SUBJECT: Science
UNIT: Y10 Atoms and radiation

SANDHILL VIEW

Key Equations

Density

$$\rho = \frac{m}{V}$$

Specific Latent Heat

$$E = m\ x\ L$$

Specific heat capacity

E = m x SHC x temp change

Pressure

$$P\ x\ V = constant$$

Quantities and units

ρ = Density (kg/m^3)
m = Mass (kg)
V = Volume (m^3)
E = Energy (J)
L = Specific Latent Heat (J/kg)
P = Pressure (Pa)
SHC = J/Kg°C

Internal Energy

The sum of the kinetic energy (speed) and potential energy (space between particles) of a substance.

Irradiation = exposure to radiation
Contamination = radiation is in or on you even when you leave the area

Decay Equations

Alpha

The atomic number goes down by two and its mass number decreases by four.

$$^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha$$

Beta The mass of the nucleus does not change but the number of protons increases.

$$^{8}_{3}Li \rightarrow {}^{8}_{4}Be + {}^{0}_{-1}\beta$$

Gamma Does not have mass or charge so no changes to the nucleus when released.

Background radiation

Background radiation is radiation from natural sources - from sources like rocks, food, and air. As well as man-made sources such as nuclear weapons, waste, or accidents.

Changing State

The process of changing between a solid and a liquid is melting (solid to liquid) or freezing (liquid to solid). The process of changing between a liquid and a gas is evaporating, boiling (liquid to gas), or condensing (gas to liquid). When a substance changes state there is no chemical change, only physical. No new substance is formed and the substance can return to its original state..

Required Practical: Density

Regularly shaped object:

Measure all three sides, multiply together to find the volume. Place on a balance to find the mass. Divide the mass by the volume to find the density.

Irregularly shaped object:

Fill a eureka can to just below the spout, place the object in and collect water from the spout in a measuring cylinder – this is the volume. Place the object on a balance to find the mass. Divide the mass by the volume to find the density.

Pressure in Gases

Heating a gas provides more kinetic energy leading to more collisions and therefore a higher pressure. Volume and pressure are inversely proportional, when one increases, the other decreases.

Radioisotopes and Ionisation

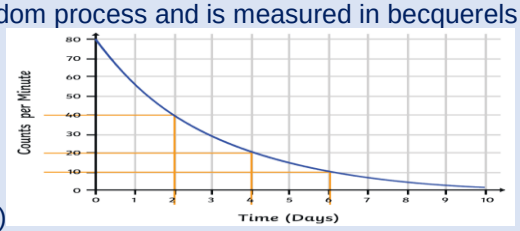
Some isotopes are unstable and decay, giving out radiation. Ionising radiation is radiation that can knock electrons off atoms.

Isotopes

Atoms with the same number of protons but a different number of neutrons.

Half-life

The time taken for the number of radioactive nuclei in an isotope to halve. Radioactivity is a random process and is measured in becquerels (Bq)



The graph will always be this shape. By halving the counts and drawing a horizontal line to the curve, then a vertical line, you can find the half-life.

Uses of Radiation

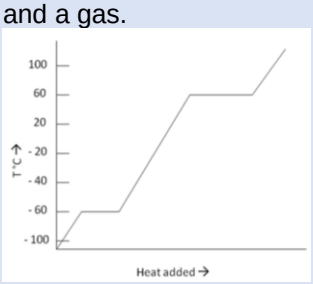
Gamma sources can be used as a medical tracer with isotopes can be injected or swallowed. As the isotope goes around the body it can be monitored and any issues can be spotted. Gamma is used as it is the least ionising and can penetrate through skin. High doses of radiation can be used to treat cancer by killing cancerous cells. It also kills healthy cells which can make the patient feel ill.

Ambitious Vocabulary

Density Fusion Vaporisation Latent heat Radioactive Decay Becquerel

Specific Latent Heat

Specific latent heat of fusion - the amount of energy required to get 1kg of a substance to change between a solid and a liquid.
Specific latent heat of vaporisation – the amount of energy required to get 1kg of a substance to change between a liquid and a gas.



As energy is increased through heating the temperature of the substance also increases as particles move faster. This is shown by the diagonal line.
Where the line becomes flat, energy is still increasing however the temperature remains constant as the potential energy increases instead of the kinetic energy. This represents a change of state.
The internal energy of the substance is increasing throughout the graph.

Specific heat capacity is the energy needed to increase the temperature of 1kg of a substance by 1°C

Types of Radiation

Alpha

Two protons and two neutrons. Largest type of radiation. Mass = 4. Charge = +2. Travels 5cm in air. Least penetrating – stopped by paper/skin. Highly ionising.

Beta

High energy electron. Mass = negligible. Charge = -1. Travels 1m in air. Moderately penetrating – stopped by metal foil. Moderately ionising.

Gamma

Electromagnetic wave. Mass = 0. Charge = 0. Travels large distances in air. Most penetrating – stopped by thick lead or 1m of concrete. Least ionising.

Fusion and Fission

Nuclear fusion is the joining together of smaller nuclei to make a larger atom.
Fission is the splitting of a larger nuclei into smaller ones.
They both release energy however fusion produces more energy.

While you were away

1. Review lesson
    a. Name three states of matter
    b. Name the change in state when a solid becomes a liquid

2. Key content
    a. State the equation used to calculate density
    b. State the units of mass
    c. State the units of volume

3. Density required practical
    a. How could you calculate the volume of a cube?
    b. How would you find the volume of an irregular shaped object?
    c. What piece of apparatus is used to measure mass?

4. Internal energy
    a. What is internal energy?

5. Specific latent heat
    a. What is specific latent heat of fusion?
    b. What is specific latent heat of vaporisation?

6. Pressure in gases
    a. Why does heating cause an increase in pressure?
    b. What happens to pressure when volume decreases?

7. Specific heat capacity
    a. What is specific heat capacity?
    b. Write the equation for specific heat capacity

8. Specific heat capacity required practical
    a. What piece of equipment is used to measure mass?
    b. What piece of equipment is used to measure temperature?

9. Radioactive decay
    a. Name three types of radiation
    b. List the radiation in order of ionising power

10. Nuclear equations
    a. What happens to the atomic number and mass number when an alpha particle is lost?
    b. What happens to the atomic number when a beta particle is lost?
    c. Why does gamma show no change in the nucleus?
11. Half-life
    a. What is half-life?
    b. What is radioactivity measured in?
12. Contamination and irradiation
    a. What is radioactive contamination?
    b. What is irradiation?
13. Background radiation (SEP)
    a. What is background radiation?
14. Uses of radiation (SEP)
    a. What type of radiation is used as a medical tracer?
    b. What properties do medical tracers need to be safe?
    c. Why are high doses of radiation dangerous?
15. Nuclear fission (SEP)
    a. What is nuclear fission?
16. Nuclear fusion (SEP)
    a. What is nuclear fusion?