1. LAW OF CHEMICAL EQUATIONS

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. In a chemical reaction, 100 g of lead nitrate reacts with 60 g of potassium iodide to produce 85 g of lead iodide and ___ g of potassium nitrate.
A)75 g B) 65 g C) 55 g D) 85 g

Answer:A

Solution: $Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$

Masses:$Pb(NO_3)_2$=100g
KI=60g
PbI_2=85g
Solution:
Law of Conservation of Mass:
Mass of reactants=Mass of products
100g+60g=85g+Mass of KNO_3
Mass of KNO_3=160g-85g=75g.

2. Iron reacts with sulfur to form iron sulfide. If 56 g of iron reacts with 32 g of sulfur, but after reaction, only 80 g of iron sulfide is measured, which best explains the result?
A)Measurement error. B)Gas escaped during reaction.
C)Matter was destroyed. D)Iron sulfide decomposed.

Answer:B

Solution:$Fe+S \rightarrow FeS$
Expected mass of
FeS=56g+32g=88g.
Actual mass = 80 g.
Explanation:
B) Gas escaped during reaction (Sulfur can form gaseous byproducts like SO_2).

3. A reaction between barium chloride and sodium sulfate produces barium sulfate and sodium chloride. If you start with 233 g of barium chloride and 142 g of sodium sulfate, what total mass of products should you expect?
A)375 g B) 400 g C) 375.5 g D) 380 g

Answer:A

Solution: $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + NaCl$ 2

Total mass of products = Mass of reactants

233g+142g=375g.
4. A student heats 10 g of calcium carbonate and produces 5.6 g of calcium oxide. What mass of carbon dioxide gas is released?
A)4.4 g B) 5.6 g C) 10 g D) 15.6 g
Answer:A

Solution: $CaCO_3 \rightarrow CaO + CO_2$

Masses:$CaCO_3$=10g ,CaO=5.6g
Solution:Mass of CO_2:10g-5.6g=4.4g.
5. When 4 g of hydrogen burns with 32 g of oxygen, it produces water. According to the law of conservation of mass, what mass of water is produced?
A)28 g B) 32 g C) 36 g D) 40 g
Answer:C

Solution: $2H_2 + O_2 \rightarrow 2H_2O$

Masses:H_2=4g,O_2=32g
Total mass of water:4g+32g=36g.
Law of Definite Proportions:
6. Which best describes the law of definite proportions?
A)A compound always has the same mass ratio of elements.
B)Compounds form in multiple mass ratios.
C)Mass is conserved in reactions.
D)Gases combine in simple volume ratios.
Answer:A
Solution:A given compound always contains exactly the same proportion of elements by mass, regardless of the source or method of preparation.
7. In carbon dioxide (CO_2), carbon and oxygen always combine in a mass ratio of 12:32. If you have 24 g of carbon, how much oxygen is needed?
A)24 g B) 48 g C) 64 g D) 96 g
Answer:C
Solution:Mass ratio C:O=12:32.

For 24 g C:Mass of O= $24 \times \frac{32}{12}$ g

8. 100 g of pure water contains 11.1 g hydrogen and 88.9 g oxygen. If you have 200g of water, how much oxygen will it contain?
A)44.4 g B) 88.9 g C) 177.8 g D) 100 g
Answer:C
Solution:H_2O has H:O=11.1:88.9.

For 200 g H_2O:Mass of O= $200 \times \frac{88.9}{100}$ g

9. Which pair of samples shows the law of definite proportions?
A)Two samples of NaCl from different sources.

B)Two samples of CO and CO_2.
C)Hydrogen gas and oxygen gas.
D)Carbon and sulfur mixture.
Answer:A
Solution: Two samples of NaCl from different sources (NaCl always has 39.3% Na and 60.7% Cl by mass).
Law of Multiple Proportions:
10. Which statement explains the law of multiple proportions?
A)Elements combine in different simple ratios to form different compounds.
B)Compounds have fixed mass ratios.
C)Gases combine in equal masses.
D)Atoms cannot be divided.
Answer:A
Solution:The law of multiple proportions states that when two elements form more than one compound, the masses of one element combining with a fixed mass of the other are in a simple whole-number ratio.
11. Carbon and oxygen form CO and CO_2. For the same mass of carbon, CO has 16 g O,CO_2 has 32 g O. What is the ratio of oxygen masses?
A) 1:1 B) 1:2 C) 2:1 D) 1:3
Answer:B
Solution:CO: 16 g O per fixed mass of C.
CO_2: 32 g O per the same mass of C.
Ratio: 16:32=1:2.
12. Nitrogen forms two oxides:
NO $\rightarrow$14 g N + 16 g O
N_2O_3 $\rightarrow$28 g N + 48 g O
If nitrogen increases from 14 g to 28 g when forming N_2O_3, how much oxygen is added in comparison to NO?
A) 16 g B)32 g C) 48 g D) 64 g
Answer:B
Solution:NO: 16 g O per 14 g N.
N_2O_3: 48 g O per 28 g N.
For 28 g N in NO: 16×2=32 g O.
Added O in N_2O_3: 48-32=16 g (per 14 g N) $\rightarrow$ 32 g for 28 g N.
13. What is the ratio of oxygen combining with same mass nitrogen?
A) 1:2 B) 2:1 C) 3:2 D) 1:3
Answer:C
Solution:NO: 16 g O per 14 g N.
N_2O_3: 48 g O per 28 g N $\rightarrow$24 g O per 14 g N.
Ratio: N_2O_3:NO=24:16=3:2
14. Sulfur combines with oxygen to form SO_2 and SO_3. For the same mass of sulfur, oxygen masses are 32 g and 48 g. What is the mass ratio?
A) 2:3 B) 1:2 C) 1:3 D) 3:2
Answer:A
Solution:SO_2: 32 g O.

SO_3: 48 g O.
Ratio: 32:48=2:3.
15. Which pair demonstrates the law of multiple proportions?
A)H_2O and H_2O_2 B)NaCl and NaOH C)$CaCl_2$ and HCl D)FeS and $FeCl_3$
Answer:A
Solution:H_2O: 16 g O per 2 g H.
H_2O_2: 32 g O per 2 g H.
Oxygen ratio: 16:32=1:2 (simple whole-number ratio).
Law of Reciprocal Proportions:
16. Which statement defines the law of reciprocal proportions?
A) Elements that combine separately with a third element will combine with each other in the same or simple ratio.
B) Compounds have fixed mass ratios.
C) Mass is conserved during reactions.
D) Gases combine in simple volume ratios.
Answer:A
Solution:The law of reciprocal proportions states that if two elements (e.g., A and B) combine separately with a fixed mass of a third element (e.g., C), their mass ratio in the compound A-B will be the same or a simple multiple of their ratios with C.
17. Hydrogen combines with oxygen (H_2O) and with chlorine (HCl). Oxygen and chlorine combine to form Cl_2O. According to the law, their mass ratio in Cl_2O is related to:
A) How they combine with hydrogen. B) Their individual masses.
C) Their atomic numbers. D) None.
Answer:A
Solution:H_2O: 1 g H : 8 g O.
HCl: 1 g H : 35.5 g Cl.
Cl_2O mass ratio (O:Cl): Should be a simple ratio of their masses with hydrogen $\rightarrow$ 8 : 35.5 (or simplified).
18. Given:
1g H + 8 g O $\rightarrow$ H_2O
1g H + 35.5 g Cl $\rightarrow$HCl
What mass ratio will oxygen and chlorine combine in?
A)1:8 B)8:35.5 C)1:35.5 D)35.5:8
Answer:B
Solution:Reciprocal proportion: The ratio of O:Cl in Cl2O is the same as their ratios with H $\rightarrow$ 8 g O : 35.5 g Cl.
19. Carbon combines with oxygen and with sulfur. Oxygen and sulfur combine to form SO_2. According to the law of reciprocal proportions, the mass ratio of S:O in SO_2 should relate to:
A)How carbon combines with oxygen and sulfur.
B)How sulfur combines with oxygen only.
C)How carbon and sulfur combine only. D)None of the above.
Answer:A
Solution:The law of reciprocal proportions connects the ratios of C-O, C-S, and S-O combinations.

Mixed Complex Questions:

20. Which set of laws explain that:
A compound has fixed mass ratios, Same elements can form multiple compounds, and Combinations follow simple whole-number relationships?
A)Only definite and multiple proportions
B)Only reciprocal proportions
C)All three: definite, multiple, and reciprocal
D)Only conservation of mass

Answer:C

Solution:Definite proportions: Fixed mass ratios in a compound.
Multiple proportions: Simple ratios in different compounds.
Reciprocal proportions: Relates ratios across multiple element combinations.

21. A compound of A and B contains 40 g A and 60 g B. Another compound contains 40g A and 120 g B. Which law explains the mass ratio between B in both compounds?
A)Law of definite proportions
B)Law of multiple proportions
C)Law of reciprocal proportions
D)Law of conservation of mass

Answer:B

Solution:The law of multiple proportions explains the simple ratio (1:2) of B masses (60 g vs. 120 g) for the same mass of A (40 g).

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

22. In a closed system, which situations follow the law of conservation of mass?
A) Vinegar and baking soda react, and the total mass of the system stays the same.
B) Hydrogen and oxygen gases combine to form water with the same totalmass.
C) Heating calcium carbonate leads to calcium oxide and carbon dioxide, with total mass equal to the original.
D) Gas escapes during a reaction, so the measured mass decreases.

Answer:A,B,C

Solution:A, B, C: In a closed system, no mass is lost (even gases are contained).
D: Incorrect because escaping gas violates mass conservation in an open system.

23. Which of the following examples obey the law of definite proportions?
A) 100 g of pure water contains 11.1 g hydrogen and 88.9 g oxygen.
B) Sodium chloride from sea salt and from rock salt has the same Na:Cl ratio.
C) CO and CO_2 both have the same carbon-to-oxygen mass ratio.
D) 20 g of CaCO3 from shells and 20 g from limestone both have the same Ca:C:O ratio.

Answer:A,B,D

Solution:A, B, D: Demonstrate fixed mass ratios in compounds (H_2O, NaCl, $CaCO_3$).

C: Incorrect because CO and CO_2 have different C:O ratios (12:16 vs. 12:32).
24. Which experimental findings support the law of multiple proportions?
A) 12 g of carbon combines with 16 g of oxygen to form CO.
B) 12 g of carbon combines with 32 g of oxygen to form CO_2.
C) Oxygen-to-carbon ratios in CO and CO_2 are related by a simple 1:2 ratio.
D) Hydrogen and oxygen combining to form only H_2O.

Answer:A,B,C

Solution:A, B, C: Show simple whole-number ratios (16:32 = 1:2 for O in CO vs. CO_2).
D: Incorrect because it describes one compound only, not multiple ratios.

Assertion and Reason Type:

25. Assertion : According to the law of reciprocal proportions, oxygen and chlorine, which both combine with hydrogen, should combine in a mass ratio related to their separate combinations with hydrogen.
Reason : The law of reciprocal proportions does not apply to compounds where the same element is repeated.

Answer:C

Solution: Assertion is correct.
Law of Reciprocal Proportions states:When two elements (like oxygen and chlorine) separately combine with a fixed mass of a third element (like hydrogen), the ratio in which they combine with each other is either the same or a simple multiple of the ratio in which they combine with the third element.
So yes, oxygen and chlorine (each forming compounds with hydrogen like H_2O and HCl) should combine with each other (to form Cl_2O, for example) in a mass ratio that reflects their combinations with hydrogen.
Reason (R): incorrect.
“The law of reciprocal proportions has nothing to do with whether elements repeat or not. It simply relates the mass ratios of how different elements combine with a common element and then with each other.

Comprehension Type:

26. Compound A contains 36% A and 64% B. Compound B contains 27% A and 73% B. According to the law of multiple proportions, the ratio of the mass of B in compound A to that in compound B is:
A) 1:2 B) 2:1 C) 2:3 D) 3:4

Answer:C

Solution:For Compound A:A = 36 g, B = 64 g $\rightarrow$B/A = 64/36 = 1.78
For Compound B:A = 27 g, B = 73 g $\rightarrow$ B/A = 73/27 = 2.70
Take the ratio of mass of B that combines with same mass of A
Let’s calculate:

Ratio= $\frac{64/36}{73/27} = \frac{1.78}{2.70} = 0.66$

Now simplify: $\frac{0.66}{0.66} = \frac{1}{1.73}$

27. The % of carbon in carbon monoxide (CO) and carbon dioxide (CO_2) is 42.9% and 27.3%, respectively. This illustrates the law of:
A) Constant Proportions B) Conservation of Mass
C) Multiple Proportions D) Reciprocal Proportions
Answer:C
Solution:CO: 12 g C : 16 g O $\rightarrow$42.9% C.
CO_2: 12 g C : 32 g O $\rightarrow$ 27.3% C.
Oxygen ratio for fixed C (12 g): 16 g : 32 g = 1:2 (simple whole-number ratio).
This demonstrates the law of multiple proportions.
Integer Type:
28. Molecular weight of Calcium Sulphate is _____
Answer:136
Solution:$CaSO_4$=40+32+4(16)=72+64=136g
29. Atomic weight of Copper is _____
Answer:63.5
Solution:There are two stable isotopes of copper, but the standard atomic weight is:63.5
Matrix Matching Type:
30.**Answer:A-1,B-2,C-3,D-4**
Solution:

Column A (Ex amples)	Column B (Related Law)
A) 18 g H_2O $\rightarrow$ 2 g H + 16 g O (1:8 mass ratio)	1) Law of Definite Proportions
B) CO and CO_2 $\rightarrow$ oxygen combines with fixed carbon mass in 1:2 ratio	2) Law of Multiple Proportions
C) S + O, S + Cl, O + Cl mass relationships match	3) Law of Reciprocal Proportions
D) Burning wood: mass of products equals mass of reactants (in closed system)	4) Law of Conservation of Mass

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LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)
1. What is the molecular mass of CO_2 (C = 12, O = 16)?
A)28 amu B)32 amu C)44 amu D)52 amu
Answer:C
Solution:Carbon (C) = 12 amu
Oxygen (O) = 16 amu
CO_2 has 1 C atom and 2 O atoms.
Calculation:
Molecular mass = (1 × C) + (2 × O)
= (1 × 12) + (2 × 16)
= 12 + 32
= 44 amu
2. Why is it important to balance chemical equations?

A)To follow the law of conservation of massB)To change the types of atoms
C)To create new atoms D)To follow the law of definite proportion

Answer:A

Solution:Balancing ensures that the number of atoms of each element is the same on both sides, following the Law of Conservation of Mass (matter cannot be created or destroyed in a chemical reaction).

3. If H = 1, O = 16, what is the molecular mass of H_2O_2 (hydrogen peroxide)?
A)34 B)36 C)32 D)30

Answer:A

Solution:Given:
Hydrogen (H) = 1 amu
Oxygen (O) = 16 amu
H_2O_2 has 2 H atoms and 2 O atoms.
Molecular mass = (2 × H) + (2 × O)
= (2 × 1) + (2 × 16)
= 2 + 32
= 34 amu

4. When balancing an equation between a metal and nonmetal, which is usually balanced first?
A)Metal B)Nonmetal
C)The one with higher atomic mass D)The one with lower atomic number

Answer:A

Solution:Metals are usually balanced first because they often appear in fewer compounds and are easier to adjust.

5. How many nitrogen (N) atoms are there after balancing this reaction?
$N_2 + H_2 \rightarrow NH_3$
A) 1 B) 2 C) 3 D) 4

Answer:B

Solution:Balanced Reaction: $N_2 + 3H_2 \rightarrow 2NH_3$
Before balancing: 2 N atoms (in N_2).
After balancing: 2 N atoms (in $2NH_3$).

6. How many oxygen atoms are there after balancing this reaction?
$CH_4 + O_2 \rightarrow CO_2 + H_2O$
A)2 B)4 C)6 D)8

Answer:B

Solution:Balanced Reaction:$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$
Oxygen atoms on the product side:
$CO_2 \rightarrow$ 2 O atoms
$2H_2O \rightarrow 2 \times 1 = 2$ O atoms
Total O atoms = 2 + 2 = 4

7. In the equation: $2Na + Cl_2 \rightarrow 2NaCl$, which substance is a reactant?
Sodium chloride (NaCl)
A)Sodium (NA) B)Chlorine (Cl_2) C)Both 2 and 3 D)None

Answer:C

Solution:Reactants are the starting substances (left side of the equation).
Here, Na (Sodium) and Cl_2 (Chlorine gas) are reactants.

8. The molecular weight of glucose ($C_6H_{12}O_6$) is:

A) 98 amu B) 100 amu C) 158 amu D) 180 amu

Answer:D

Solution:Given:

C = 12 amu

H = 1 amu

O = 16 amu

Molecular mass = (6 × C) + (12 × H) + (6 × O)

= (6 × 12) + (12 × 1) + (6 × 16)

= 72 + 12 + 96

= 180 amu

JEE MAINS LEVEL QUESTIONS

Single Answer Type:

9. If 12 g of carbon reacts with 32 g of oxygen to form carbon dioxide, what is the total mass of carbon dioxide produced?

A)12 g B) 32 g C) 44 g D) 20 g

Answer:C

Solution:Given:

Mass of carbon (C) = 12 g

Mass of oxygen (O_2) = 32 g

Reaction:

$C + O_2 \rightarrow CO_2$

Law of Conservation of Mass:

Total mass of reactants = Total mass of products

12 g (C) + 32 g (O2) = 44 g (CO_2)

10. Magnesium burns in oxygen to form magnesium oxide. If 24 g of magnesium reacts completely and forms 40 g of magnesium oxide, how much oxygen was used?

A)12 g B) 16 g C) 20 g D) 24 g

Answer:B

Solution:Given:

Mass of magnesium (Mg) = 24 g

Mass of magnesium oxide (MgO) = 40 g

Law of Conservation of Mass:

Mass of Mg + Mass of O_2 = Mass of MgO

24 g + O_2 = 40 g

O_2 = 40 g – 24 g = 16 g

11. Hydrogen reacts with chlorine to form hydrogen chloride. If 2 g of hydrogen combines with 71 g of chlorine, what is the mass of hydrogen chloride formed?

A)73 g B) 70 g C) 69 g D) 75 g

Answer:A

Solution:Given:

Mass of hydrogen (H_2) = 2 g

Mass of chlorine (Cl_2) = 71 g

Reaction:$H_2 + Cl_2 \rightarrow 2HCl$

Law of Conservation of Mass:Mass of H_2 + Mass of Cl_2 = Mass of HCl

2 g + 71 g = 73 g HCl

12. Zinc reacts with dilute hydrochloric acid to produce zinc chloride and hydrogen gas. If 65 g of zinc reacts and produces 2 g of hydrogen gas, what is the mass of zinc chloride formed?
A)63 g B) 65 g C) 67 g D) 70 g

Answer:A

Solution:Given:
Mass of zinc (Zn) = 65 g
Mass of hydrogen gas (H_2) produced = 2 g
Reaction: $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
Law of Conservation of Mass:
Mass of Zn + Mass of HCl = Mass of $ZnCl_2$ + Mass of H_2
Since HCl is in excess, we focus on Zn and products:
65 g (Zn) = Mass of $ZnCl_2$ + 2 g (H_2)
Mass of $ZnCl_2$ = 65 g – 2 g = 63 g

13. If 50 g of calcium reacts with 50 g of oxygen to form calcium oxide, but only 80 g of calcium oxide is collected, what happened?
A)Mass was lost to gases. B)Mass was lost to surroundings.
C)Some product was not collected. D)Mass conservation does not apply.

Answer:C

Solution:Given:
Mass of calcium (Ca) = 50 g
Mass of oxygen (O_2) = 50 g
Mass of calcium oxide (CaO) collected = 80 g
Expected Mass of CaO (Law of Conservation of Mass):
50 g (Ca) + 50 g (O_2) = 100 g (CaO)
But only 80 g was collected:
The missing mass (20 g) suggests some product was not collected (e.g., lost as gas or left in the container).

Law of Definite Proportions:

14. Which law states that a given compound always contains the same elements combined in the same fixed mass ratio?
A) Law of definite proportions B) Law of multiple proportions
C) Law of reciprocal proportions D) Law of conservation of mass

Answer:A

Solution:Law of Definite Proportions (Proust's Law):
A pure compound always has the same elements in the same fixed mass ratio, regardless of its source or method of preparation.

15. Water (H_2O) always contains hydrogen and oxygen in the ratio 1:8 by mass. How much oxygen will combine with 10 g of hydrogen?
A) 20 g B) 40 g C) 80 g D) 100 g

Answer:C

Solution:Given:Mass ratio of H : O in H_2O = 1 : 8
Mass of hydrogen = 10 g
Calculation:Since 1 g H combines with 8 g O,
10 g H will combine with = 10 × 8 = 80 g O

16. Two samples of calcium carbonate, one from seashells and one from limestone,are analyzed. Both show 40% calcium, 12% carbon, and 48% oxygen by mass.
This is an example of:
A) Law of definite proportions B) Law of multiple proportions
C) Law of reciprocal proportions D) Law of constant volume
Answer:A
Solution:Both samples have the same mass ratios of Ca : C : O (40:12:48), regardless of their source.
This illustrates the Law of Definite Proportions.
17. If 20 g of ammonia (NH_3) contains 17 g nitrogen and 3 g hydrogen, how much nitrogen is present in 100 g of ammonia?
A) 17 g B) 34 g C) 85 g D) 68 g
Answer:C
Solution:Given:
In 20 g NH_3:N = 17 g,H = 3 g
Mass ratio of N : H = 17 : 3
Calculation for 100 g NH_3:
Since the ratio is fixed (Law of Definite Proportions),
Nitrogen mass = (17 g N / 20 g NH_3) × 100 g NH_3 = 85 g N
Law of Multiple Proportions:
18. Which law explains that when two elements form more than one compound, the masses of one element combining with a fixed mass of the other are in simple whole-number ratios?
A) Law of definite proportions B) Law of multiple proportions
C) Law of reciprocal proportions D) Law of partial pressure
Answer:B
Solution:Law of Multiple Proportions (Dalton's Law):
When two elements form different compounds, the mass ratios of one element (per fixed mass of the other) are in small whole numbers.
19. Consider two compounds:
$CO \rightarrow$ 12 g C + 16 g O
$CO_2 \rightarrow$ 12 g C + 32 g O
What is the mass ratio of oxygen in these two compounds?
A) 1:1 B) 1:2 C) 2:1 D) 3:2
Answer:B
Solution:Given:For CO, O = 16 g per 12 g C.
For CO_2, O = 32 g per 12 g C.
Ratio of O (CO : CO_2): 16 g : 32 g = 1 : 2
20. Nitrogen and oxygen form NO and NO_2. For the same mass of nitrogen, the mass of oxygen is in the ratio:
A) 1:1 B) 1:2 C) 2:1 D) 1:3
Answer:B
Solution:Assume 14 g N (fixed mass) for simplicity:
NO: 14 g N + 16 g O $\rightarrow$ O = 16 g

NO_2: 14 g N + 32 g O $\rightarrow$ O = 32 g
Ratio of O (NO : NO_2): 16 g : 32 g = 1 : 2
21. Which of the following pairs follows the law of multiple proportions?
A) H_2O and H_2O_2 B) NaCl and NaBr
C) $CaCO_3$ and $CaCl_2$ D) KOH and NaOH
Answer:A
Solution:A) H_2O and H_2O_2:
H_2O: 2 g H + 16 g O $\rightarrow$ O/H = 8
H_2O_2: 2 g H + 32 g O $\rightarrow$ O/H = 16
Ratio = 8:16 = 1:2 (Simple whole number).
B) NaCl and NaBr: Different elements (Cl vs. Br).
C) $CaCO_3$ and $CaCl_2$: Different elements (CO_3 vs. Cl).
D) KOH and NaOH: Different elements (K vs. Na).
Law of Reciprocal Proportions:
22. Which law says that if element A combines with elements B and C separately, then B and C will combine in the same or a simple multiple mass ratio?
A) Law of definite proportions B) Law of multiple proportions
C) Law of reciprocal proportions D) Law of constant composition
Answer:C
Solution:Law of Reciprocal Proportions (Richter's Law):
When two elements (B and C) separately combine with a fixed mass of a third element (A), the ratio of their masses in the compound formed by B and C will be the same or a simple multiple of the ratio observed in their individual combinations with A.
23. Hydrogen combines with oxygen (H_2O) and with sulfur (H_2S). According to the law of reciprocal proportions, oxygen and sulfur will combine in a mass ratio related to:
A) How they combine with hydrogen B) Their atomic weights
C) Their atomic numbers D) Their densities
Answer:A
Solution:The law states that the ratio of O:S in their own compound (e.g., SO_2) will relate to how they individually combined with hydrogen (H_2O and H_2S).
24. Given:
H + O $\rightarrow$ H_2O (1 g H + 8 g O)
H + S $\rightarrow$ H_2S (1 g H + 16 g S)
According to the law of reciprocal proportions, what is the mass ratio between oxygen and sulfur when they combine?
A) 1:2 B) 2:1 C) 8:16 D) 16:8
Answer:A
Solution:Fix the mass of H (1 g) and note the masses of O and S that combine with it:O : H = 8 : 1
S : H = 16 : 1
Ratio of O : S when they combine with each other (SO2) should be a simple multiple of their ratios with H:
O/S = (8/1) ÷ (16/1) = 1/2
O:S = 1:2 (e.g., in SO_2, 32 g S combines with 32 g O, simplifying to 1:1 by atoms but 1:2 by mass ratios from H-compounds).

25. Carbon combines with sulfur and oxygen. Sulfur and oxygen also combine to form SO_2. According to the law, which relationship holds?
A) The S:O ratio in SO_2 relates to how C combines with S and O
B) The S:O ratio is unrelated to other compounds
C) The S:O ratio depends only on molecular weight
D) None of the above
Answer:A
Solution:The Law of Reciprocal Proportions states that the S:O ratio in SO_2 should relate to how C combines with S and O individually.
Mixed Challenge Questions:
26. If 40 g of element A reacts with 60 g of element B to form compound AB, what mass of compound AB will be formed?
A) 60 g B) 40 g C) 100 g D) 120 g
Answer:C
Solution:Given: Mass of A = 40 g
Mass of B = 60 g
Law of Conservation of Mass:
Total mass of reactants = Total mass of products
Mass of AB = 40 g (A) + 60 g (B) = 100 g
27. Two oxides of iron contain:
First: 56 g Fe + 16 g O
Second: 56 g Fe + 24 g O
What is the mass ratio of oxygen combining with the same iron mass?
A) 1:2 B) 2:3 C) 3:2 D) 1:1
Answer:B
Solution:Oxygen masses = 16 g vs. 24 g
Ratio = 16 : 24 = 2 : 3
28. A student claims that in a chemical reaction, the mass of products is always greater than the mass of reactants. Which law disproves this claim?
A) Law of definite proportions B) Law of multiple proportions
C) Law of reciprocal proportions D) Law of conservation of mass
Answer:D
Solution:Law of Conservation of Mass:
Mass is neither created nor destroyed in a chemical reaction. The total mass of reactants equals the total mass of products.

JEE ADVANCED LEVEL QUESTIONS

Multi correct answer type:

29. Which experimental observations support the law of conservation of mass?
A) Burning magnesium in air shows the combined mass of magnesium and oxygen equals the mass of magnesium oxide formed.
B) When ice melts, the mass remains the same before and after melting.
C) When sugar dissolves in water, the total mass remains unchanged.
D) The ash left after burning wood weighs the same as the original wood.
Answer:A,B,C
Solution:Correct Answers:
A) Burning magnesium in air shows the combined mass of magnesium and oxygen equals the mass of magnesium oxide formed.

(Mass of reactants (Mg + O_2) = Mass of product (MgO).)
B) When ice melts, the mass remains the same before and after melting.
(Physical change, no mass loss/gain.)
C) When sugar dissolves in water, the total mass remains unchanged.
(Dissolution is a physical process; mass is conserved.)
Incorrect Answer:
D) The ash left after burning wood weighs the same as the original wood.
(False: Burning wood releases CO_2 and H_2O as gases, reducing the mass of ash.)
30. Which statements correctly reflect the importance of the law of definite proportions?
A) It shows that chemical compounds have constant composition.
B) It helps calculate the chemical formula of a compound.
C) It explains why mixtures have variable compositions.
D) It allows chemists to predict the properties of a compound from its composition.
Answer:A,B,D
Solution:Correct Answers:
A) It shows that chemical compounds have constant composition.(Core principle of the law.)
B) It helps calculate the chemical formula of a compound.
(Fixed ratios allow formula determination, e.g., H_2O = 1:8 H:O by mass.)
D) It allows chemists to predict the properties of a compound from its composition.(Composition determines properties like melting point, reactivity.)
Incorrect Answer:
C) It explains why mixtures have variable compositions.
(This contrasts with the law, which applies only to pure compounds, not mixtures.)
31. Which pairs of compounds obey the law of multiple proportions?
A) CO and CO_2 (carbon monoxide and carbon dioxide)
B) NO and NO_2 (nitric oxide and nitrogen dioxide)
C) NaCl and NaOH (sodium chloride and sodium hydroxide)
D) SO_2 and SO_3 (sulfur dioxide and sulfur trioxide)
Answer:A,B,D
Solution:Correct Answers:
A) CO and CO_2 (carbon monoxide and carbon dioxide).
(CO: 12 g C + 16 g O; CO_2: 12 g C + 32 g O $\rightarrow$O ratio = 16:32 = 1:2.)
B) NO and NO_2 (nitric oxide and nitrogen dioxide).
(NO: 14 g N + 16 g O; NO_2: 14 g N + 32 g O $\rightarrow$ O ratio = 16:32 = 1:2.)
D) SO_2 and SO_3 (sulfur dioxide and sulfur trioxide).
(SO_2: 32 g S + 32 g O; SO_3: 32 g S + 48 g O $\rightarrow$ O ratio = 32:48 = 2:3.)
Incorrect Answer:
C) NaCl and NaOH (sodium chloride and sodium hydroxide).
(Different elements (Cl vs. OH), not multiple ratios of the same elements.)

Assertion and Reason Type:

32. Assertion : Hydrogen, which combines with both oxygen and sulfur, can help predict the combining ratio of oxygen and sulfur.
Reason : The law of reciprocal proportions works only when all the elements are nonmetals.

Answer:C

Solution:Assertion:Correct.
"Hydrogen, which combines with both oxygen and sulfur, can help predict the combining ratio of oxygen and sulfur."
Hydrogen forms H_2O (1:8 mass ratio of H:O) and H_2S (1:16 mass ratio of H:S). The Law of Reciprocal Proportions states that the O:S ratio in their own compound (e.g., SO_2) will relate to their ratios with hydrogen. Here, O:S = 8:16 = 1:2, which matches the ratio in SO_2 (32 g S : 32 g O = 1:1 by mass, but 1:2 by combining ratios with H)
Reason:Incorrect.
The law applies to any elements (metals or nonmetals) as long as they combine with a common third element.

Comprehension Type:

33. Which of the following is true about the reaction $2H_2 + O_2 \rightarrow 2H_2O$
A) 4 hydrogen atoms and 2 oxygen atoms on reactant side, 4 hydrogen atoms and 2 oxygen atoms on product side.
B) 4 molecules of hydrogen react with 2 molecules of oxygen to form 4 molecules of water.
C) 36 g of water is formed from 4 g hydrogen and 32 g oxygen.
D) All of the above.

Answer:D

Solution:A) Correct.
Reactants: $2H_2$ (4 H atoms) + O_2 (2 O atoms).
Products: $2H_2O$ (4 H atoms + 2 O atoms).
Balanced as per the law of conservation of mass.
B) 4 molecules of hydrogen react with 2 molecules of oxygen to form 4 molecules of water
The balanced equation is:$2H_2 + O_2 \rightarrow 2H_2O$
So this statement ($4H_2 + 2\ O_2 \rightarrow 4H_2O$) is a multiple of the original reaction — it's stoichiometrically valid.
C) Correct.
Mass calculations:
4 g H_2 + 32 g O_2 $\rightarrow$ 36 g H_2O (since $2H_2O = 2 \times 18 = 36$ g).
Follows mass conservation (4 + 32 = 36 g).

34. Which of the following is not true about balanced chemical equations?
A) They indicate the mass relationships of reactants and products.
B) They always show the physical states of the substances.
C) They follow the conservation of mass.
D) They show the number of atoms involved in the reaction.

Answer:B

Solution:B) Not Always True.Balanced equations do not always show physical

states
Physical states are optional unless specified.

Integer Type:

35. $Ca(OH)_2$ + __HCl $\rightarrow CaCl_2$ + $2H_2O$

Answer:2

Solution: Balanced Equation:$Ca(OH)_2$ + 2HCl $\rightarrow CaCl_2$ + $2H_2O$

Matrix Matching Type:

36.**Answer:A-2,B-3,C-1,D-4**

Soolution:

Column A (Laws)	Column B (Descriptions)
A) Law of Conservation of Mass	2) The total mass of reactants equals the total mass of products.
B) Law of Definite Proportions	3) A compound always contains the same elements in a fixed mass ratio.
C) Law of Multiple Proportions	1) When two elements form more than one compound, their mass ratios are in simple whole numbers.
D) Law of Reciprocal Proportions	4) The ratio in which two elements combine relates to how they combine with a third element.

KEY

			TEACHING TASK							
1	2	3	4	5	6	7	8	9	10	
A	B	A	A	C	A	C	C	A	A	
11	12	13	14	15	16	17	18	19	20	
B	B	C	A	A	A	A	B	A	C	
21	22	23	24	25	26	27	28	29	30	30
B	A,B,C	A,B,D	A,B,C	C	C	C	136	63.5	1,B-2,C-3,D-4	
			LEARNERS TASK							
1	2	3	4	5	6	7	8	9	10	
C	A	A	A	B	B	C	D	C	B	
11	12	13	14	15	16	17	18	19	20	
A	A	C	A	C	A	C	B	B	B	
21	22	23	24	25	26	27	28	29	30	
A	C	A	A	A	C	B	D	A,B,C	A,B,D	
31	32	33	34	35	36					
A,B,D	C	D	B	2	2,B-3,C-1,D-4					