

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

- (a) Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

- (i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

(2)

- (ii) What is released during both nuclear fission and nuclear fusion?

(1)

- (b) Plutonium-239 is used as a fuel in some nuclear reactors.

- (i) Name another substance used as a fuel in some nuclear reactors.

(1)

- (ii) There are many isotopes of plutonium.

What do the nuclei of different plutonium isotopes have in common?

(1)

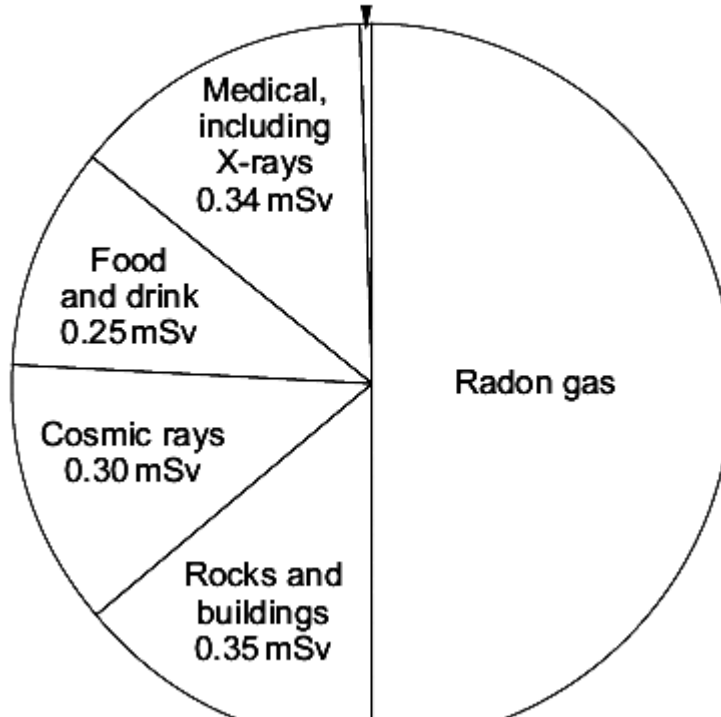
(Total 5 marks)

Q2.

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 sources, including nuclear weapons testing,
nuclear accidents and power stations
0.01 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)

- (ii) A person may receive a higher than average dose of radiation from background sources.

Suggest **two** reasons why.

1. _____

2. _____

(2)

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

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

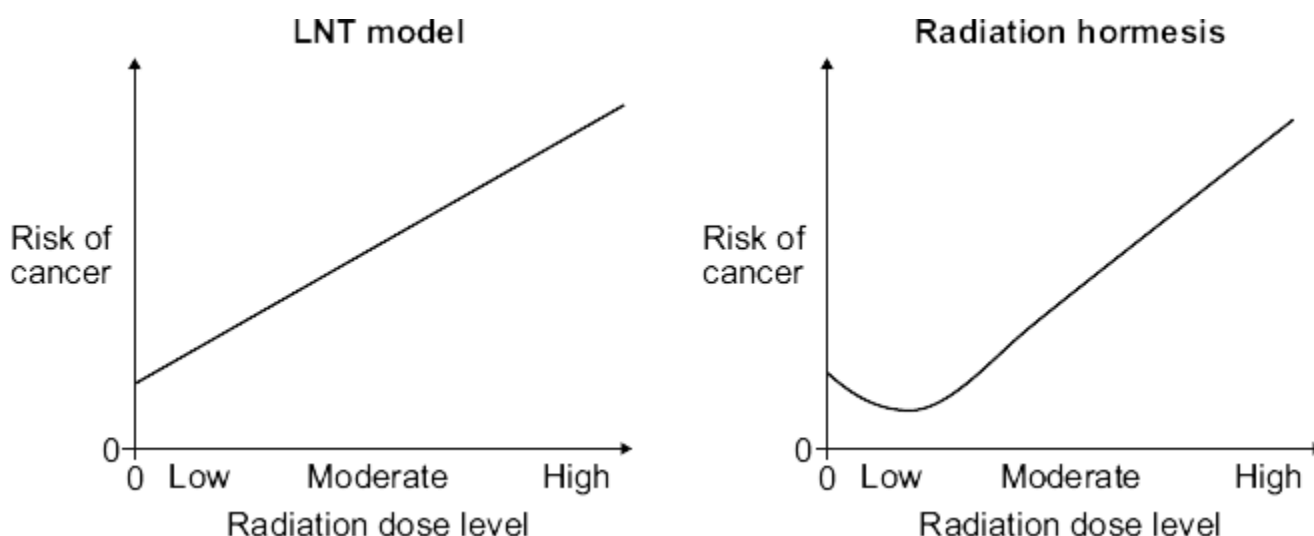
(1)

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

(2)

- (c) 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.

Describe how.

(2)

- (d) Scientists have conducted experiments in which mice have been exposed to different levels of radiation. The number of mice developing a cancer has then been measured.

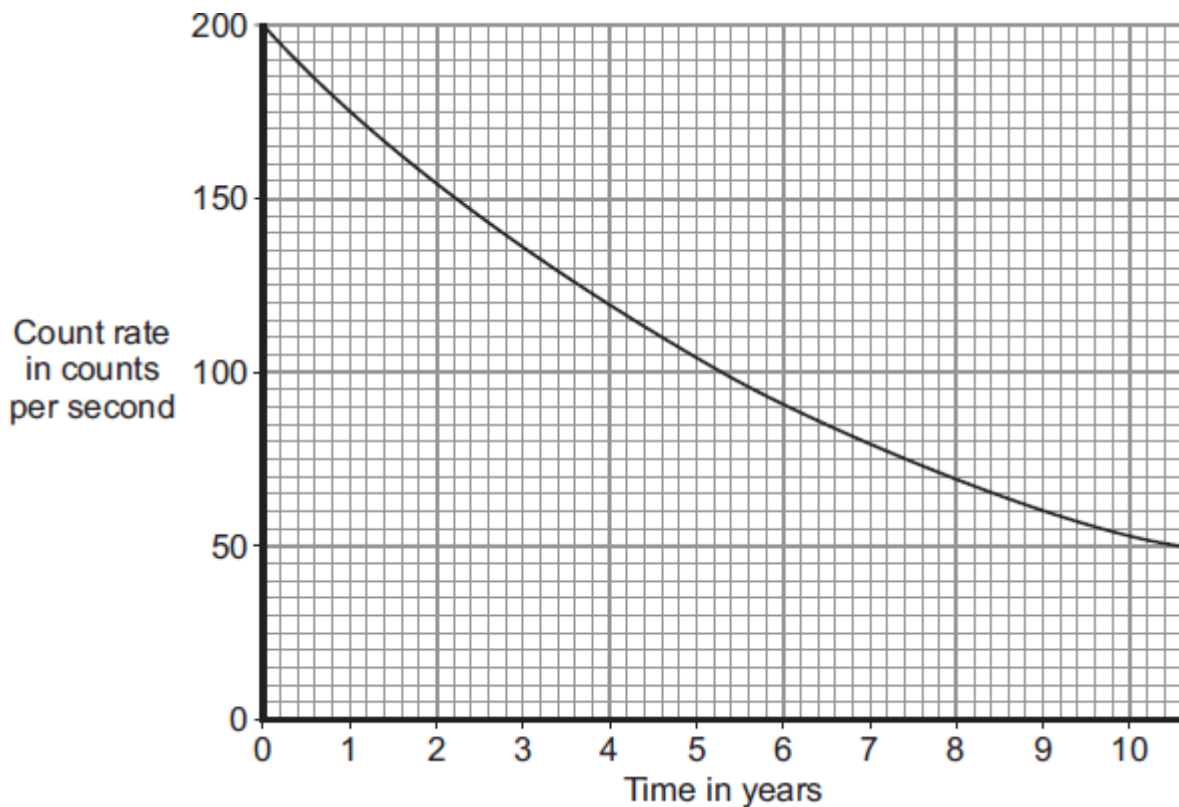
Discuss whether it is ethical to use animals in scientific experiments.

(2)

(Total 10 marks)

Q3.

- (a) The graph shows how the count rate from a sample containing the radioactive substance cobalt-60 changes with time.



- (i) What is the range of the count rate shown on the graph?

From _____ counts per second to _____ counts per second.

(1)

- (ii) How many years does it take for the count rate to fall from 200 counts per second to 100 counts per second?

Time = _____ years

(1)

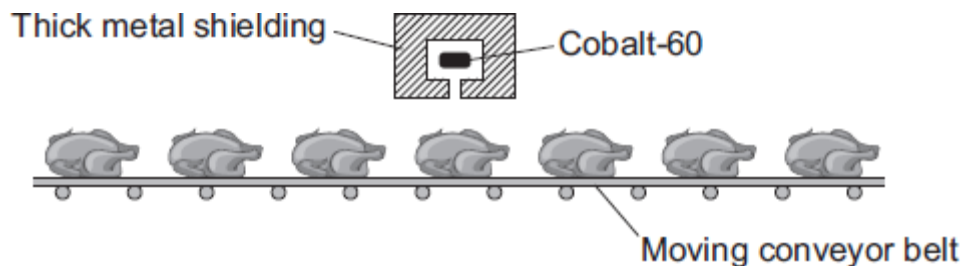
- (iii) What is the half-life of cobalt-60?

Half-life = _____ years

(1)

- (b) The gamma radiation emitted from a source of cobalt-60 can be used to kill the bacteria on fresh, cooked and frozen foods. Killing the bacteria reduces the risk of food poisoning.

The diagram shows how a conveyor belt can be used to move food past a cobalt-60 source.



- (i) Which **one** of the following gives a way of increasing the amount of gamma radiation the food receives?

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

Increase the temperature of the cobalt-60 source.

☐

Make the conveyor belt move more slowly.

☐

Move the cobalt-60 source away from the conveyor belt.

☐

(1)

- (ii) To protect people from the harmful effects of the gamma radiation, the cobalt-60 source has thick metal shielding.

Which **one** of the following metals should be used?

Draw a ring around your answer.

aluminium

copper

lead

(1)

- (c) A scientist has compared the vitamin content of food exposed to gamma radiation with food that has not been exposed.

The table gives the data the scientist obtained when she tested 1 kg of cooked chicken.

Vitamin	Food not exposed to gamma radiation	Food exposed to gamma radiation
	Mass in milligrams	Mass in milligrams
B6	1.22	1.35
B12	21.00	28.00
E	3.30	2.15
Niacin	58.00	55.50
Riboflavin	2.10	2.25

Considering only this data, which **one** of the following is a correct conclusion?

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

Vitamin content is not affected by gamma radiation.

☐

Gamma radiation completely destroys some types of vitamin.

☐

Exposure increased the content of some types of vitamin.

☐

(1)
(Total 6 marks)