

# Nuclear Radiations and Isotopes 2

**Q:1(a)** The names of three types of radiation are given in List A. Various properties of these three types of radiation are given in List B.

Draw a line to link each type of radiation in List A to its correct property in List B.

List A Type of radiation	List B Property of radiation
alpha ( $\alpha$ )	not dangerous
beta ( $\beta$ )	stopped by paper
gamma ( $\gamma$ )	travels at 300 000 000 m/s
	travels up to 1 metre in air

(3 marks)

**(b)** This sign warns people that a radioactive source is being used in a laboratory.



Why is it important to warn people that a radioactive source is being used?

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(1 mark)

**(c)** To study the blood flow in a patient's lungs, a doctor injects some technetium-99 compound into the patient. The gamma radiation given out by the technetium-99 atoms is detected using a gamma camera outside the patient's body.

Which statement gives the reason why gamma radiation is used? Put a tick (☑) in the box next to your choice.

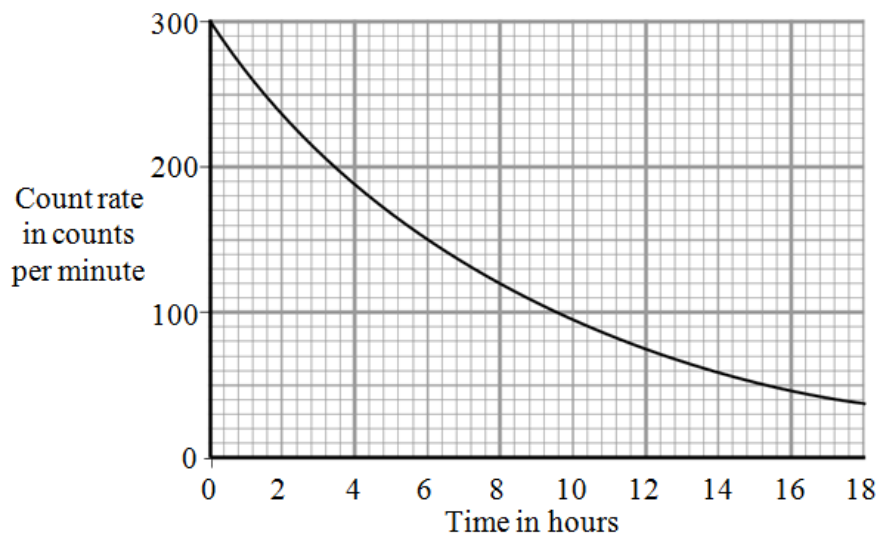
It can travel through a vacuum.

It is not affected by a magnet.

It can pass through the human body.

(1 mark)

**(d)** The graph shows how the count rate from a sample of technetium-99 changes with time.



(i) How many hours does it take for the count rate to fall from 300 counts per minute to 150 counts per minute?

Time = \_\_\_\_\_ hours

(1 mark)

(ii) What is the half-life of technetium-99?

Half-life = \_\_\_\_\_ hours

(1 mark)

**Q:2 (a)** Alpha particles ( $\alpha$ ), beta particles ( $\beta$ ) and gamma rays ( $\gamma$ ) are types of nuclear radiation.

Which of the three types of radiation is the most strongly ionising?

\_\_\_\_\_

(1 mark)

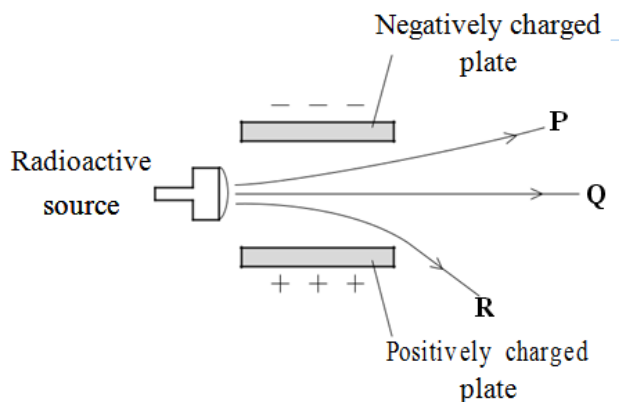
**b)** What effect does nuclear radiation have on living cells?

\_\_\_\_\_

(1 mark)

**Q:3** A radioactive source emits alpha ( $\alpha$ ), beta ( $\beta$ ) and gamma ( $\gamma$ ) radiation. The diagram shows what happens to the radiation as it passes between two charged metal plates.

**Diagram 1**



(a) Which line P, Q or R shows the path taken by:

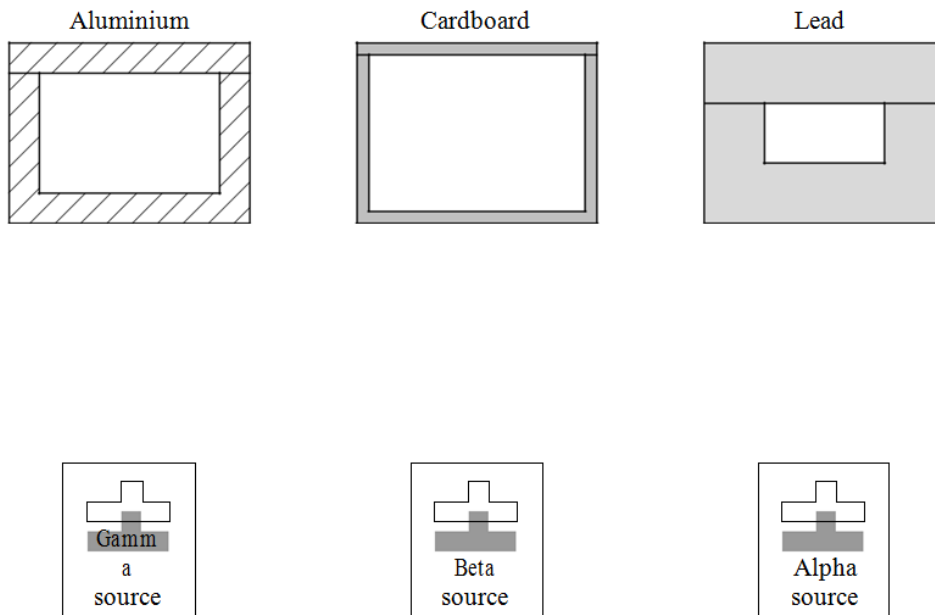
(i) alpha radiation \_\_\_\_\_

(1 mark)

(ii) gamma radiation? \_\_\_\_\_

(1 mark)

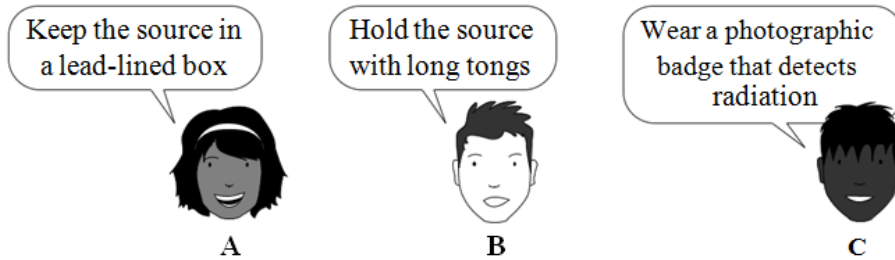
(b) The diagram shows three different boxes and three radioactive sources. Each source emits only one type of radiation and is stored in a different box. The box reduces the amount of radiation getting into the air.



Draw three lines to show which source should be stored in which box so that the minimum amount of radiation gets into the air.

(2 marks)

**Q:4** Before using a radioactive source, a teacher asked her students to suggest safety procedures that would reduce her exposure to the radiation. The students made the following suggestions.

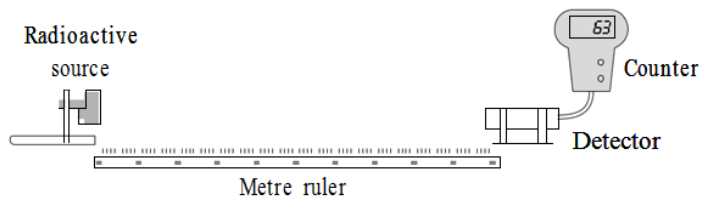


**(a)** Which suggestion, A, B or C, would not reduce the exposure of the teacher to radiation?

\_\_\_\_\_

(1 mark)

**(b)** The diagram shows how the teacher measured the distance that the radiation travelled from the source. The count-rate at different distances from the source was measured and recorded in the table.



Distance from source to detector in cm	Count-rate in counts per minute
20	85
40	81
60	58
80	53
100	23

What type of radiation was the source emitting, alpha, beta or gamma?

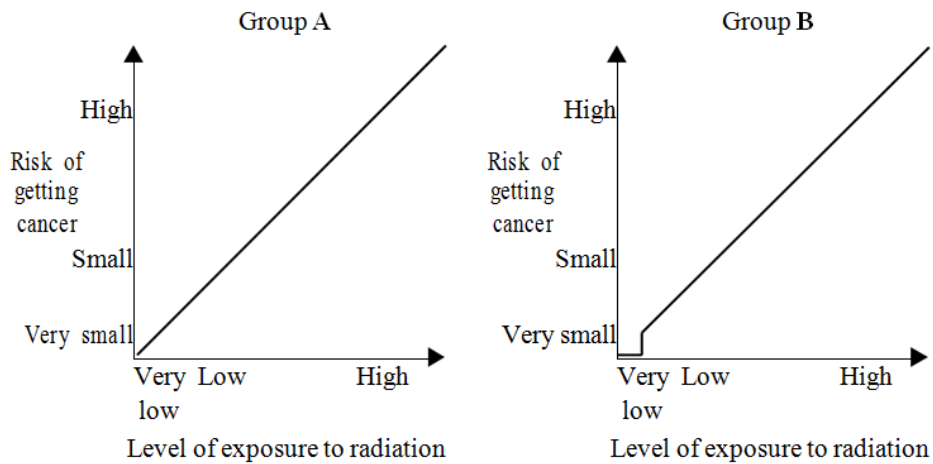
\_\_\_\_\_

Explain the reasons for your choice.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(3 marks)

**(c)** The graphs show how two groups of scientists, A and B, link exposure to radiation and the risk of getting cancer.



**(c)(i)** Complete the following sentence using a word or phrase from the box.

decreases	has no effect on	increases
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Both groups of scientists agree that a high level of exposure to radiation \_\_\_\_\_  
the risk of getting cancer.

(1 mark)

**(c)(ii)** Use the graphs to describe carefully how the two groups of scientists disagree  
when the level of exposure to radiation is very low.

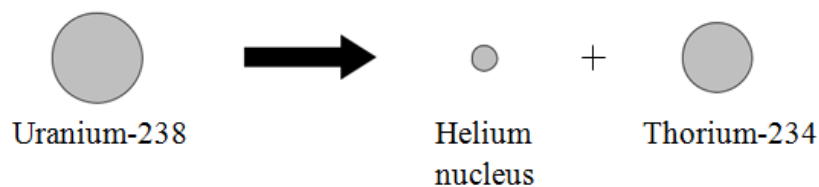
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(2 marks)

**Q:5 (a)** Some rocks inside the Earth contain uranium-238, a radioactive isotope of uranium. When an atom of uranium-238 decays, it gives out radiation and changes into a thorium-234 atom.



**(a)(i)** What type of radiation is emitted when a uranium-238 atom decays?

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(1 mark)

**(a)(ii)** From which part of a uranium-238 atom is the radiation emitted?

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(1 mark)

**(a)(iii)** Uranium-235 is another isotope of uranium. How is an atom of uranium-235 similar to an atom of uranium-238?

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(1 mark)

**Q:6(a)** The names of the three types of nuclear radiation are given in List A.

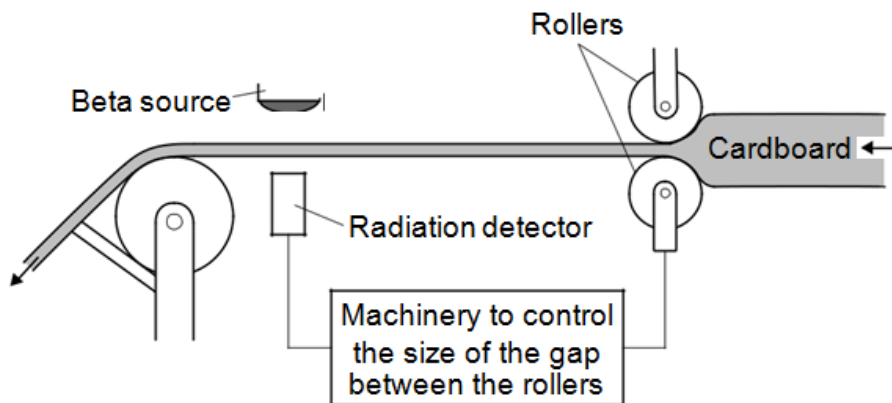
Some properties of these types of radiation are given in List B.

Draw a straight line to link each type of radiation in List A to its correct property in List B.

Draw only three lines.

List A Type of nuclear radiation	List B Property of radiation
Alpha	Has the same mass as an electron
Beta	Very strongly ionising
Gamma	Passes through 10cm of aluminium
	Deflected by a magnetic field but <u>not</u> deflected by an electric field

**(b)** The diagram shows a system used to control the thickness of cardboard as it is made.





The cardboard passes through a narrow gap between a beta radiation source and a radiation detector.

The table gives the detector readings over 1 hour.

Time	Detector reading
08:00	150
08:15	148
08:30	151
08:45	101
09:00	149

**(b) (i)** Between 08:00 and 08:30, the cardboard is produced at the usual, correct thickness.

Explain how you can tell from the detector readings that the cardboard produced at 08:45 is thicker than usual.

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(2 marks)

**(b) (ii)** Which would be the most suitable half-life for the beta source?

Draw a ring around your answer.

six days      six months      six years

(1 mark)

**(b) (iii)** This control system would not work if the beta radiation source was replaced by an alpha radiation source. Why not?

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(1 mark)

TOTAL MARKS=