

(SOLUTION)

Physics1. **Soln.: (3)**

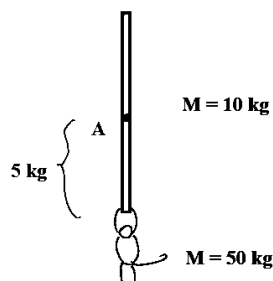
The two 5N force results in $5\sqrt{2}$, exactly opposite to the 15 N force .

$$\therefore \text{Resultant} = (15 - 5\sqrt{2})\text{N}$$

2. **Soln. (4)**

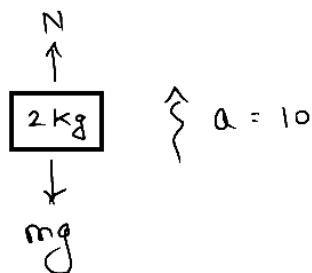
Midpoint A is holding (5 + 50) kg below it

$$\begin{aligned}\therefore T &= M_{\text{total}} \times g \\ &= 55 \times 10 = 550\text{N}\end{aligned}$$

3. **Soln.: (3)**

$$\text{Force due to gravity: } \frac{GMm}{R^2}$$

$$\therefore \text{B has more mass } F_B > F_A$$

4. **Soln.: (3)**

$$N - mg = ma$$

$$\Rightarrow N = m(a + g)$$

$$\Rightarrow N = 2(10 + 10) = 40\text{N}$$

5. **Soln.: (4)**

$$\text{Since force average} = \frac{\text{change in momentum}}{\text{time taken}}$$

We need values of α & β to comment on Force, hence not enough data

6. **Soln.: (2)**

In case B, friction will act less $\therefore$ normal is reduced. Hence case B is easier

7. **Soln.: (1)**

$$T = 10$$

$$\omega = \frac{2\pi}{10} \Rightarrow v = r\omega = 5 \times \frac{2\pi}{10} = \pi \text{ m/s}$$

$$S = v \times 1 = \pi \text{ m}$$

$$W = F \cdot S = 15\pi \text{ J}$$

8. **Soln.: (2)**

The body moves from (3, 4, 5) to (5, 6, 3)

So, **displacement vector**

$$\vec{d} = (5-3)\hat{i} + (6-4)\hat{j} + (3-5)\hat{k} = 2\hat{i} + 2\hat{j} - 2\hat{k}$$

Forces:

$$\vec{F}_1 = 3\hat{i} + 4\hat{j} + 5\hat{k}$$

$$\vec{F}_2 = 5\hat{i} + 6\hat{j} + 3\hat{k}$$

$$\vec{F}_3 = \hat{i} + \hat{j} + \hat{k}$$

Formula for Work Done: $W = \vec{F} \cdot \vec{d}$ For $\vec{F}_1$:

$$W_1 = (3)(2) + (4)(2) + (5)(-2)$$

$$W_1 = 6 + 8 - 10 = 4$$

For $\vec{F}_2$:

$$W_2 = (5)(2) + (6)(2) + (3)(-2)$$

$$W_2 = 10 + 12 - 6 = 16$$

For $\vec{F}_3$:

$$W_3 = (1)(2) + (1)(2) + (1)(-2)$$

$$W_3 = 2 + 2 - 2 = 2$$

 $\therefore W_2$ is highest9. **Soln.: (3)**

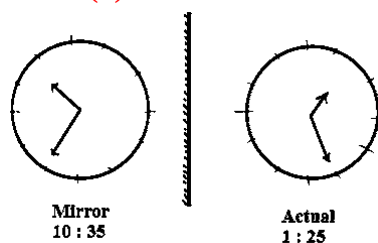
$$W = |\vec{F}| |\vec{S}| \cos \theta$$

$$= 100 \cos \theta$$

This can vary from -100 to $+100$ $\therefore +110 \text{ J}$ is not possible10. **Soln.: (1)**

$$\sum W = \Delta KE = \frac{1}{2} m (v_f^2 - v_i^2) = 2(16 - 4)$$

$$= 24 \text{ J}$$

11. **Soln.: (2)**12. **Soln.: (1)**

$$\delta = \pi - 2i$$

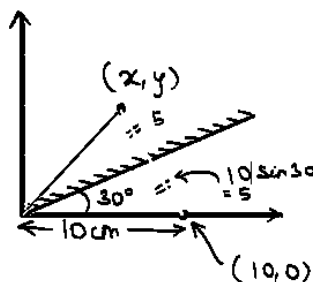
$$\Rightarrow i = \pi - 2i \quad (\because \delta = i)$$

$$\Rightarrow 3i = \pi$$

$$\Rightarrow i = \frac{\pi}{3} \quad \text{or} \quad 60^\circ$$

13. **Soln.: (3)**
Standard result; $\delta = 360^\circ - 2\theta$

14. **Soln.: (4)**
 $y = 10 \cos 30$
 $= 5\sqrt{3}$
 $x = 10 \sin 30$
 $= 5$
 Ans $(5, 5\sqrt{3})$



15. **Soln.: (3)**
Frequency don't change when light goes from one medium to other, its speed and wavelength changes.

Chemistry

16. **Soln.: (2)**
The correct order of increasing reactivity of halogens is $I_2 < Br_2 < Cl_2$
As you move down the halogen group on the periodic table, the reactivity of the halogens decreases. This is because the size of the halogen atom increases, which weakens the bond between the halogen atoms and makes it easier to break them apart and react with other substances. Therefore, iodine (I_2) is the least reactive, followed by bromine (Br_2), and then chlorine (Cl_2).
17. **Soln.: (1)**
MgO (Magnesium Oxide): This is a typical metal oxide and is considered highly basic due to the electropositive nature of Magnesium. It reacts readily with water to form a strong base, magnesium hydroxide
18. **Soln.: (2)**
This is a double displacement reaction because the two compounds, silver nitrate ($AgNO_3$) and sodium chloride ($NaCl$), exchange their ions (Ag^+ swaps with Na^+) to form two new compounds, silver chloride ($AgCl$) and sodium nitrate ($NaNO_3$). Silver chloride forms as an insoluble precipitate.
19. **Soln.: (2)**
As you move across a period on the periodic table, the number of protons in the nucleus increases, which leads to a stronger attraction between the nucleus and the electrons, causing the atom to become smaller
20. **Soln.: (4)**
The colour change observed when ferrous sulphate crystals are heated is due to all of these
The heating process involves two distinct stages of colour change
1. Loss of water of crystallization: initially the pale green hydrated ferrous sulphate crystals ($Fe_2SO_4 \cdot 7H_2O$) lose their water molecules upon gentle heating, forming white or greyish – white anhydrous ferrous sulphate ($FeSO_4$)

$$1. Fe_2SO_4 \cdot 7H_2O(s) \xrightarrow{\text{heat}} FeSO_4(s) + 7H_2O(g)$$

 2) Formation of Fe_2O_3 and Liberation of SO_2 (and SO_3): On further strong heating the anhydrous ferrous sulphate decomposes to form a reddish brown solid residue, ferric oxide (Fe_2O_3), and liberates sulfur dioxide (SO_2) and sulfur trioxide (SO_3) gases.

$$1. 2FeSO_4(s) \xrightarrow{\text{heat}} Fe_2O_3(s) + SO_2(g) + SO_3(g)$$

 The overall change in colour from green to white and then to reddish – brown is a result of all these steps occurring in sequence.

21. **Soln.: (2)**
Aluminum (Al) has a +3 valency, and oxygen (O) has a -2 valency, so the charges balance out to form a neutral compound with two aluminum atoms and three oxygen atoms.
22. **Soln.: (1)**
A combination reaction is defined as two or more reactants combining to form a single product. In this reaction, hydrogen gas (H₂) and oxygen gas (O₂) combine to form water (H₂O), satisfying the criteria for a combination reaction.
23. **Soln.: (1)**
When lead (II) nitrate is heated, it undergoes thermal decomposition to produce lead (II) oxide, nitrogen dioxide gas, and oxygen gas:
$$2\text{Pb}(\text{NO}_3)_2(\text{s}) \xrightarrow{\text{heat}} 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$$

The gas that is reddish-brown and has an irritating smell is nitrogen dioxide (NO₂). Nitrogen dioxide is an acidic oxide, and when it dissolves in the moisture on the litmus paper, it forms an acid (nitrous and nitric acid) which turns moist blue litmus paper red.
Therefore, the gas evolved that turns moist blue litmus paper red is NO₂.
24. **Soln.: (3)**
An amphoteric oxide can act as both an acid and a base, and aluminum oxide (Al₂O₃) exhibits this behavior.
25. **Soln.: (2)**
Melting of ice is a physical change because the state of the water changes from solid to liquid, but the chemical composition remains the same. Rusting of iron, burning of magnesium, and cooking food are all chemical changes as they involve the formation of new substances with different chemical properties.
26. **Soln.: (3)**
They have one valence electron
Group 1 elements, also known as alkali metals, have only one electron in their outermost shell.
27. **Soln.: (2)**
A double displacement reaction is a reaction where the cations (positively charged ions) and anions (negatively charged ions) of two compounds switch places, forming two new compounds.
The sodium (Na⁺) and barium (Ba²⁺) cations switch places, resulting in the formation of barium sulfate (BaSO₄) and sodium chloride (NaCl).
28. **Soln.: (2)**
As you move down a group on the periodic table, the atomic radius increases. This means the valence electrons are further away from the nucleus, making it less likely for them to attract additional electrons and form bonds. This decrease in the tendency to gain electrons corresponds to a decrease in reactivity.
29. **Soln.: (3)**
In a chemical reaction, two or more substances combine to form a new substance with different properties than the original reactants. This new substance is called a compound. A compound is formed when the elements involved are chemically bonded together.
30. **Soln.: (1)**
“4th is also balanced but not the simplest whole-number ratio. Therefore, 1st is the correct and simplest balanced chemical equation”

Biology

31. **Soln.: (4)**
Auxin is a plant hormone that plays a crucial role in the regulation of plant growth and directional responses to light (phototropism) and gravity (geotropism).
32. **Soln.: (2)**
The pancreas produces insulin, a hormone vital for regulating blood glucose levels by facilitating the uptake of glucose into cells and reducing blood sugar levels.
33. **Soln.: (2)**
Pollen grains, produced in the anthers of flowering plants, carry the male gametes required for fertilization. They transfer genetic material to the ovules in the ovary.
34. **Soln.: (1)**
Vitamin K is crucial for synthesizing proteins involved in blood clotting, helping to prevent excessive bleeding during injuries by promoting clot formation.
35. **Soln.: (4)**
The combination of sex chromosomes determines the baby's gender, Females have XX chromosomes, while males have XY chromosomes, with the father's contribution deciding the outcome
36. **Soln.: (4)**
A gene is the smallest unit of heredity, found on chromosomes. It carries the instructions for specific traits and is made up of DNA.
37. **Soln.: (2)**
A food chain represents the flow of energy in an ecosystem, where one organism eats another, transferring energy from producers to consumers and finally to decomposers.
38. **Soln.: (1)**
Villi are finger – like projections in the small intestine that increase the surface area for maximum absorption of nutrients from digested food into the bloodstream.
39. **Soln.: (3)**
Cellular respiration is a metabolic process in cells where glucose is broken down in the presence of oxygen to produce ATP, the energy required for cellular activities.
40. **Soln.: (2)**
Stomata are tiny pores on leaf surfaces that facilitate the exchange of gases, allowing plants to absorb carbon dioxide and release oxygen and water vapor during photosynthesis and respiration.
41. **Soln.: (4)**
Yeast reproduces asexually through budding, where a new cell develops as an outgrowth of a parent cell and eventually detaches to form an independent organism.
42. **Soln.: (3)**
Life processes refer to basic activities required for the survival of living organisms, such as nutrition, respiration, transport, excretion, and reproduction.
43. **Soln.: (1)**
Binary fission is a simple asexual reproduction method where a single organism splits into two identical daughter organisms, commonly seen in bacteria.

44. **Soln.: (2)**
A dominant trait is visible when a dominant allele is present, even if the organism is heterozygous (has one dominant and one recessive allele).
45. **Soln.: (1)**
Decomposers, such as fungi and bacteria, play an essential role in breaking down dead and decaying organic matter, recycling nutrients back into the ecosystem.
46. **Soln.: (4)**
Alveoli are microscopic air sacs in the lungs where oxygen diffuse into the blood and carbon dioxide is expelled, making them the primary site for gas exchange.
47. **Soln.: (1)**
The epiglottis is a flap – like structure that covers the windpipe (trachea) when swallowing ensuring that food enters the esophagus instead of the respiratory tract.
48. **Soln.: (4)**
ATP (Adenosine Triphosphate) stores and releases energy for various cellular activities, making it the primary energy currency in living organisms.
49. **Soln.: (2)**
The anther is a part of the stamen in flowers, containing pollen grains that produce male gametes (sperm cells) for reproduction.
50. **Soln.: (4)**
Alleles are variations of a gene located at the same position on homologous chromosomes. These variation can result in different traits, such as flower color or eye color.