

## Atomic structure: teacher guidance

These worksheets offer questions related to atomic structure in an applied context and are suitable for learners who are looking for additional challenge. Learners answer questions about hydrogen isotopes found in the Sun and are challenged to apply their knowledge and understanding of atomic structure to this unfamiliar context. Available at Foundation and Higher level and as fully editable versions, giving you the flexibility to adapt to suit individual learners and lessons.

Also available to assess this topic:

- **Review my learning worksheets:** available with three levels of scaffolded support to help build confidence in every learner. Use before, during or after teaching the relevant topic to understand progress and identify misconceptions, [rsc.li/44igB7V](https://rsc.li/44igB7V).
- **Knowledge check worksheets:** select from **Foundation and Higher level** to assess learners' knowledge and understanding of this topic at the end of a period of teaching or as revision, [rsc.li/3VorKQy](https://rsc.li/3VorKQy).

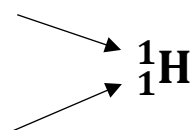
## Answers

### Foundation

1 (a)

| Isotope   | Number of protons | Number of neutrons | Number of electrons |
|-----------|-------------------|--------------------|---------------------|
| protium   | 1                 | 0                  | 1                   |
| deuterium | 1                 | 1                  | 1                   |
| tritium   | 1                 | 2                  | 1                   |

(b) **mass** number



**atomic** number

(c)  ${}^3_1\text{H}$

(d) Protium, deuterium and tritium are isotopes because their atoms have the same number of protons, but different numbers of neutrons.

**OR**

Protium, deuterium and tritium are isotopes because they have the same atomic number, but different mass numbers.

- 2 (a) The protium nucleus has a positive charge because it has one positively charged proton.
- (b) i. deuterium nucleus  ${}^2_1\text{H}^+$   
ii. tritium nucleus  ${}^3_1\text{H}^+$
- (c) the new nucleus will have two protons  
(d) helium
- 3 (a) An exothermic reaction is one that transfers heat energy to the surroundings.
- (b) percentage of deuterium =  $\frac{1}{6420} \times 100$   
 $= 0.0156\%$  (to three sig figs)
- (c) relative formula mass of heavy water =  $(2 + 2) + 16$   
 $= 20$
- (d) percentage by mass of deuterium in heavy water =  $\frac{4}{20} \times 100$   
 $= 20\%$

## Higher tier

- 1 (a) i. protium  ${}^1_1\text{H}$   
 ii. deuterium  ${}^2_1\text{H}$   
 iii. tritium  ${}^3_1\text{H}$
- (b) Protium is the only element whose atoms do not have neutrons.
- 2 (a)  $\text{H} \rightarrow \text{H}^+ + \text{e}^-$
- (b) i. protium nucleus  ${}^1_1\text{H}^+$   
 ii. deuterium nucleus  ${}^2_1\text{H}^+$   
 iii. tritium nucleus  ${}^3_1\text{H}^+$
- (c) **C.**  $1 \times 10^{-14} \text{ m}$
- (d) twice as heavy
- (e) i. 2  
 ii. 2  
 iii. 2
- (f)  ${}^2_1\text{H}^+ + {}^3_1\text{H}^+ \rightarrow {}^4_2\text{He} + \text{n/neutron}$
- 3 (a) percentage of deuterium =  $\frac{1}{6420} \times 100$   
 $= 0.0156\%$  (to three sig figs)
- (b) Electrons are rearranged in chemical reactions. Protium and deuterium both have one electron.
- (c) relative formula mass of heavy water =  $(2 + 2) + 16$   
 $= 20$   
 percentage by mass deuterium in heavy water =  $\frac{4}{20} \times 100$   
 $= 20\%$
- (d) Heavy water is separated from normal water by fractional distillation.
- 4 (a) A hydrogen nucleus has one proton, a helium nucleus has two protons. When they combine, the product has three protons.
- (b) Lithium nuclei have three protons each.
- (c) Six protons
- (d) The nucleus is carbon.
- (e) A carbon nucleus combining with a helium nucleus will produce an oxygen nucleus.
- (f) Accept any two elements with  $A_r$  greater than 26, for example, gold and silver.