Topic 4 Atomic Structure F

Name: _____

Class: _____

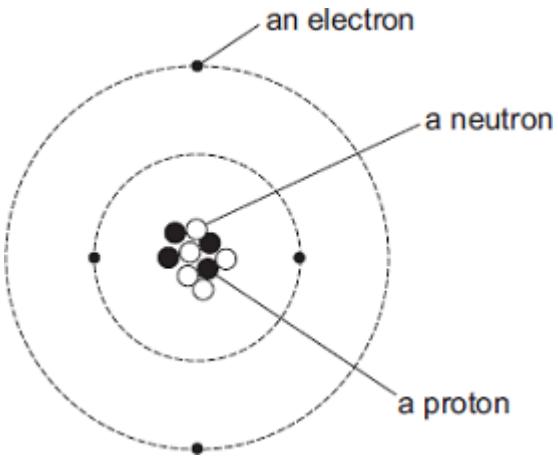
Date: _____

Time: **40 minutes**

Marks: **39 marks**

Comments:

Q1. The diagram represents an atom of beryllium. The three types of particle that make up the atom have been labelled.



(a) Use the labels from the diagram to complete the following statements.

Each label should be used once.

The particle with a positive charge is ..... .

The particle with the smallest mass is ..... .

The particle with no charge is ..... .

(2)

(b) What is the mass number of a beryllium atom?

Draw a ring around your answer.

4	**5**	**9**	**13**

Give a reason for your answer.

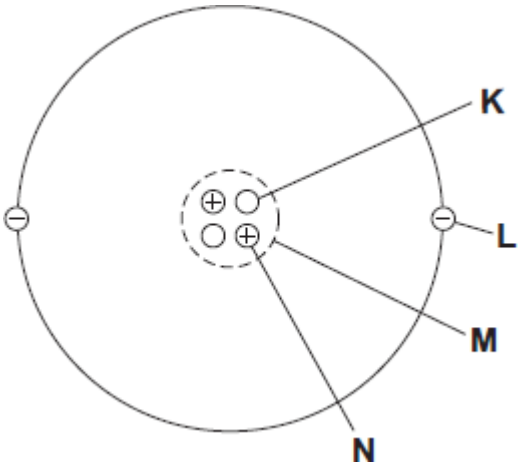
.....

.....

(2)

(Total 4 marks)

Q2. (a) The diagram represents a helium atom.



(i) Which part of the atom, **K**, **L**, **M** or **N**, is an electron?

Part ☐

(1)

(ii) Which part of the atom, **K**, **L**, **M** or **N**, is the same as an alpha particle?

Part ☐

(1)

(b) A radioactive source emits alpha particles.

What might this source be used for?

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

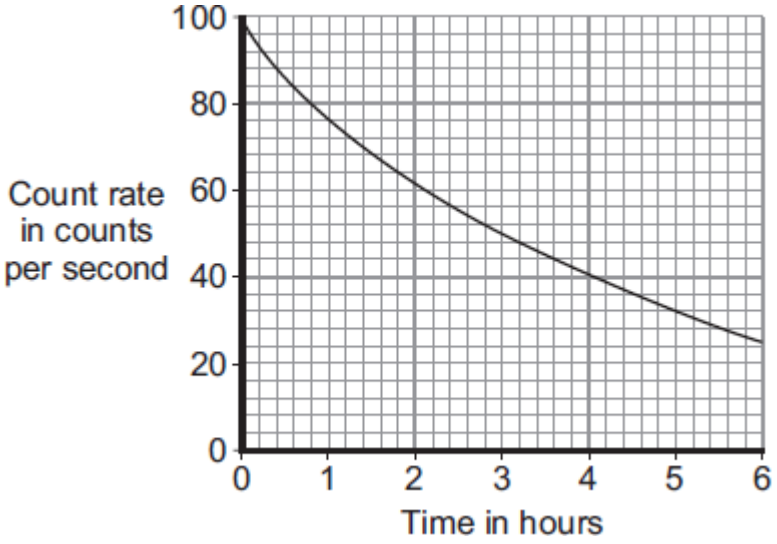
to monitor the thickness of aluminium foil as it is made in a factory ☐

to make a smoke detector work ☐

to inject into a person as a medical tracer ☐

(1)

(c) The graph shows how the count rate from a source of alpha radiation changes with time.



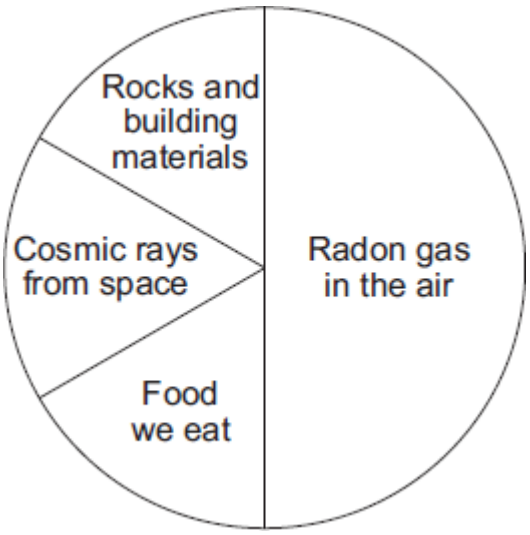
What is the count rate after 4 hours?

..... counts per second

(1)

(Total 4 marks)

Q3. The pie chart shows the average proportions of natural background radiation from various sources in the UK.



(a) (i) Complete the following sentence.

On average, ... of the natural background

radiation in the UK comes from radon gas.

(1)

(ii) Radon gas is found inside homes.

The table shows the results from measuring the level of radon gas inside four homes in one area of the UK.

Home	**Level of radon gas in Bq per m^3 of air**
1	25
2	75
3	210
4	46
Mean	89

One of the homes has a much higher level of radon gas than the other three homes.

What should be done to give a more reliable mean for the homes in this area of the UK?

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

ignore the data for home number 3 ☐

measure the radon gas level in more homes in this area ☐

include data for homes from different areas of the UK ☐

(1)

(b) Each atom of radon has 86 protons and 136 neutrons.

(i) How many electrons does each atom of radon have?

Draw a ring around your answer.

50 **86** **136** **222**

(1)

(ii) How many particles are there in the nucleus of a radon atom?

Draw a ring around your answer.

50 **86** **136** **222**

(1)
(Total 4 marks)

Q4. Four different processes are described in **List A**. The names of these processes are given in **List B**.

Draw a line to link each description in **List A** to its correct name in **List B**.
Draw only **four** lines.

List A	List B
the nuclei of two atoms joining together	gamma emission
the nucleus of an atom splitting into several pieces	electric current
an atom losing an electron	ionisation
an electric charge moving through a metal	nuclear fission
	nuclear fusion

(Total 4 marks)

Q5. Alpha, beta and gamma are types of nuclear radiation.

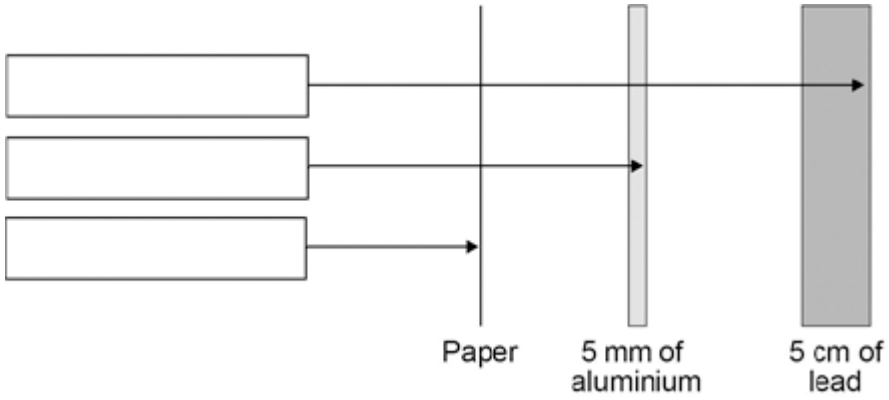
(a) Draw **one** line from each type of radiation to what the radiation consists of.

Type of radiation	**What radiation consists of**
Alpha	Two protons and two neutrons
Beta	Electromagnetic radiation
Gamma	Neutron from the nucleus
	Electron from the nucleus

(3)

(b) A teacher demonstrates the penetration of alpha, beta and gamma radiation through different materials.

The demonstration is shown in the figure below.



Complete the figure above by writing the name of the correct radiation in each box.

(2)

(c) Give **two** safety precautions the teacher should have taken in the demonstration.

1 .....

.....

2 .....

.....

(2)

(d) The table below shows how the count rate from a radioactive source changes with time.

Time in seconds	0	40	80	120	160
Count rate in counts / second	400	283	200	141	100

Use the table to calculate the count rate after 200 seconds.

.....

.....

(2)

(e) The half-life of the radioactive source used was very short.

Give **one** reason why this radioactive source would be much less hazardous after 800 seconds.

.....

.....

(1)
(Total 10 marks)

Q6. The equation below shows the process by which two atomic nuclei join to form a different nucleus.

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

(a) Where does the process shown by the equation above happen naturally?

Tick (✓) **one** box.

Inside the Earth ☐

Inside a nuclear power station ☐

Inside the Sun ☐

(1)

(b) Use the correct answer from the box to complete the sentence.

fission	**force**	**fusion**

The process of joining two atomic nuclei to form a different nucleus is called nuclear ..... .

(1)

(c) What is released during this process?

Draw a ring around the correct answer.

charge **energy** **force**

(1)
(Total 3 marks)

Q7. Nuclear fission and nuclear fusion are two processes that release energy.

(a) (i) Use the correct answer from the box to complete each sentence.

Geiger counter	**nuclear reactor**	**star**

Nuclear fission takes place within a ..... .

Nuclear fusion takes place within a ..... .

(2)

(ii) State **one** way in which the process of nuclear fusion differs from the process of nuclear fission.

.....

.....

(1)

(b) The following nuclear equation represents the fission of uranium-235 (U-235).

$$^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{236}_{92}U \longrightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n + \text{energy}$$

Chemical symbols:

Ba - barium

Kr - krypton

(i) Use the information in the equation to describe the process of nuclear fission.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(ii) An isotope of barium is Ba-139.
Ba-139 decays by beta decay to lanthanum-139 (La-139).

Complete the nuclear equation that represents the decay of Ba-139 to La-139.

$$^{139}Ba \longrightarrow {}^{139}La + \quad \text{(.....)} \quad \text{(.....)} \quad \text{(.....)}$$

(3)

(Total 10 marks)

M1.(a) proton

all 3 in correct order

electron

*allow **1** mark for 1 correct do **not***

neutron

accept letters p, e, n

2

(b) 9

reason only scores if 9 is chosen

1

number of neutrons and protons

1

[4]

M2. (a) (i) **L**

1

(ii) **M**

1

(b) To make a smoke detector work.

1

(c) **40**

no tolerance

1

[4]

M3. (a) (i) half / 50 %

1

(ii) Measure the radon gas level in more homes in this area

1

(b) (i) 86

1

(ii) 222

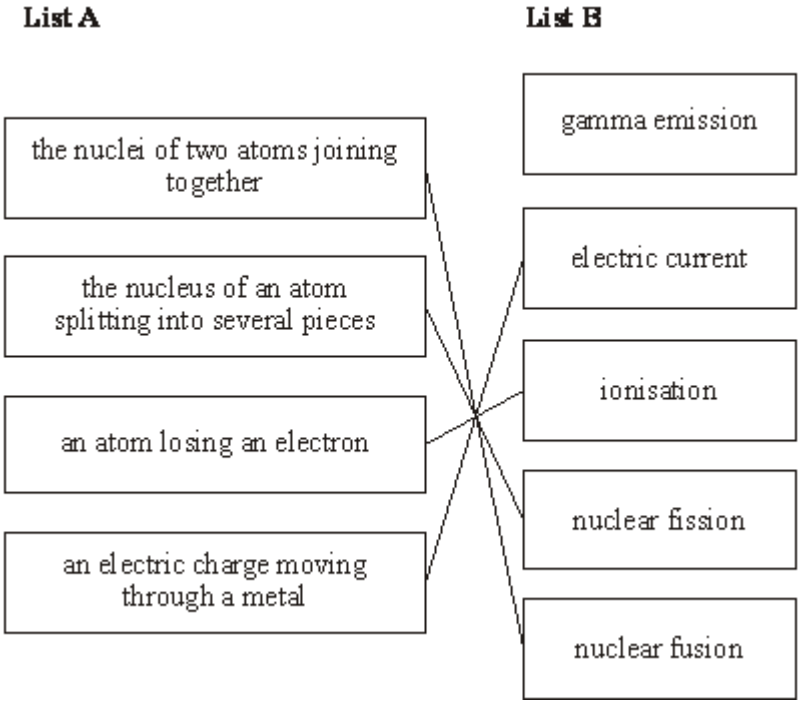
1

[4]

M4. **four** lines correct

*allow **1** mark for each correct line*

if more than 1 line is drawn from a box in List A, mark each line incorrect



[4]

M5.(a) Alpha – two protons and two neutrons

1

Beta – electron from the nucleus

1

Gamma – electromagnetic radiation

1

(b) Gamma

Beta

Alpha

*allow **1** mark for 1 or 2 correct*

2

(c) any **two** from:

- (radioactive) source not pointed at students
- (radioactive) source outside the box for minimum time necessary
- safety glasses **or** eye protection **or** do not look at source
- gloves
- (radioactive) source held away from body
- (radioactive) source held with tongs / forceps

accept any other sensible and practical suggestion

2

(d) half-life = 80 s

1

counts / s after 200 s = 71

accept an answer of 70

1

(e) very small amount of radiation emitted

accept similar / same level as background radiation

1

[10]

M6.(a) inside the Sun

1

(b) fusion

1

(c) energy

1

[3]

M7.(a) (i) nuclear reactor

1

star

1

(ii) nuclei are joined (not split)

accept converse in reference to nuclear fission
*do **not** accept atoms are joined*

1

(b) (i) any **four** from:

- neutron
- (neutron) absorbed by U (nucleus)

  ignore atom
  *do **not** accept reacts*
  *do **not** accept added to*
- forms a larger nucleus
- (this larger nucleus is) unstable
- (larger nucleus) splits into two (smaller) <u>nuclei</u> / into Ba and Kr
- releasing <u>three</u> neutrons and energy

  accept fast-moving for energy

4

(ii) 56 (Ba)

1

57 (La)

*if proton number of Ba is incorrect allow **1** mark if that of La is 1 greater*

1

$^{0}_{-1}\beta$

accept e for β

$^{139}_{56}Ba \longrightarrow {}^{139}_{57}La + {}^{0}_{-1}\beta$

*scores **3** marks*

1

[10]