Environmental Science Practice Problems Worksheet

1. Exponential Decay (Radioactive Elements)

A scientist begins with 100 grams of a radioactive isotope with a half-life of 5 years.

How much of the substance remains after 15 years?

2. Isotopes (Atomic Number and Mass)

Carbon-12 and Carbon-14 are both isotopes of carbon.

What do they have in common, and how are they different in terms of protons and neutrons?

3. Exponential Growth (Rule of 70)

A country has a population growth rate of 2% per year.

Use the Rule of 70 to estimate how many years it will take for the population to double.

4. pH (Log Scale)

Lemon juice has a pH of 2. Tomato juice has a pH of 4.

How many times more acidic is lemon juice compared to tomato juice?

5. Trophic Pyramids (10% Rule)

If a plant produces 10,000 Joules of energy,

How much energy is available to a secondary consumer?

6. Energy vs. Power

A microwave uses 1.2 kilowatts (kW) of power. If it runs for 30 minutes,

How much energy (in kilowatt-hours) does it use?

7. Photosynthesis (Tracking Carbon)

In the process of photosynthesis, carbon dioxide and water form glucose and oxygen.

Which molecule provides the carbon atoms found in glucose?

8. Ocean Acidification

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Explain what happens to the pH of ocean water as more CO_2 is absorbed from the atmosphere.

Use the equation: $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$

9. Ozone Depletion (Tracking Chlorine)

One chlorine atom from CFCs can destroy thousands of ozone molecules.

How does chlorine act as a catalyst in ozone depletion?

10. Respiration and Combustion

Compare respiration and combustion in terms of energy release and byproducts.

11. Aerobic vs. Anaerobic Respiration

During intense exercise, muscles may switch to anaerobic respiration.

What are the differences in energy output and waste products between aerobic and anaerobic respiration?

12. Efficiency (Work Out / Work In)

A motor receives 500 J of electrical energy and does 350 J of useful work.

What is the efficiency of the motor as a percentage?

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Answer Key

1. 12.5 grams

2. Both have 6 protons; Carbon-12 has 6 neutrons, Carbon-14 has 8 neutrons.

3. 35 years (70 ÷ 2)

4. 100 times more acidic (10^2)

5. 100 Joules (10% of 1,000, which is 10% of 10,000)

6. 0.6 kWh (1.2 × 0.5 hours)

7. CO_2 (carbon dioxide)

8. pH decreases; H^+ increases due to carbonic acid dissociation.

9. Chlorine breaks ozone and is regenerated, acting repeatedly as a catalyst.

10. Both release energy and CO_2; respiration is slow and biological, combustion is fast.

11. Aerobic: more ATP, $CO_2 + H_2O$; Anaerobic: less ATP, lactic acid/ethanol.

12. 70% efficiency (350 ÷ 500 × 100)