

Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

When a photographic film that is not exposed to light is placed near to a source of ionising radiation the film darkens.

(a) (i) State what is meant by ionising radiation.

(1)

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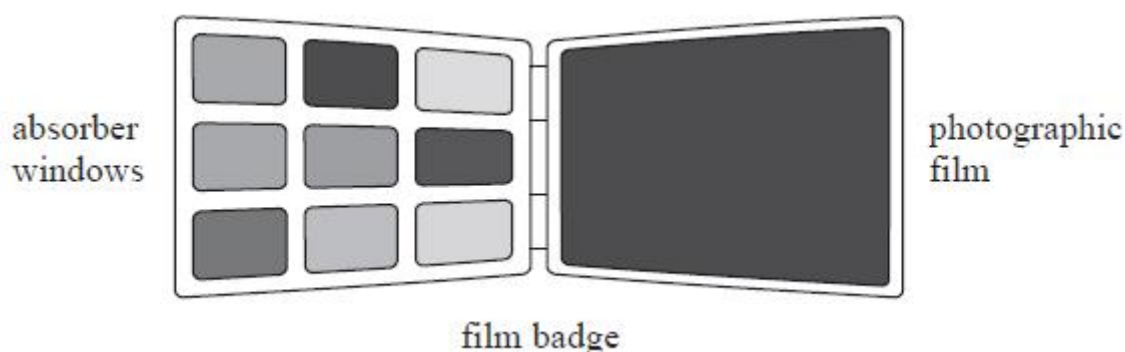
(ii) Complete the table to show α , β , and γ radiations in order of increasing ionising power.

(1)

Least ionising	_____→	Most ionising

(b) In a physics lesson some students are learning about the use of a film badge to monitor exposure to ionising radiation.

Each absorber window is made from a different material and the type of radiation can be determined from the extent to which the film is darkened.



The students are asked to predict what would happen if α , β , and γ radiations were incident upon absorber windows made from paper, aluminium and lead.

(i) Complete the table to show the penetration of α , β , and γ radiations through each material.

Use the words "passes through" or "stopped".

(3)

	Paper	0.5 cm aluminium	0.5 cm lead
α radiation		stopped	
β radiation			stopped
γ radiation	passes through		

(ii) In a nuclear power plant there may be other radiation present which would **not** be detected by a film badge.

Suggest what type of radiation this is and why it would not be detected by a film badge.

(2)

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(Total for question = 7 marks)

Q2.

State what is meant by binding energy.

(2)

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(Total for question = 2 marks)

Q3.

On 1st November 2006, the former Russian spy Alexander Litvinenko fell ill. Twenty one days later he died from the radiation effects of polonium-210. Experts suggest that as little as 0.89 μg of polonium-210 would be enough to kill, although Mr Litvinenko's death was linked to a much larger dose of the radioactive isotope. Traces of the isotope were later found in washrooms at five locations around London visited by the Russian.

Polonium-210 has a half life of 138 days.

(a) (i) In a 0.89 μg sample of polonium-210 there are 2.54×10^{15} atoms of polonium. Show that the decay constant for polonium-210 is about $6 \times 10^{-8} \text{ s}^{-1}$, and hence calculate the activity of a sample of this size.

(4)

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Activity =

(ii) Calculate the fraction of polonium-210 nuclei that have decayed after a time of 21 days. (3)

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Fraction decayed =

(b) Polonium-210 emits alpha particles. Explain why polonium-210 is virtually harmless unless it is taken into the body. (2)

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(c) (i) Complete the equation below for the decay of polonium. (2)



(ii) State why the Pb nuclei would recoil from the alpha particles emitted during the decay. (1)

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(d) Radioactive decay is said to occur spontaneously and randomly. Explain what is meant by spontaneous and random in this context. (2)

Spontaneous

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Random

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(e) Suggest why traces of the isotope were found in locations visited by the Russian.

(2)

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(Total for Question = 16 marks)