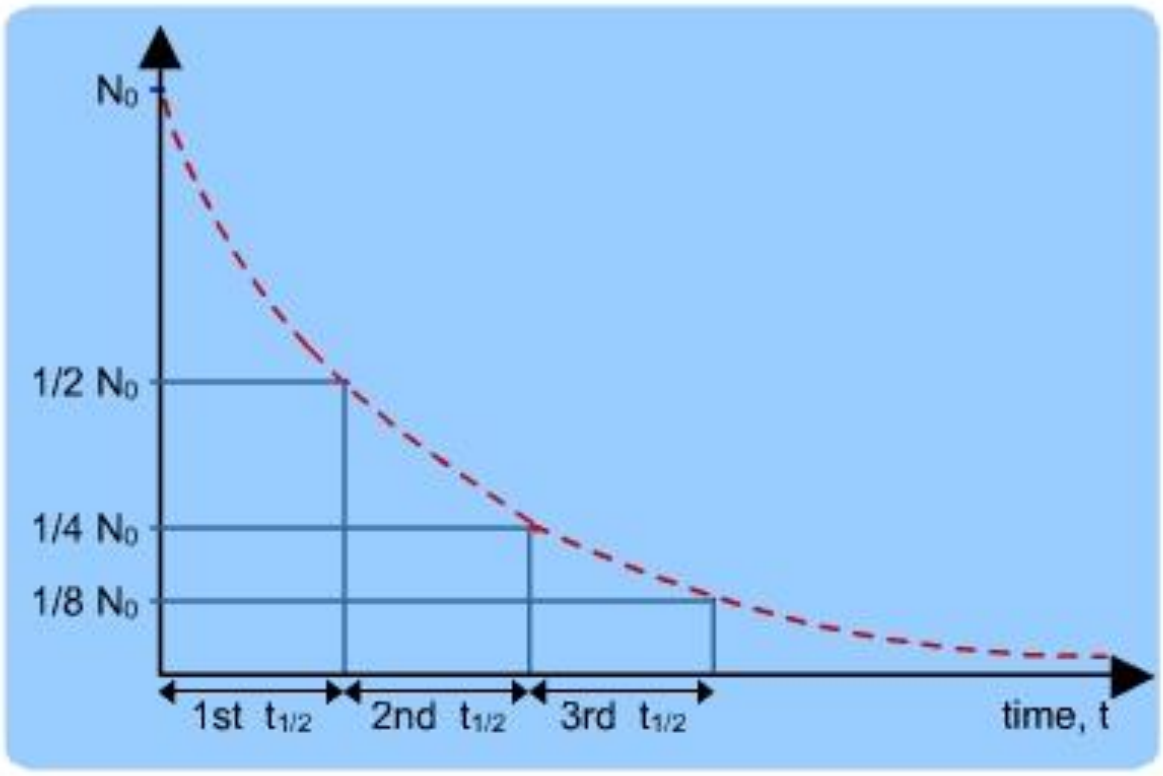
PHYSICS
FORM 5
HALF LIFE

This is defined as the time taken for half the mass of a radioactive substance to undergo decay. Half-life is usually a constant value.

Half-life is denoted by the symbol $t_{1/2}$.



$$Final\ Mass = \frac{Initial\ Mass}{2^{no\ of\ t_{1/2}}}$$

$$Final\ Mass = \frac{Initial\ Mass}{2^{\frac{time\ taken}{t_{1/2}}}}$$

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Ex. 64 grams of a radioactive substance undergoes decay. Find out what mass of substance remains after:

a. 1 half life
b. 3 half lives

Ex. A radioactive substance X has a half life of 20minutes. Calculate the mass of substance that underwent radioactive decay if 1 gram of the substance undergoes decay for 2 hours.

Ex. The half life of a substance B is 5 minutes. Calculate the mass of B which underwent decay if 2048g of B underwent decay for 60 minutes.

Ex. Radioactive uranium underwent decay, initially there was 1024 grams. After 24 hours only 1 gram was left. Calculate the length of the half life.

Ex. After 3 hours, 0.5g of a sample remained. Calculate the half life if the initial mass was 512g.

Ex. A radioactive substance X has a half life of 20 minutes. 1 gram of the substance was left for 4 hours. Calculate the mass of substance that underwent radioactive decay.

Ex. 2048 of a radioactive substance underwent radioactive decay. After 22 hours only 1 gram was left. Calculate the half life.

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Reaction Equations of Radioactive Decay

Atoms are unstable due to conditions within the nucleus that is too many neutrons or too few neutrons. The right amount of neutrons is the proton to neutron ratio which is 1:1.

An unstable atom will therefore try to lose neutrons and or protons in order to achieve a near 1:1 ratio.

If the proton number changes, the element changes.

Radioactive decay is the process by which atoms give of radioactive emissions and form new elements.

Alpha Decay:

$$^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\alpha + energy$$

Beta Decay:

$$^{A}_{Z}X \rightarrow {}^{A-0}_{Z+1}Y + {}^{0}_{-1}\beta + energy$$

Gamma Decay:

$$^{A}_{Z}X \rightarrow {}^{A}_{Z}X + \gamma + energy$$

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$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}\alpha$$

$$^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}\beta + {}^{0}_{0}\gamma$$

$$^{234}_{91}Pa \rightarrow {}^{234}_{92}U + {}^{0}_{-1}\beta + {}^{0}_{0}\gamma$$

Ex. Radioactive radium, mass number – 226, atomic number – 88, undergoes alpha decay. Write a radioactive equation to show this reaction.

Ex. Radioactive carbon, mass number – 14, atomic number – 6 undergoes beta decay. Write a radioactive equation to show this reaction.

Ex. Radioactive palladium, mass number 110, atomic number – 46, undergoes 2 beta decay. Write a radioactive equation to show this reaction.

Ex. Radioactive plutonium, mass number – 240, atomic number – 94, undergoes alpha and beta decay. Write a radioactive equation to show this reaction.