

# Physics

## 4. Atomic Structure

### Revisiting Booklet

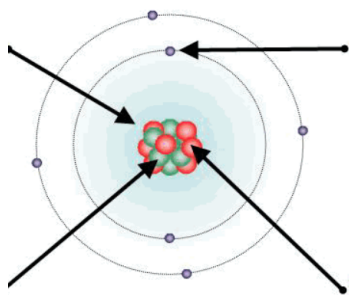
Name:

## Atomic Structure

### Topics:

1. The structure of an atom
2. Mass number, atomic number and isotopes
3. The development of the model of the atom (common content with chemistry)
4. Radioactive decay and nuclear radiation
5. Nuclear equations
6. Half-lives and the random nature of radioactive decay
7. Radioactive contamination
  
8. Background radiation – (Triple)
9. Different half-lives of radioactive isotopes (Triple)
10. Uses of nuclear radiation (Triple)
11. Nuclear fission (Triple)
12. Nuclear fusion (triple)

## Structure of the atoms



Label the parts of the atom

What charge does each part have?

## How big are atoms?

Atoms are very small, having a radius of about  $1 \times 10^{-10}$  metres.

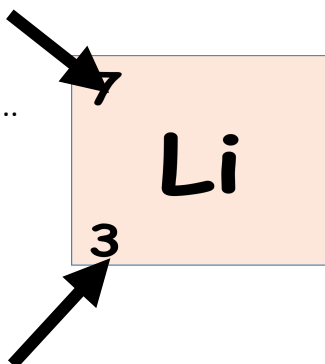
Can you fill in the zeros? 0. \_\_\_\_\_ 1

Convert to standard form: (E.g  $1 \times 10^5$ )

- a) 100m
- b) 10000s
- c) Ext (to 3s.f) : 299 792 458 m / s

What is the top number called?

.....



What is the bottom number called?

.....

How many electrons does Lithium have?

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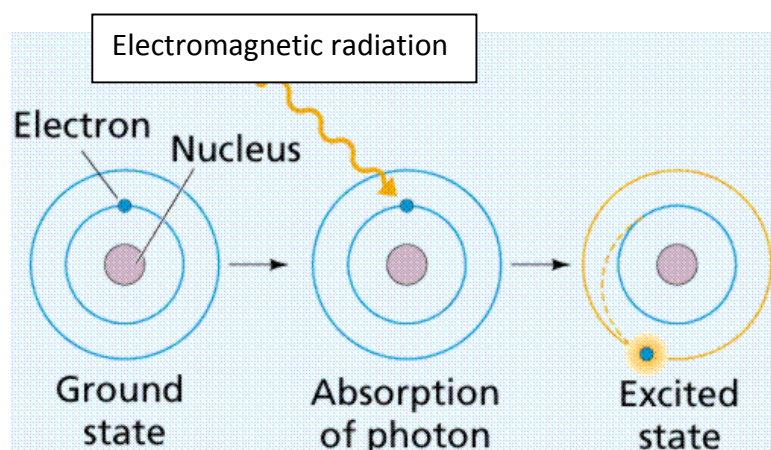
How many protons does Lithium have?

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How many neutrons does lithium have?

.....

## Energy levels



Electrons are arranged at different ..... from the nucleus (**energy levels**)

..... electromagnetic radiation moves electrons to a ..... energy level, further from the nucleus

Electromagnetic radiation is ..... when an electron drops to a lower energy level.

Key words to use  
**Absorbing, higher, emitted distances,**

Using your periodic table, complete the table below

Element	Symbol	Mass number	Atomic number	Number of protons	Number of neutrons	Number of electrons
Hydrogen						
Boron						
Oxygen						
Sodium						
Chlorine						
Uranium						

Explain why Uranium is unstable

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.....

# Isotopes

What is an isotope?

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Draw hydrogen 1 Hydrogen2 and Hydrogen 3 showing the protons neutrons and electrons

Hydrogen 1

Hydrogen 2

Hydrogen 3

## History of the atom

Describe the difference between the plum pudding model of the atom and the nuclear model of the atom. Use diagrams to illustrate your answer

Diagrams

Description of differences

## Rutherford's Alpha Scattering

1) What was the name of the particles fired at the gold foil?

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2) What was the expected result when the particles were fired at the gold foil?

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3) What was Rutherford's explanation for why 1 in 8000 particles bounced back?

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## Niels Bohr

1) Describe how Niels Bohr developed the model we use today.

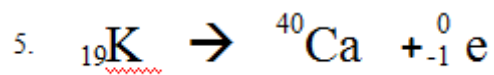
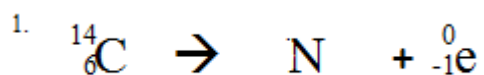
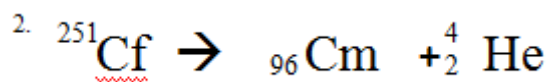
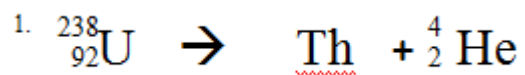
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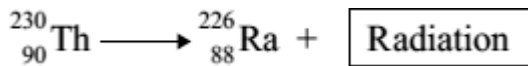
## Nuclear Radiation – complete the table

Type of Radiation	Description	Diagram	Penetrating Power	Uses	Ionising power

Complete the following nuclear equations



When a thorium-230 nucleus decays, it emits radiation and changes into radium-226.



What type of radiation, alpha, beta or gamma, is emitted by thorium?

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Explain the reason for your answer.

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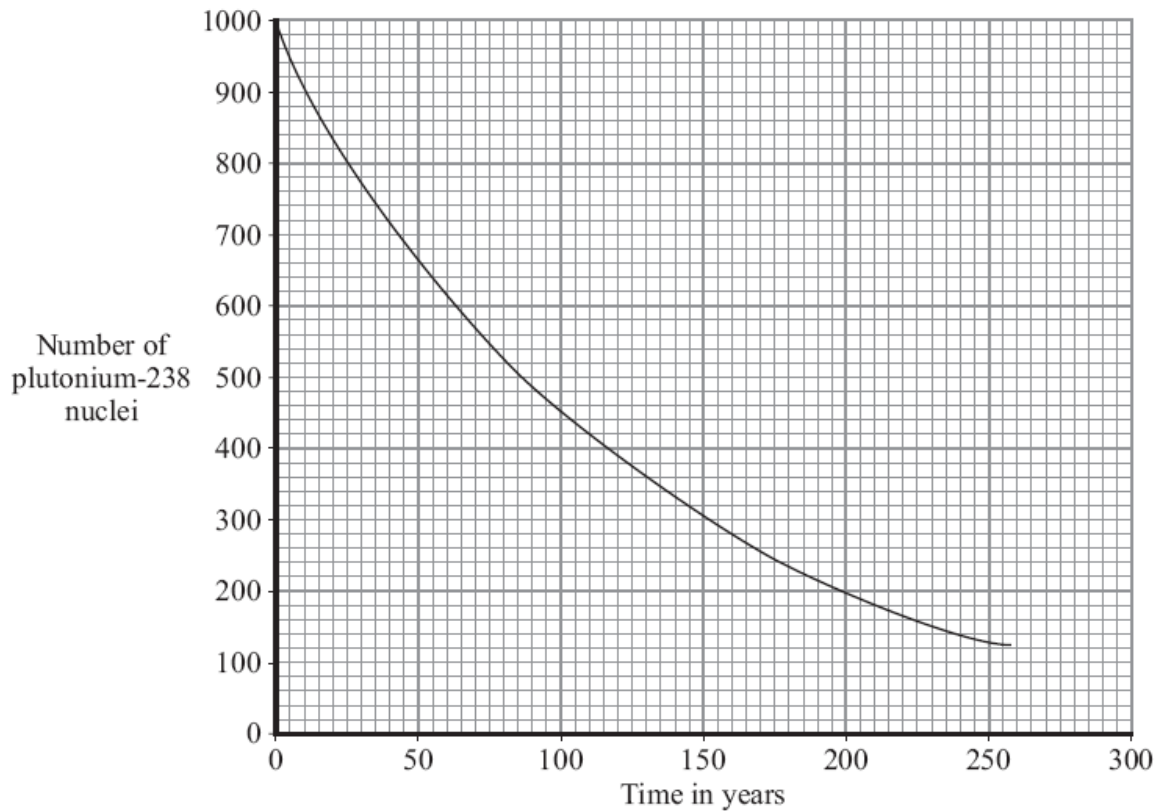
(3)

## Half Life

1. A radioactive isotope has a half life of 14 days. It has an initial count rate of 1080Bq. What will the count rate be after 4 weeks?
2. A radioactive isotope has a half life of 15 minutes. It has an initial count rate of 36000 Bq. What will the count rate be after 1.5 hours?
3. A radioactive isotope has a half life of 5000 years. What fraction of the radioactive material will remain after 20000 years?
4. A radioactive isotope has a count rate of 4000Bq and a half life of 12 hours. How long will it take the count rate to drop to 500Bq?



5. Use the graph to find the half-life of Plutonium-238.



Extension Questions:

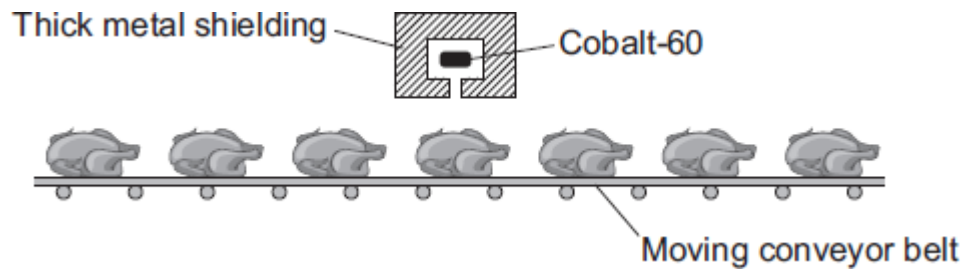
6. A radioactive isotope has a count rate of 6400 Bq and a half life of 4 days. What fraction of the isotope will have decayed after 20 days? What will the count rate now be?
7. Before an isotope is placed near the detector a counter gives a reading of 14 Bq. When the isotope is placed near the reading increases to 2234 Bq. When tested 30 minutes later the count rate has dropped to 569 Bq. What is the half life of the substance?

## Radioactive Contamination

1. Why is Irradiation potentially dangerous?
2. Would an apple be more dangerous if it was contaminated with an alpha or gamma source?
3. Would a nuclear power source be more dangerous as an alpha or gamma source?
4. Describe the danger of travelling to Chernobyl using the keywords: radioactive contamination and irradiation
5. How is radioactive contamination different from irradiation?

- (b) The gamma radiation emitted from a source of cobalt-60 can be used to kill the bacteria on fresh, cooked and frozen foods. Killing the bacteria reduces the risk of food poisoning.

The diagram shows how a conveyor belt can be used to move food past a cobalt-60 source.



- (i) Which **one** of the following gives a way of increasing the amount of gamma radiation the food receives?

Put a tick (✓) in the box next to your answer.

Increase the temperature of the cobalt-60 source.

Make the conveyor belt move more slowly.

Move the cobalt-60 source away from the conveyor belt.

- (ii) To protect people from the harmful effects of the gamma radiation, the cobalt-60 source has thick metal shielding.

Which **one** of the following metals should be used?

Draw a ring around your answer.

**aluminium**

**copper**

**lead**

- (c) A scientist has compared the vitamin content of food exposed to gamma radiation with food that has not been exposed.

The table gives the data the scientist obtained when she tested 1 kg of cooked chicken.

Vitamin	Food not exposed to gamma radiation	Food exposed to gamma radiation
	Mass in milligrams	Mass in milligrams
B6	1.22	1.35
B12	21.00	28.00
E	3.30	2.15
Niacin	58.00	55.50
Riboflavin	2.10	2.25

Considering only this data, which **one** of the following is a correct conclusion?

Put a tick (✓) in the box next to your answer.

Vitamin content is not affected by gamma radiation.

Gamma radiation completely destroys some types of vitamin.

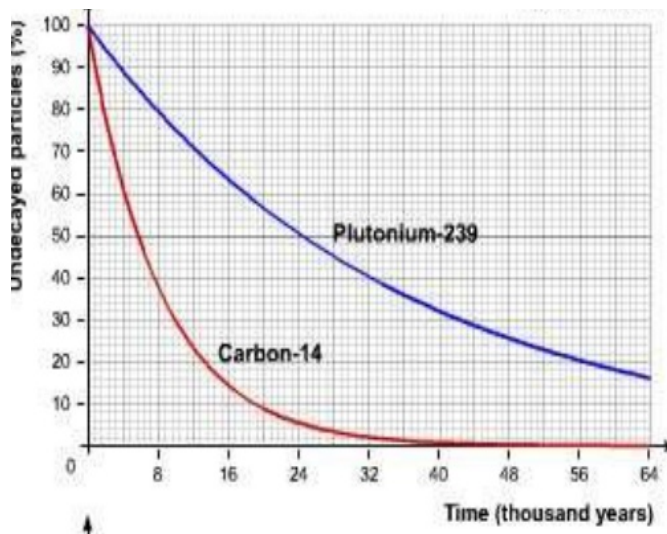
Exposure increased the content of some types of vitamin.

## Triple only from here

### Background radiation

There is always background radiation around us which comes from different sources.

1. What does the level of background radiation depend on?
2. What are the units to measure radiation dose in?



Name one **advantage** and one **disadvantage** for isotopes with

a) A **short** half life

b) A **long** half life

## Uses of radiation

1) What is a medical tracer?

2) How are medical tracers administered?

Complete the table for as many examples of tracers as you can:

<b>Use of tracer</b>	<b>Description</b>

## Nuclear fission

Explain in detail what is happening in the diagram on the right

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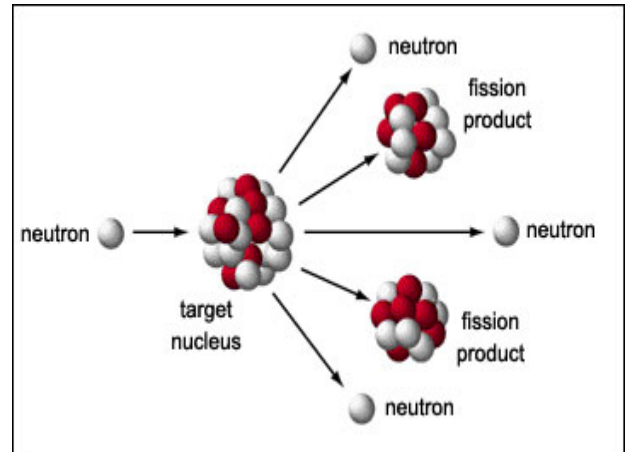
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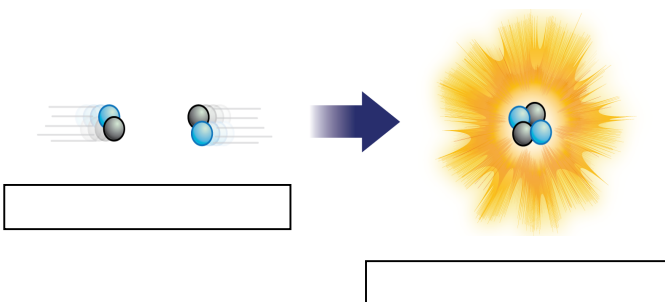
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- 3) Why is uranium more likely to go through fission than helium?
- 4) How might nuclear fission cause a chain reaction?
- 5) How could we control this chain reaction?

## Nuclear Fusion

Explain nuclear fusion by annotating and using the diagram below



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- 1) What conditions are needed for nuclear fusion?
- 2) Give an example of where nuclear fusion happens
- 3) Why are we not using fusion already?
- 4) What are the advantages of using nuclear fusion?
- 5) Why are fusion bombs more destructive than fission bombs?

The End