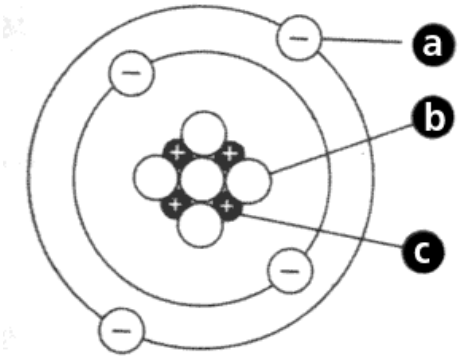
A. Atomic structure – Atoms and isotopes

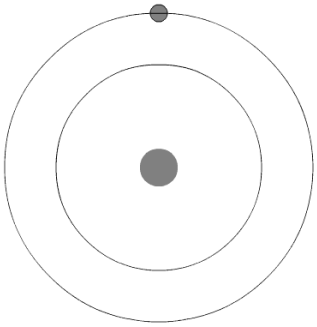
1. a) The diagram shows an atom of Beryllium. Name the parts labelled a, b and c. (3)



b) What is the atomic mass of this atom? (1)

c) Which parts make up the nucleus of the atom? (1)

2. The diagram shows an electron orbiting the nucleus of an atom. (2)



Under certain conditions the electron may fall into an orbit closer to the nucleus.

Explain what is likely to result from this event. (2)

3. The diagram represents an atom of sodium.

$^{23}_{11}Na$

a. Use this information to calculate the number of:

Protons, Neutrons and Electrons (3)

b. What is the overall electrical charge of this atom? (1)

4. Two isotopes of the element carbon are:

$^{12}_{6}C$ $^{14}_{6}C$

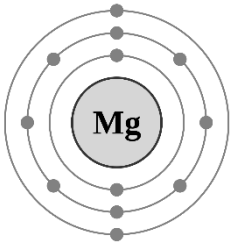
Complete the table of information for these two isotopes. (5)

Isotope	Atomic Number	Mass Number	Number of Protons	Number of Neutrons
$^{12}_{6}C$				6
$^{14}_{6}C$		14	6	

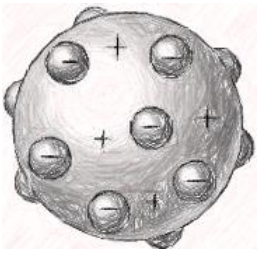
5. The diagram represents an atom of magnesium.

What will happen to this atom if it is to become an ion of magnesium? (1)

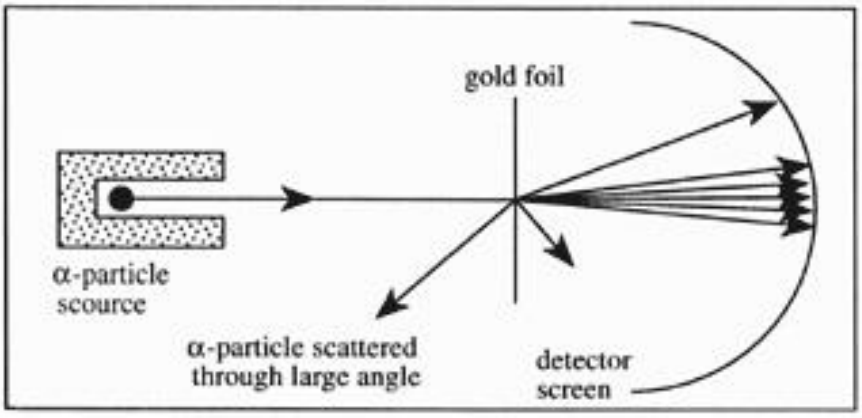
magnesium 2,8,2



6. The diagram below represents the "plum pudding" model of the atom.
Around 1911, this model of the atom was modified.
How does the modern atomic model differ from this model of the atom? (3)



7. The diagram shows Rutherford's experiment where alpha (α) particles are fired at a thin layer of gold atoms. The majority of the alpha particles pass straight through the gold foil without being deflected.



   a. Explain why the majority of alpha particles pass straight through the gold foil. (1)

   b. A few alpha particles are scattered through a large angle. What is the cause of this large angle scattering? (1)

B. Atomic structure – Atoms and nuclear radiation

8. Complete the table to show the nature of the different types of nuclear radiations. (6)

Radiation type	Composition	Charge
Alpha		
Beta		
Gamma		

9. When a water pipe is leaking under a road, a gamma emitting tracer is added to the water so the leak can be detected above ground.
   Explain why alpha and beta emitting radiations are not used for this purpose. (2)

10. Explain why radioactive emissions are ionising. (2)

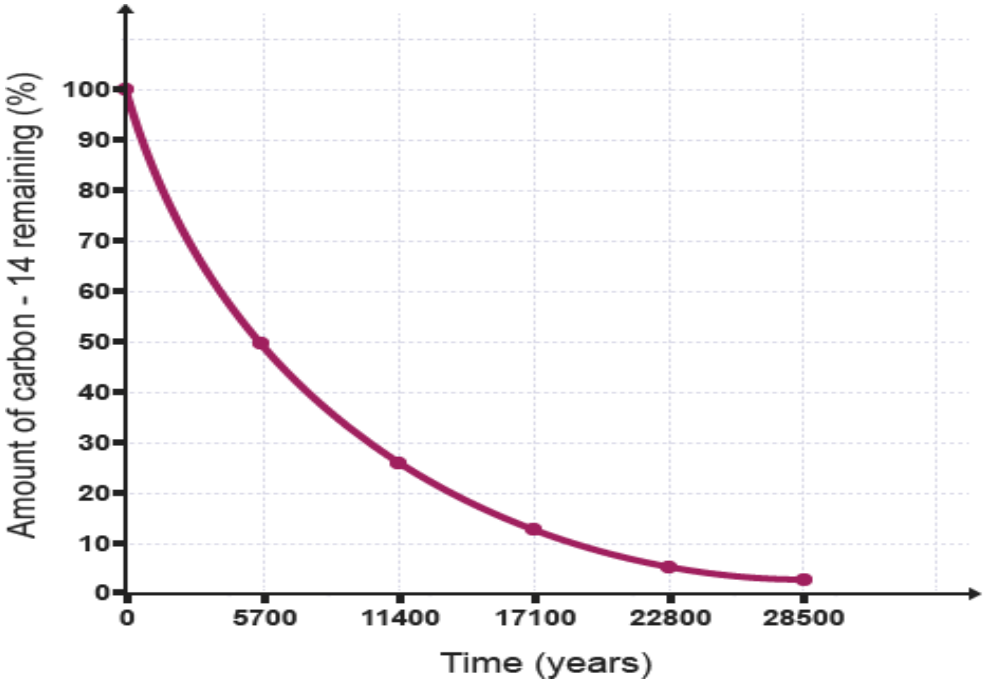
11. Complete the nuclear equation for the radioactive decay of Radon (Ra). (3)

$$^{219}_{86}Ra \longrightarrow Po + ^{4}_{2}$$

12. When a radioactive isotope decays by beta emission, what changes occur in the nucleus of the atom? (2)

13. What is meant by the half-life of a radioactive isotope? (1)

14. a. Use the graph to determine the half-life of Carbon-14. (3)



b. The initial sample of Carbon14 had 6400 counts/min. When tested, the sample had a count rate of 800 counts/min.

(i) How many half-lives has the sample gone through? (2)

(ii) Use this information to calculate the age of the sample. (2)

c. (Physics only) What is the net decline of this isotope over this number of half-lives? (2)

15. Describe the difference between radioactive irradiation and radioactive contamination. (2)

C. Atomic structure – Hazards and uses of radiation emission and background radiation (physics only)

16. Describe the precautions a medical worker should take if they are working with samples of beta emitting radioactive isotopes. (4)

17. The following sources of background radiation can be either naturally occurring or man made.

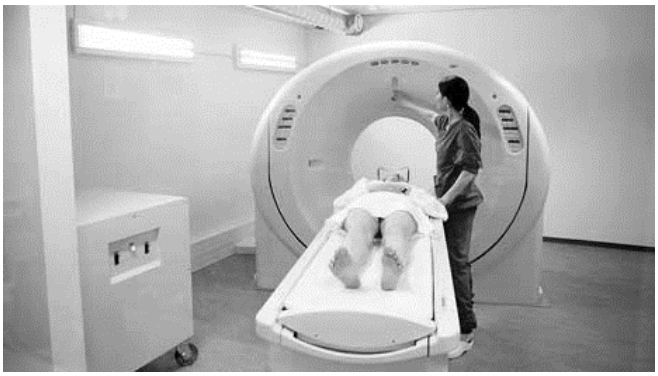
Cosmic rays fallout from nuclear weapons radon from rocks

Nuclear power waste Building materials Medical tracers

List these radioactive sources as natural or man-made. (2)

18. Uranium has a half-life of thousands of years whereas Iodine has a half-life of a few days. Explain which you think will pose the greatest hazard to humans. (2)

19. In a CT scanner, radioactive emissions are used to assess damaged or diseased organs.



a. Explain why these machines usually use gamma radiation. (1)

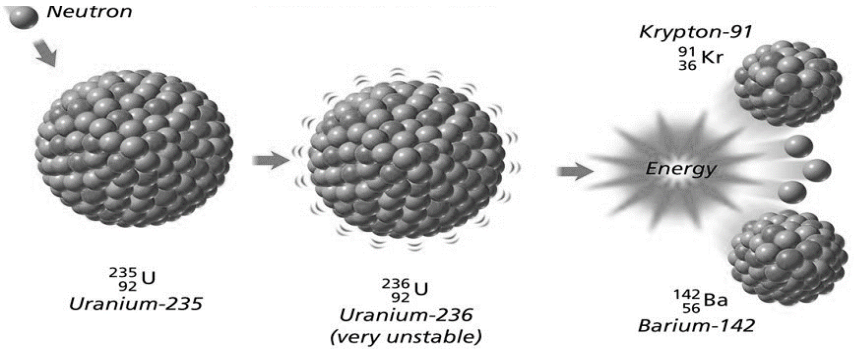
b. Radiation is dangerous for the body so why is this procedure carried out on patients? (1)

c. Describe how the radiation source used could lead to ionisation of cells in the body. (1)

20. Radiation is used for the destruction of unwanted tissue. Describe how this process differs from the scanning process described above. (2)

D. Atomic structure – Nuclear fission and fusion (physics only)

21. The diagram shows the nuclear fission of Uranium. Below the diagram write a nuclear reaction for this process. (3)



22. In the nuclear fission of uranium, the neutrons released by fission can go on to split further uranium atoms.

    a. What is this process called? (1)

    b. How is this process controlled in a nuclear reactor? (2)

23. The reaction below represents one stage of nuclear fusion in a star. Draw a diagram to show this process. (3)

$$^{2}_{1}H + ^{3}_{2}He \rightarrow ^{4}_{2}He + ^{1}_{1}H$$