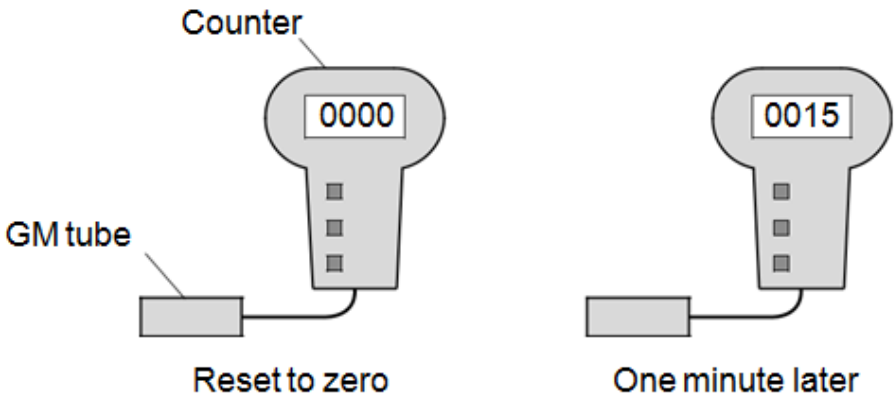
BACKGROUND RADIATIONS AND HAZARDS 2

Q:1 **(a)** A teacher used a Geiger-Műller (GM) tube and counter to measure the background radiation in her laboratory.

The teacher reset the counter to zero, waited one minute and then took the count reading. The teacher repeated the procedure two more times.



(a) (i) Background radiation can be either from natural sources or from man-made sources.

Name one man-made source of background radiation.

_____

(1 mark)

(a) (ii) The three readings taken by the teacher are given in the table.

Count after one minute
15
24
18

The readings given in the table are correct.

Why are the readings different?

_____

_____

(1 mark)

(b) Some scientists say they have found evidence to show that people living in areas of high natural background radiation are less likely to develop cancer than people living in similar areas with lower background radiation.

The evidence these scientists found does not definitely mean that the level of background radiation determines whether a person will develop cancer.

Suggest a reason why.

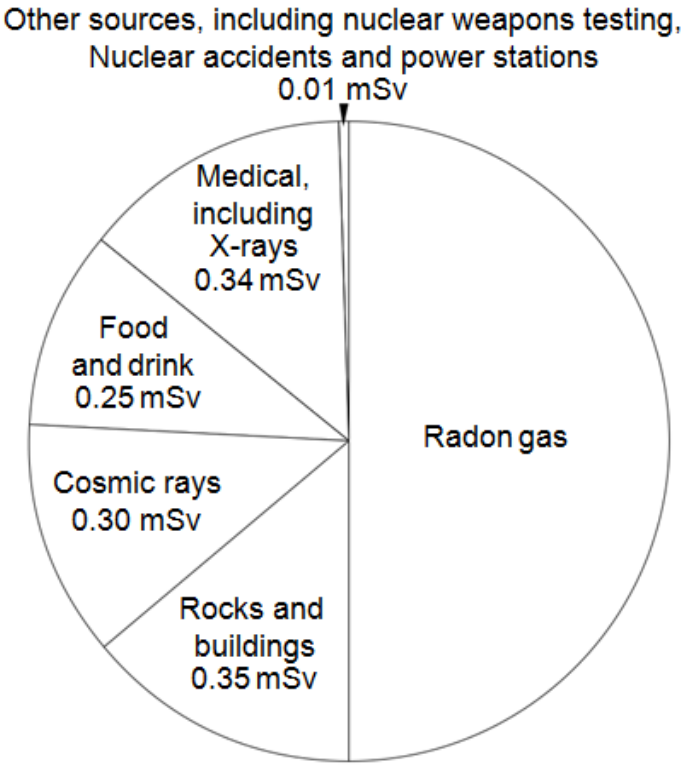
_____

_____

(1 mark)

Q:2 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).



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

_____

_____

Radiation dose from radon gas = _____ mSv

(1 mark)

(a) (ii) A person may receive a higher than average dose of radiation from background sources. Suggest two reasons why.

1 _____

_____

2 _____

_____

(2 marks)

(b) Exposure to radon gas can cause lung cancer.A recent study has compared the risk of getting lung cancer, by the age of 75 years, for cigarette smokers and non-smokers.The people in the study had been exposed throughout their lives to different levels of radon gas.

A summary of the data produced from the study is given in the table.

Exposure to radon gas	Risk of lung cancer by age of 75	
	Non-smoker	Smoker
No exposure	0.4 %	10 %
Moderate exposure	1.0 %	14 %
Very high exposure	1.5 %	32 %

(b) (i) Why were people that have had no exposure to radon gas included in the study?

_____

_____

(1 mark)

(b) (ii) Using information from the table, what conclusions can be made about exposure to radon gas and the risk of getting lung cancer?

_____

_____

_____

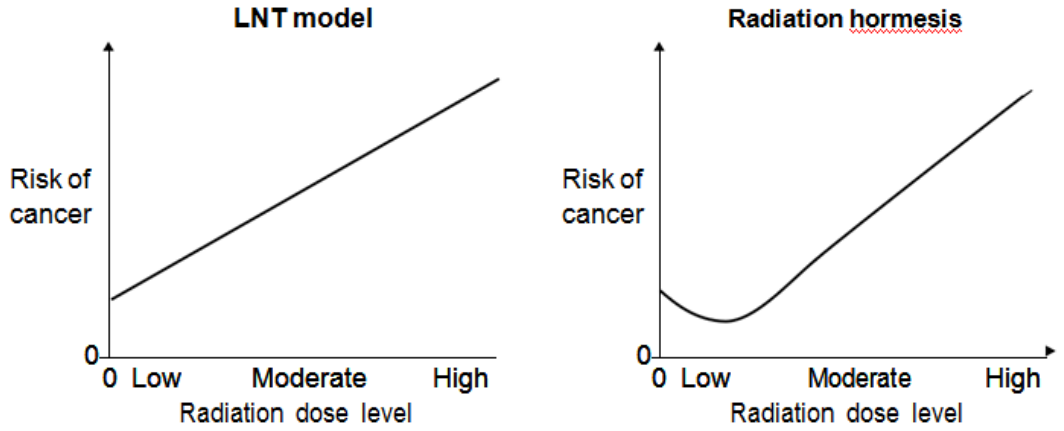
_____

(2 marks)

At the moment, the regulations designed to protect people from over-exposure to radiation are based on a model called the 'linear no-threshold' (LNT) model.

Some scientists believe that the LNT model is too simple. These scientists believe that at low radiation levels a process called 'radiation hormesis' happens.

The graphs show that each model suggests a link between the risk of developing a cancer and exposure to low levels of radiation.



The link between the risk of developing cancer and exposure to low levels of radiation suggested by each of the models is different.

c) Describe how.

_____

_____

_____

(2 marks)

Q:3 **(a)**Sources of background radiation are either natural or man-made.

Which two of the sources listed in the box are natural sources of background radiation?

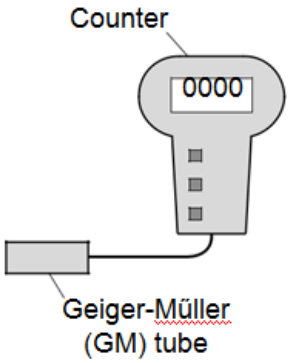
Draw a ring around each of your answers.

cosmic rays nuclear accidents X-rays radon gas

(2 marks)

(b)A teacher used a Geiger-Műller (GM) tube and counter to measure the background radiation in her laboratory. The teacher reset the counter to zero, waited one minute and then took the count reading. The teacher repeated this two more times.

The three readings taken by the teacher are given in the table.



Count
17
21
19

(b) (i) The three readings are different.What is the most likely reason for this?

Tick (☒) one box.

The teacher did not reset the counter to zero. ☐

Radioactive decay is a random process ☐

The temperature in the laboratory changed. ☐

(1 mark)

(b) (ii) Calculate the mean (average) value of the three readings given in the table.

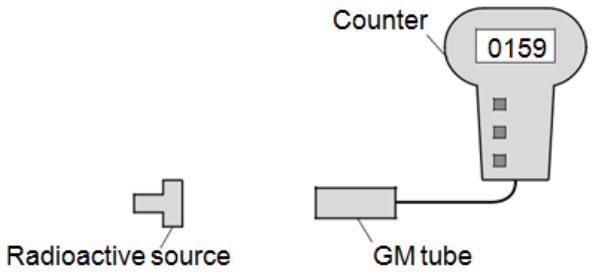
_____

Mean (average) value = _____ counts

(1 mark)

(b) (iii) The diagram shows how the teacher used the GM tube and counter to measure the radiation emitted from a radioactive source.

The counter was reset to zero. The count after one minute was 159.



Calculate how many counts were due to the radiation from the radioactive source.

_____

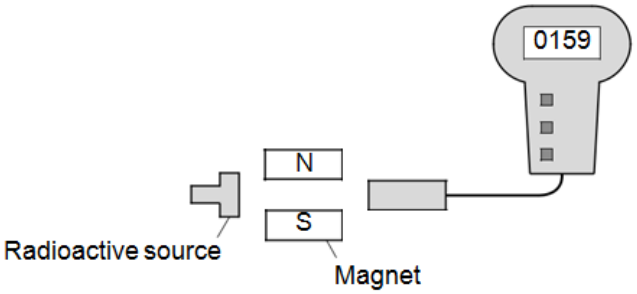
_____

Counts due to the radiation from the radioactive source = _____

(1 mark)

(b) (iv) The teacher then put a powerful magnet between the radioactive source and the GM tube.

The counter was reset to zero. The number on the counter shows the count after one minute.



What type of radiation was being emitted from the radioactive source?

Draw a ring around your answer.

alpha beta gamma

Explain the reason for your answer.

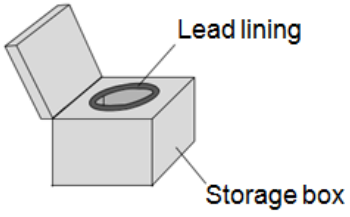
_____

_____

_____

(3 marks)

(c) At the end of the lesson the teacher put the radioactive source back inside its storage box.



Why is the inside of the box lined with lead?

_____

_____

(1 mark)

(d) Which one of the following questions cannot be answered by scientific study? Tick (✓) one box.

Where does background radiation come from? ☐

What is meant by the half-life of a radioactive source? ☐

Should radioactive waste be dumped in the oceans? ☐

(1 mark)

Q:4 The table shows the average background radiation dose from various sources that a person living in the UK receives in one year.

Source of background radiation	Average radiation dose received each year in dose units
Cosmic rays (from space)	300
Food and drink	250
Medical treatments (including X-rays)	350
Radon gas	1250
Rocks	350
TOTAL	2500

(a) (i) A student looked at the data in the table and then wrote down four statements.Only two of the statements are true.Put a tick (✓) in the boxes next to the two true statements.

More than half of the average radiation dose comes from radon gas

On average, cosmic rays produce less background radiation than rocks.

Everyone living in the UK receives the same background radiation dose.

Having no X-rays reduces a person's radiation dose.

(2 marks)

(a) (ii) Each time a chest X-ray is taken, the patient receives about 100 units of radiation.

How many chest X-rays would just exceed the yearly average dose for medical treatments?

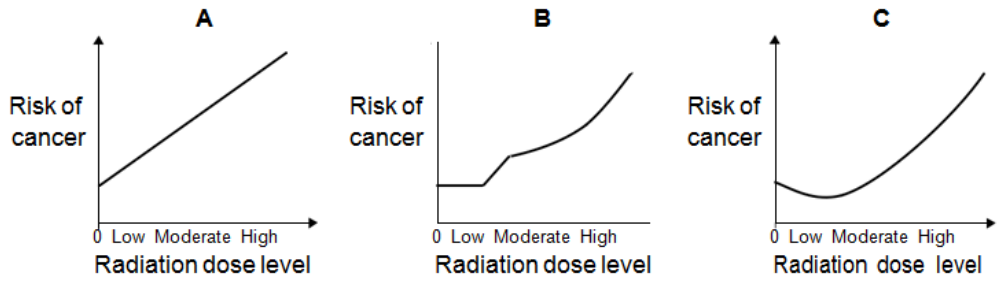
_____

Number of chest X-rays = _____

(2 marks)

(b) Exposure to radiation can cause cancer.

The graphs, A, B and C, show three different ways that the exposure to radiation and the risk of getting cancer could be linked.



(b) (i) What do all three of these graphs suggest happens to the risk of getting cancer when the radiation dose goes from moderate to high?

_____

_____

(1 mark)

(b) (ii) Some scientists believe that exposure to low radiation doses reduces the chance that a person will get cancer. This effect is called 'radiation hormesis'.

Which one of the graphs, A, B or C, shows 'radiation hormesis'?

Give a reason for your answer.

_____

_____

_____

(2 marks)

(c) Scientists did an experiment in which mice were exposed to different doses of radiation.

The results from the experiment are given in the table.

Description of exposure	Percentage of mice getting cancer
Mice exposed to a low dose of radiation and then a high dose of radiation.	16%
Mice exposed to a high dose of radiation only.	46%

(c) (i) Do the results from this experiment provide evidence to support 'radiation hormesis'?

Draw a ring around your answer. NO YES

Explain the reason for your answer.

_____

_____

_____

_____

(2 marks)

(c) (ii) Complete the following sentence by drawing a ring around the correct word in the box.

Using animals in scientific experiments raises

Environmental
ethical
social

issues.

(1 mark)

TOTAL MARKS=31