightleftharpoons 2\,NH_3\,(g)}$

From the above reaction , 3 moles of hydrogen are required to produce 2 moles ammonia

Therefore , $\frac{3}{2}$moles of hydrogen required to produce 1 mole of ammonia

To produce 20 mole of ammonia , $\mathbf{\frac{3}{2} \times 20 = 30}$ moles of hydrogen needed.

Hence 30 moles of hydrogen molecules are required to produce 20 moles of ammonia through Haber's process

Q64) **Explanation:**

Let the mixture contains

CO = a litre

CO_2 = b litre

therefore, a +b = 2.5 .....(i)

On passing the mixture over charcoal only CO_2 reacts as :

$$CO_2 + C \rightarrow 2CO$$

Volume before reaction	b	
Volume after reaction	0	2b

therefore total CO present after reaction = a +2b

a + 2b = 3.5 .....(ii)

By equation (i) and (ii)

a = 1.5 litre or a = 60%

b = 1.0 litre or b = 40%

Q65) **Explanation:**

Hint: $\mathbf{M_f V_f = M_1 V_1 + M_2 V_2 + M_3 V_3}$

Q66) **Explanation:**

Hint: Balance all the atoms and charge.

Explanation:

The given reaction is: $CS_2 + Cl_2 \rightarrow CCl_4 + S_2Cl_2$

This question aims to find the sum of the coefficients of the reactants in the balanced reaction.

A balanced equation is an equation for a chemical reaction in which the number of atoms for each element in the reaction and the total charge are the same for both the reactants and the products.

(I) To balance the number of chlorine atoms on both sides, multiply Cl_2 by **3**. The reaction will be:

$CS_2 + 3Cl_2 \rightarrow CCl_4 + S_2Cl_2$

(II) The sulfur atoms and the charge are also balanced on both sides. So, the sum of the coefficients of the reactants is $1 + 3 = 4$

Option 4 is the correct choice.

Q67) **Explanation:**

Hint: A redox reaction involves electron transfer, changing the oxidation states of reactants.

Q68) **Explanation:**

To calculate the mass of AgCl precipitated, find mass of $AgNO_3$ and NaCl in 50 ml (given) with the help of mole concept.
100 mL solution of $AgNO_3$ contains=16.9g $AgNO_3$
50 mL solution of $AgNO_3$ contains =8.45g $AgNO_3$
Also, given,
100 mL solution of NaCl contains= 5.8 g NaCl
50 mL solution of NaCl contains= 2.9g NaCl
Number of moles of $AgNO_3$=8.45/169.8=0.049
Number of moles of NaCl=2.9/58.5=0.049

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

Initial moles 0.049 0.049 0 0
After reaction 0 0 0.049 0.049
∴Mass of AgCl precipitated=Number of moles of AgCl ×Molecular mass
= 0.049 x 143.5
= 7 g

Q69) **Explanation:**

Hint: $X_{solute} = = \frac{number\ of\ mole\ of\ solute}{number\ of\ mole\ of\ solution}$

Explanation:

Mole fraction is the number of moles of a specific component in the solution divided by the total number of moles in the given solution.

$X_{solute} = = \frac{number\ of\ mole\ of\ solute}{number\ of\ mole\ of\ solution}$

So, it is a unitless quantity as the denominator and numerator have same units. Thus, assertion and reason are correct statements and reason is the correct explanation of assertion.

Hence, **option 1** is the correct answer.

Q70) **Explanation:**

Hint:

$2H_2 + O_2 \rightarrow 2H_2O$

$\frac{3g}{2} = \frac{1.5\ mole}{2} \qquad \frac{20}{32} = \frac{0.625}{1}$

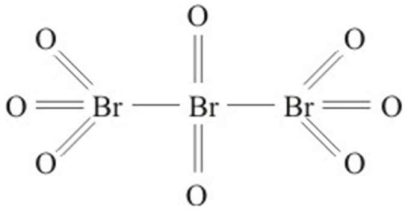
$\therefore 1\ mole O_2 - 2\ mole H_2O$

$\therefore 0.625\ mole O_2 - \frac{1}{1} \times 0.625$

$= 1.25\ mole$

$Mass\ of\ H_2O = 1.25 \times 18 = 22.5\ g$

Q71) Br_3O_8 is a non charged species.



Q72) **Explanation:**

(I) 0.5 mole $O_3 = 24$ g O_3;
(II) 0.5 g atom of oxygen $= 8$g
(III) $\frac{3.011\times10^{23}}{6.022\times10^{23}} \times 32 = 16$ g O_2
(IV) $\frac{5.6}{22.4} \times 44$ g $CO_2 = 11$ g CO_2

Q73) **Explanation:**

Hint: Potassium's oxidation state is +1.

The alkali metals are strong reducing agents, lithium being the most and sodium the least powerful. The value of oxidation potential is 3.04 V.

The alkali metals react with water to form hydroxide and dihydrogen. The reaction is as follows:

$$2M + 2H_2O \rightarrow 2M^+ + 2OH^- + H_2$$

($M =$ an alkali metal)

Ionization enthalpy of alkali metals decreases from top to bottom in the group. This is because the effect of increasing size outweighs the increasing nuclear charge, and the outermost electron is very well screened from the nuclear charge.

The oxidation number of K in KO_2 is +4 is a wrong statement because the K oxidation state is +1, not +4.

Q74) Step 1:

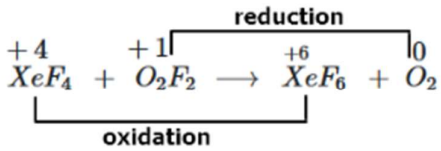
In the first two reactions, the oxidation state of any element does not change. Hence, they are not an example of a redox reaction.

$$\overset{+6\ -1}{XeF_6} + \overset{+1\ -2}{H_2O} \longrightarrow \overset{+6\ -2\ -1}{XeOF_4} + 2\overset{+1\ -1}{HF}$$

$$\overset{+6\ -1}{XeF_6} + 2\overset{+1\ -2}{H_2O} \longrightarrow \overset{+6\ -2\ -1}{XeOF_4} + \overset{+1\ -1}{HF}$$

Step 2:

But in the third reaction, Xe oxidation state changes from +4 to +6, and it is an oxidation reaction. The oxidation state of oxygen changes from +1 to zero. Hence, it is a reduction reaction.



Hence, it is a redox reaction.

The fourth reaction is also not a redox reaction because the oxidation state of any element does not change.

$$\overset{+2}{XeF_2} + \overset{+5}{PF_5} \longrightarrow \overset{+2}{[XeF]^{+1}} + \overset{+5}{PF_6^-}$$

Q75) Step 1:
Given that, the mass of Zn=32.65 g
1 mole of gas occupies=22.4 L volume at STP
The atomic mass of Zn=65.3u

The given equation is

$$\underset{65.3\ g}{Zn} + 2HCl \rightarrow ZnCl_2 + \underset{1\ mol=22.4\ L\ at\ STP}{H_2}$$

Step 2:
From the above equation, it is clear that,

65.3 g Zn, when reacts with HCl, produces= $22.7\ \ L\ \ of\ \ H_2\ \ at\ \ STP$

$\therefore\ \ 32.65\ \ g\ \ Zn,\ \ when\ \ reacts\ \ with\ \ HCl,\ \ will\ \ produce = \frac{22.4 \times 32.65}{65.3} = 11.2\ \ L\ \ of\ \ H_2$

Q76) **Explanation:**

Hint: See the change in the oxidation number of atoms.

Explanation:

The given reaction occurs because XeO_6^{4-} oxidises F^- and F^- reduces XeO_6^{4-}.

$$\overset{+8}{X}eO_{6(aq)}^{4-} + 2F^{-1}{}_{(aq)} + 6H^+{}_{(aq)} \rightarrow \overset{+6}{X}eO_{3(g)} + \overset{0}{F}_{2(g)} + 3H_2O_{(l)}$$

In this reaction, the oxidation number (O.N.) of Xe decreases from +8 in XeO_6^{4-} to +6 in XeO_3 and the O.N. of F increases from -1 in F^- to O in F_2.
Hence, we can conclude that XeO_6^{4-} is a stronger oxidizing agent that F^-.

Q77) **Hint:** The oxidation state of oxygen changes in both compounds.

Explanation:

(i) Oxidation is the process of losing an electrons, while reduction is the process of gaining them. For the given conversion, the reaction is as follows:

$$2\ H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$$

(ii) In H_2SO_4, the oxidation state of sulphur is +6 and the oxidation state of oxygen is -2. Similarly, in $H_2S_2O_8$, the oxidation state of sulphur is +6 and the oxidation states of oxygen atoms are -2 and -1.

Thus, this reaction is an example of an oxidation reaction. So, **option 1** is the correct answer.

Q78) **Explanation:**

Hint = 1 mole of carbon = $6.023\ x\ 10^{23}$atoms

one mole carbon = 12 gram

1 mole is having = $6.023\ x\ 10^{23}$ atoms

so 12 gram carbon will have $6.023\ x\ 10^{23}$atom

Q79) Hint: Use mole concept and unitary method

1 molecule of $Mg_3(PO_4)_2$ contains 8 oxygen atoms.

8 moles of O-atom are contained by 1 mole $Mg_3(PO_4)_2$.
Hence, 0.25 moles of O-atom

$= \frac{1}{8} \times 0.25$
$= 3.125 \quad \times 10^{-2}$

Q80) **Explanation:**

Hint: An element in one oxidation state is simultaneously oxidised and reduced.

$$\overset{+6}{3MnO^{2-}_4} + 4H^+ \longrightarrow \overset{+7}{2MnO^-_4} + \overset{+4}{MnO_2} + 2H_2O$$

Q81) **Explanation:**

Hint : $Ca(H_2PO_2)_2 \rightarrow Ca^{2+} + 2H_2PO_2^-$

$Ca(H_2PO_2)_2 \rightarrow Ca^{2+} + 2H_2PO_2^-$
$H_2PO_2^-$
$2 \times 1 + x + 2(-2) = -1$
$x = +1$

Q82) **Explanation:**

Hint: 1 mole hydrogen volume is 22.4 L.

Explanation:

STEP 1: The given equation is: $SnO_2 + 2H_2 \rightarrow Sn + 2H_2O$

The given mass of SnO_2 = $2.00\,g$

Molar mass of SnO_2 = $150.71\,g\,mol^{-1}$

So, the number of moles of SnO_2 = $\frac{2.00\,g}{150.71\,g\,mol^{-1}}$ = $0.0133\,mol$

STEP 2: According to the balanced equation, 1 mole of SnO_2 reacts with 2 moles of H_2.

So, 0.0133 mol of SnO_2 reacts with $0.0266\,moles$ of H_2.

We also know that, at STP volume of one mole of gas is 22.4 L.

The volume of $0.0266\,moles$ of H_2 = $0.0266 \times 22.4\,L = 0.595\,L$

Hence, option 4 is the correct answer.

Q83) **Explanation:**

Hint: The reaction is $\mathbf{Mg(HCO_3)_2 \rightarrow MgCO_3 + H_2O + CO_2}$

Step 1:

The reaction is as follows:

$Mg(HCO_3)_2 \rightarrow MgCO_3 + H_2O + CO_2$

No. of moles of $Mg(HCO_3)_2$ in 7.3 g= $\frac{7.3}{\text{moles of 1 Mg(HCO}_3)_2} = \frac{7.3}{146} = 0.05$ moles

0.05 moles of $Mg(HCO_3)_2$ will generate 0.05 moles of CO_2

Step 2:

At STP, 1 mole of gas is 22.4 L or 22400 mL

Volume of $\mathbf{CO_2} = \frac{5}{100} \times 22400 = 1120$ mL

The decomposition temperature for $MgCO_3$ is 350 degree, and Here STP is written.

Q84) **Explanation:**

Hint: If the element present in its maximum oxidation state does not show disproportionation reactions

A disproportionation reaction is a reaction in which, the same element is simultaneously oxidized and reduced. If the element is present in its maximum or minimum oxidation state then it will not show a disproportionation reaction.

In Cl_2, ClO^-_2, ClO^-_3, and S_8 , the oxidation state is 0, +3, +5 and 0. The element does not show its maximum or minimum oxidation state hence it can give disproportionation reaction.

Q85) **Explanation:**

Hint: use the general rule to calculate the oxidation number.

Let the oxidation state of nitrogen in the given compound be x.

(a) $\overset{x}{N}_2\overset{-1}{H}_4$

2(x) + (+1)4=0

2x=-4

X=-2

(b) $\overset{x}{N}\overset{-1}{H}_3$

X +1×3=0

X=-3

(c) $\overset{x}{N}_3\overset{-1}{H}$

3X+ 1= 0

3X = -1

$$X = -\frac{1}{3}$$

(d) $\overset{x}{N}\overset{-1}{H}_2\overset{-2}{o}\overset{-1}{H}$

X+ (+1)2+ (-2)+ (+1)= 0

X+2-2+1= 0

X+1 =0

X = -1

Thus, the oxidation state of nitrogen is highest in N_3H.

Q86) **Explanation:**

Hint: Oxidation takes place at anode.

At anode oxidation reaction takes place. In oxidation, loss of electron takes place.

The first reaction is reduction.

Reaction (d) and (c) are not feasible , i.e., Cr^{3+} is not oxidised to $Cr_2O_7^{2-}$ under given condition

Q87) Hint: Use the Empirical formula concept

First, convert the mass percentage into grams. The mass percentage of A and B is 75 % and 25 % respectively and in grams, it is 75 g and 25 g respectively.

Calculate the simplest ratio of A and B as follows:

	Number of moles	Simplest ratio
A	$\frac{75}{75} = 1$	1
B	$\frac{25}{25} = 1$	1

Thus, the formula of the compound is AB.

Q88) **Explanation:**

Hint: The reaction is an example of disproportionation reaction.

Explanation:

The given reaction is: $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

On the reactant side, MnO_4^{2-} is present where Mn is in $+6$ oxidation state. Similarly, on the product side, MnO_4^- and MnO_2 are present where Mn is in $+6$ and $+4$ oxidation state.

Manganese (VI) is oxidised to +7 oxidation state and reduced to +4 oxidation state.

Thus, it is not present in +2 and +3 oxidation state. **Option 4** is the correct answer.

Q89) **Explanation:**

Hint = The oxidizing substance loses electrons in the reaction, and the reducing substance gains electrons.

oxidized

Fe goes from +2 to +3..

C goes from +3 (oxalate) to +4 (CO_2)

reduced

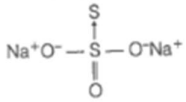
Mn goes from +7 to +2

Q90) HINT: it should be remembered that the maximum oxidation state of sulphur is +6 and the minimum oxidation state of sulphur is -2.

Explanation:

Step 1:

$Na_2S_2O_3$ Let us consider the structure of $Na_2S_2O_3$.



There is a coordinate bond between two sulphur atoms. The oxidation number of the acceptor S-atom is -2. Let, the oxidation number of other S-atom be x.

$$\underset{\text{For Na}}{2(+1)} + \underset{\text{For O-atoms}}{3 \times (-2)} + x + \underset{\text{For coordinate S-atom}}{1(-2)} = 0$$

$$x = +6$$

Step 2:

Therefore, the two sulphur atoms in $Na_2S_2O_3$ have -2 and +6 oxidation number.

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