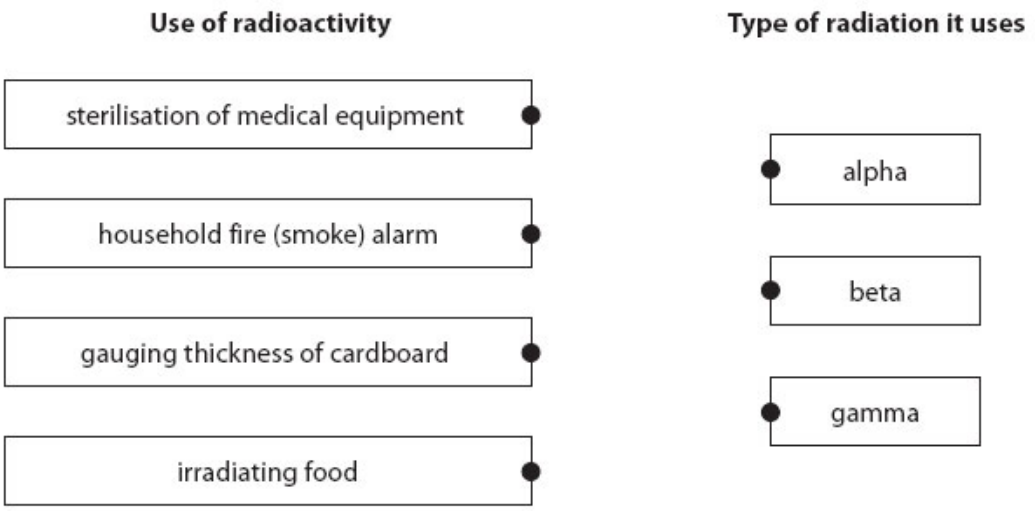
Questions

Q1.

Here are four uses of radioactivity.
Draw a line from each one of them to the type of radiation it uses.

Each type of radiation may be chosen once, more than once or not at all.

(4)



Q2. * Used nuclear fuel is removed from a reactor for reprocessing.

The workers who remove the fuel are at risk.

Explain how the safety precautions the workers take help to reduce the risks.

(6)

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Q3.

Some nuclear reactors used to generate electricity also produce cobalt-60.

(i) When cobalt-60 decays it releases high energy gamma rays.

Which of these is a correct use of gamma rays?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** smoke detectors

☒ **B** monitoring the thickness of paper

☒ **C** sterilising hospital equipment

☒ **D** reducing background radiation

(ii) Explain why gamma rays are dangerous.

(2)

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(iii) A sample of nuclear waste contains 2.0 mg of cobalt-60.

The half-life of cobalt-60 is 5 years.

Calculate the mass of cobalt-60 remaining after 10 years.

(2)

mass = ... mg

(iv) State one safety precaution that should be taken when storing cobalt-60.

(1)

.....

(Total for question = 6 marks)

Q4.

The main purpose of nuclear reactors is to generate electricity.

(i) Describe two advantages of generating electricity using nuclear reactors compared to generating electricity using fossil fuels.

(2)

1 .....

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2 .....

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(ii) Nuclear reactors used to generate electricity produce dangerous radioactive waste.

Describe one method of dealing with this radioactive waste safely.

(2)

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(Total for question = 4 marks)

Q5.

Hospitals use ionising radiation for many purposes.

(a) State **one** use of ionising radiation in a hospital.

(1)

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(b) An isotope of technicium, technicium-99, has a half-life of 6 hours.

A hospital has a sample which contains 40 mg of technicium-99.

Calculate how much technicium-99 will be in this sample after 12 hours.

(2)

amount remaining = ... mg

Q6.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The unit of activity of a radioactive isotope is the

(1)

☒ **A** americium

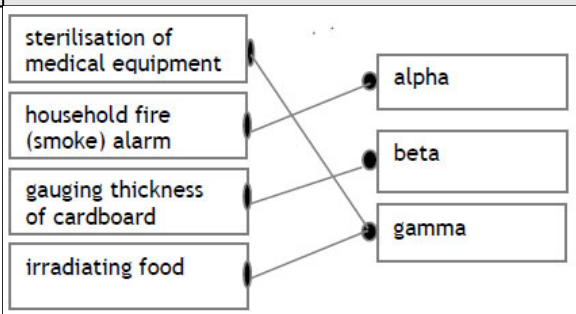
☒ **B** becquerel

☒ **C** einstein

☒ **D** radium

Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
		one mark for each correct line	**(4)**

Q2.

Question Number		Indicative content	Mark
QWC	*	An explanation linking some of the following points **Risks** • fuel rods have high temperature when removed from reactor • different types of ionising radiation produce different dangers • energy from the ionising radiation can be absorbed by the human body • (prolonged) exposure to radiation can cause {tissue / cell} damage and {mutation / damage to DNA}	**(6)**

		• increased risk due to long term exposure to raised background levels of radiation • damage to rods during transport • leak from {reactor / rods / reprocessing unit } **Safety precautions** • appropriate working practices should be adopted protective clothing and handling systems should be used • people working with radioactive material should minimise their exposure to the ionising radiation • intensity of radiation decreases with distance from the source • personal radiation dose should be monitored • monitoring of background levels of radiation • use of canister to carry fuel rods	
Level	**0**	No rewardable material	
1	**1-2**	• a limited explanation of risk or precautions e.g. alpha particles can cause cancer • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3-4**	• some explanation of risk and precaution e.g. idea of relative dangers of some ionising radiations and some sensible suggestions	

		regarding working practice • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed explanation of appropriate precautions clearly linked to risks (ORA) e.g. idea that intensity of radiation decreases according to the nature of the medium through which it is travelling therefore the canister should be of a high density material in order to reduce escape of ionising radiation • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Q3.

Question Number	Answer	Acceptable answers	Mark
(i)	**C** sterilising hospital equipment		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	an explanation linking any **two** of the following: • (gamma rays are) ionising (1) • (gamma rays are very/highly) penetrating (1) • cause {DNA/cells} to mutate (1) • cause cancer (1)	accept reverse arguments eg difficult to shield against as reverse to penetrating ignore radioactive ignore high energy as in stem penetrate body/tissue/skin/cells/paper /aluminium/lead accept damage your insides for idea of penetration only mutates/damages {DNA/cells/tissue/ organs} condone kills cells/cause mutation(s) ignore harm cells/kill you tumours damage cells inside your body scores two marks for damage cells and penetration	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	idea of halving mass (1) 0.5(0) (mg) (1)	1(.00) (mg) accept idea of 2 half-lives for this mark ignore 60 ÷ 2 AND 10 ÷ 2 for this mark allow both marks for correct answer with no working shown. no power of ten error on this item	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iv)	any **one** from: • use a lead (-lined) box **(1)** • warning signs **(1)** • restricted access owtte **(1)** • locked room/cupboard **(1)**	ignore references to temperature/safety goggles/gloves/don't touch it/keep it at a distance/protective clothing/(face) mask sealed/secure container eg metal-lined box or in concrete (block) or behind lead (walls) keep people away / keep away from people	**(1)**

Q4.

Question Number	Answer	Acceptable answers	Mark
(i)	any **two** advantages from: • no carbon dioxide (produced) (1) • no {sulphur dioxide/nitrogen oxides} (produced) (1) • conserves fossil fuels (1) • reduces dependence on foreign supplies of energy (1) • good safety record (under normal operating conditions) (1) • uses less fuel (1)	less/no {greenhouse gases/global warming} less/no {acid rain/atmospheric pollution} condone no harmful gases released ignore less pollution fossil fuel (reserves) will last longer owtte condone nuclear fuel (reserves) will last longer than (those for fossil fuels) accept nuclear power is more efficient (per kg of fuel used) ignore references to more power/reliability/energy/electricity generated or cost and vague terms such as environmentally friendly ignore nuclear energy is (a) renewable (energy source)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	a description including any **two** from: idea of initial treatment (1) idea of containment (1) idea of long term storage or reprocessing (1)	 (radioactive waste/fuel rods/it) under water or vitrification any description of immobilising waste by combining with inert material eg put it in a concrete block/glass sealing in (stainless) steel (cylinder) condone suitable (sealed) {cylinder/box/container/barrel} eg metal barrel (long term) storage (deep) underground put in (salt/coal) mines or any underground cavern (radioactive) waste is reprocessed/turned into new fuel can be combined with any of the above points to score up to two marks ignore keep it away from people/houses ignore dump it in the sea	**(2)**

Q5.

Question Number	Answer	Acceptable answers	Mark
(a)	Any one of Treatment of cancer / radiotherapy Imaging e.g.: looking at broken bones, tracers sterilizing (equipment/dressings) (1)	NOT ultrasound applications/ chemotherapy accept(to) cure/kill/detect cancer (cells) accept X-ray(s)/X-ray machine accept PET/CT scans ignore MRI scans accept (to) kill bacteria ignore medical treatment and similar vague statements	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	12 hours = 2 half lives (1) 10 (mg) (1)	idea of halving seen e.g. 40 ÷ 2 or 20 (mg) ignore 80 (mg) and 99 ÷ 2 OR idea of 2 half lives seen or 40/4 OR (6 is 1 half-life and)12 is 2 (half-lives) OR 1/4 Give full marks for correct answer with no working.	**(2)**

Q6.

	Answer	**Acceptable answers**	**Mark**
	☒ **B** becquerel		**(1)**