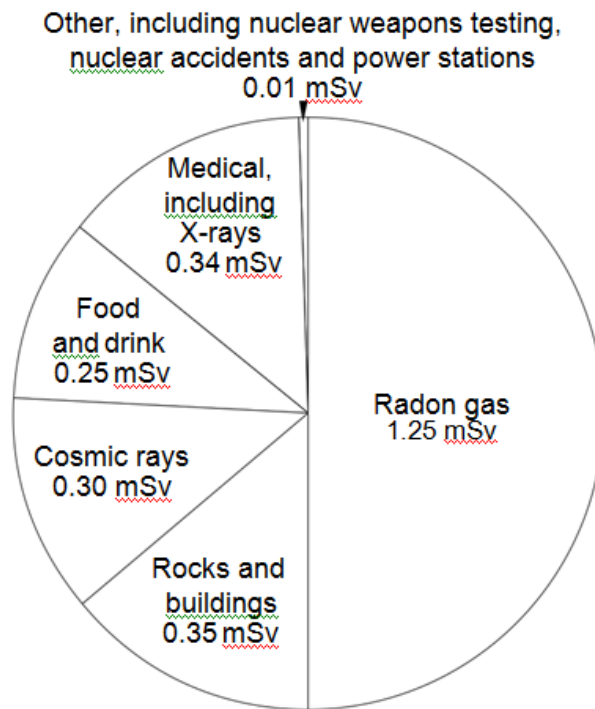# BACKGROUND RADIATION AND HAZARDS

Q:1 The pie chart shows the sources of the background radiation and the radiation doses that the average person in the UK is exposed to in one year.

Radiation dose is measured in millisieverts (mSv).

Other, including nuclear weapons testing, nuclear accidents and power stations
0.01 mSv

Medical, including X-rays
0.34 mSv

Food and drink
0.25 mSv

Cosmic rays
0.30 mSv

Rocks and buildings
0.35 mSv

Radon gas
1.25 mSv

(a) (i)   What is the total radiation dose that the average person in the UK receives?

_____

_____

Total radiation dose =_____ mSv

(1 mark)

(a) (ii) A student looked at the pie chart and then wrote down three statements. Which one of the following statements is a correct conclusion from this data? Put a tick (☐) in the box next to your answer.

In the future, more people will be exposed to a greater proportion of radon gas.   ☐

People that have never had an X-ray get 50% of their radiation dose from radon gas.   ☐

The radiation dose from natural sources is much greater than from artificial sources.   ☐

(1 mark)

 (b)The concentration of radon gas inside a home can vary from day to day. In some homes, the level can build up to produce a significant health risk. It is estimated that each year 1000 to 2000 people die because of the effects of radiation from radon gas.

(b) (i) It is not possible to give an exact figure for the number of deaths caused by the effects of radiation from radon gas. Why?

_____

_____

(1 mark)

The table gives data for the radiation levels measured in homes in 4 different parts of the UK. The radiation levels were measured using two detectors, one in the living room and one in the bedroom. The measurements were taken over 3 months.

Area of the UK	Number of homes in the area	Number of homes in the sample	Average radiation level in Bq/m^3	Maximum radiation level in Bq/m^3
A	590 000	160	15	81
B	484 000	130	18	92
C	221 000	68 000	162	10 000
D	318 000	35 300	95	6 900

(b) (ii) Give one reason why the measurements were taken over 3 months using detectors in different rooms.

_____

_____

(1 mark)

(b) (iii) Use information from the table to suggest why a much higher proportion of homes were sampled in areas C and D than in areas A and B.

_____

.   _____

(2 marks)

Q:2   (a)   Background radiation is all around us all the time.

(a) (i)Radon is a natural source of background radiation.
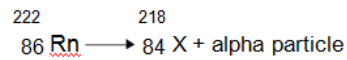
Name another natural source of background radiation.

_____

(1 mark)

(a) (ii) X-rays are an artificial source of background radiation.

Name another artificial source of background radiation.

_____

(1 mark)

(a) (iii) An atom of radon-222 decays by emitting an alpha particle. The equation representing the decay is shown below.

$$^{222}_{86}Rn \longrightarrow {}^{218}_{84}X + \text{alpha particle}$$

How can you tell from the equation that 'X' is not an atom of radon?

_____

_____

(1 mark)

(b)Having an X-ray taken increases your exposure to radiation.

The table gives:

☐   the radiation doses received for 6 different medical X-rays;

☐   the number of days' of exposure to natural background radiation each dose is equivalent to.

Medical X-ray	Radiation dose received (in arbitrary units)	Equivalent number of days of exposure to natural background radiation
Chest	2	2.4
Skull	7	8.4
Pelvis	22	26.4
Hip	44	52.8
Spine	140	
CT head scan	200	240

A hospital patient has an X-ray of the spine taken.

Calculate the number of days of exposure to natural background radiation that an X-ray of the spine is equivalent to.

Show how you work out your answer.

_____

_____

_____

Equivalent number of days = _____

(2 marks)

(c) Scientists have shown that X-rays increase the risk of developing cancer.

The scientists came to this conclusion by studying the medical history of people placed in one of two groups, A or B.

The group into which people were put depended on their X-ray record.

(c) (i)   Person J has been placed into group A.

Place each of the people, K, L, M, N and O, into the appropriate group, A or B.

Person	J	K	L	M	N	O
Medical X-ray record	3 arm	None	None	2 skull	None	4 leg

Group A	Group B
J	

(1 mark)

(c) (ii) To be able to make a fair comparison, what is important about the number of people in each of the two groups studied by the scientists?

_____

_____

(1 mark)

(c) (iii) What data would the scientists have compared in order to come to the conclusion that X-rays increase the risk of developing cancer?

_____

_____

(1 mark)

(c) (iv) The chance of developing cancer due to a CT head scan is about 1 in 10 000. The chance of developing cancer naturally is about 1 in 4.

A hospital patient is advised by a doctor that she needs to have a CT head scan.

The doctor explains to the patient the risks involved.

Do you think that the patient should give her permission for the CT scan to be taken?

Draw a ring around your answer.

Yes   No

Give a reason for your answer.

_____

_____

(1 mark)

Q:3   The table shows the average background radiation dose from various sources that a person living in Britain receives in one year.

Source of background radiation	Average amount each year in dose units
Buildings	50
Food and drink	300
Medical treatments (including X-rays)	300
Radon gas	1250
Rocks	360
Space (cosmic rays)	240
TOTAL	2500

(a)Only two of the following statements are true. Tick (☑) the boxes next to the true statements.

Half the average background radiation dose comes from radon ☐s.

Everyone receives the same background radiation do☐

Cosmic rays produce less background radiation than food and d☐k.

(1 mark)

(b) Most sources of background radiation are natural but some are artificial (man-made). Which source of background radiation given in the table is artificial?
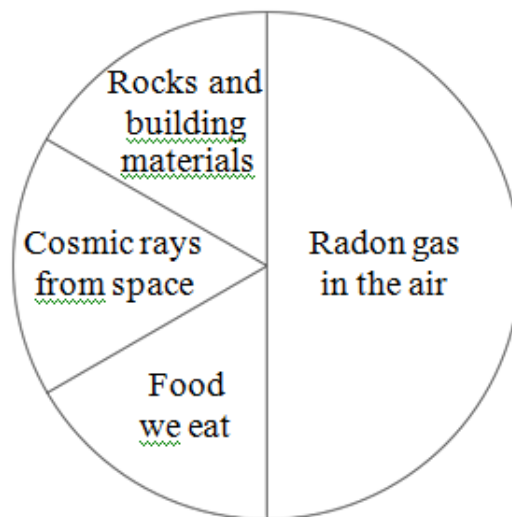
_____

(1 mark)

(c) Each time a dental X-ray is taken, the patient receives about 20 units of radiation. How many dental X-rays would give the yearly average dose for medical treatments?

_____

_____

Number of X-rays = _____

(2 marks)

5 (a) The pie chart shows the average proportions of natural background radiation from various sources in one part of the UK.

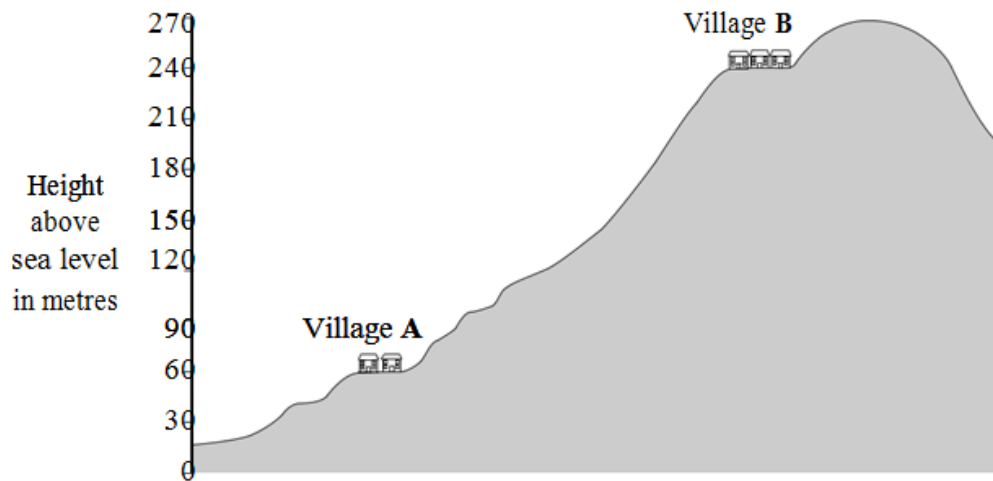(a)(i)What proportion of the background radiation comes from radon gas?

_____

(a)(ii)Suggest why our bodies are slightly radioactive.

_____

_____

(b) The level of background radiation from cosmic rays is not the same everywhere.

For every 30 metres above sea level, the amount of background radiation increases by one unit.

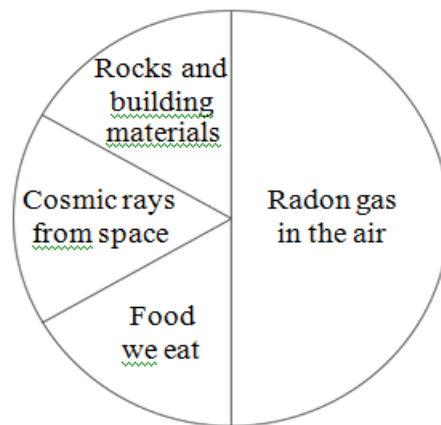The diagram shows the position of two villages, A and B, built on a hill.

How is the amount of background radiation from cosmic rays different in village A compared to village B?

To obtain full marks you must include a calculation in your answer.

_____

_____

_____

_____

(3 marks)

Q:6 The pie chart shows the average proportions of background radiation from various sources in the UK.

Three sources of background radiation are given in List A.

Statements about sources of background radiation are given in List B.

Draw one line to link each source of background radiation in List A to the statement about that source given in List B.

Draw only three lines.

List A	List B
Are used to show broken bones.	X-rays
The radiation comes from outer space.	Cosmic rays
Comes from soil containing a radioactive isotope of potassium.	Radon gas
Gives about 50 % of all background radiation.	

(3 marks)

TOTAL MARKS= 27 MARKS