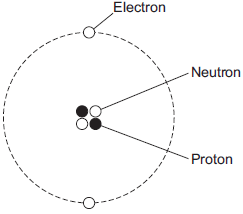
**Q1.**

(a)     The figure below shows a helium atom.



(i)      Which **one** of the particles in the atom is **not** charged?

Draw a ring around the correct answer.

**electron                neutron                proton**

**(1)**

(ii)     Which **two** types of particle in the atom have the same mass?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(iii)    What is the atomic number of a helium atom?

Draw a ring around the correct answer.

**2                4                6**

Give a reason for your answer.

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

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

**(2)**

(b)     Alpha particles are one type of nuclear radiation.

(i)      Name **one** other type of nuclear radiation.

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

**(1)**

(ii)     Use the correct answer from the box to complete the sentence.

|  |
| --- |
| **electrons                neutrons                protons** |

The difference between an alpha particle and a helium atom is that the alpha

particle does **not** have any \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ .

**(1)**

(iii)    Which **one** of the following is a property of alpha particles?

Tick (✓) **one** box.

|  |  |
| --- | --- |
| Have a long range in air |  |
| Are highly ionising |  |
| Will pass through metals |  |

**(1)**

(c)     Doctors may use nuclear radiation to treat certain types of illness.

Treating an illness with radiation may also harm a patient.

(i)      Complete the following sentence.

The risk from treating a patient with radiation is that the radiation may

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ healthy body cells.

**(1)**

(ii)     Draw a ring around the correct answer to complete the sentence.

Radiation may be used to treat a patient if the risk from the

|  |  |  |
| --- | --- | --- |
| radiation is | much bigger than  about the same as  much smaller than | the possible benefit of having |

the treatment.

**(1)**

**(Total 9 marks)**

**Q2.**

Gamma radiation is emitted from the nuclei of some atoms.

(a)  What is a gamma ray?

Tick **one** box.

|  |  |
| --- | --- |
| A helium nucleus |  |
| A high speed electron |  |
| A neutron |  |
| A type of electromagnetic radiation |  |

**(1)**

(b)  Which would be the best absorber of gamma radiation?

Tick **one** box.

|  |  |
| --- | --- |
| A few mm of air |  |
| A thick sheet of cardboard |  |
| A thick sheet of lead |  |
| A thin sheet of paper |  |

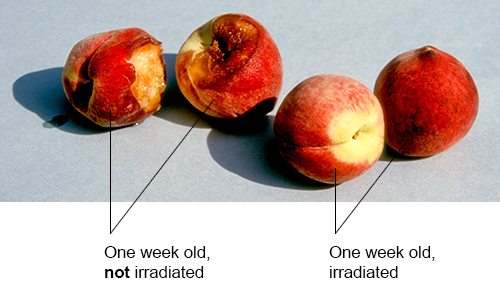
**(1)**

Food can be irradiated with gamma rays to kill bacteria.

Below is a photograph of peaches.

Two of the peaches were irradiated.

The photograph was taken one week after irradiation.



(c)  Why do food producers need to kill bacteria on food?

Tick **two** boxes.

|  |  |
| --- | --- |
| To change the colour of the food |  |
| To decrease the rate of decay of the food |  |
| To decrease the shelf life of the food |  |
| To prevent food poisoning |  |
| To remove dirt from food |  |

**(2)**

(d)  How do gamma rays kill bacteria?

Tick **one** box.

|  |  |
| --- | --- |
| Gamma rays cause meiosis to occur |  |
| Gamma rays cause mutations |  |
| Gamma rays decrease the size of bacterial cells |  |
| Gamma rays destroy the food source for bacteria |  |

**(1)**

(e)  Food producers can irradiate food by passing it close to a radioactive source.

How can food producers increase the level of radiation that the food is exposed to?

Tick **two** boxes.

|  |  |
| --- | --- |
| Boil the food before passing it close to the radioactive source |  |
| Decrease the distance between the food and the radioactive source |  |
| Increase the time for which the food is close to the radioactive source |  |
| Put the radioactive source in a box |  |
| Reduce the temperature of the radioactive source |  |

**(2)**

**(Total 7 marks)**

**Q3.**

The Chernobyl disaster was a nuclear accident that happened in 1986

Radioactive isotopes were released into the environment.

The radioactive isotopes emitted alpha, beta and gamma radiation.

(a)  What is an alpha particle?

Tick **one** box.

|  |  |
| --- | --- |
| 2 charged particles and 2 neutral particles. |  |
| 2 charged particles and 4 neutral particles. |  |
| 4 charged particles and 2 neutral particles. |  |
| 4 charged particles and 4 neutral particles. |  |

**(1)**

(b)  Which statement about beta radiation is true?

Tick **one** box.

|  |  |
| --- | --- |
| It is the fastest moving type of radiation. |  |
| It is the type of radiation with a negative charge. |  |
| It is the type of radiation with the greatest mass. |  |
| It is the type of radiation with the greatest range in air. |  |

**(1)**

(c)  Which statement about gamma radiation is true?

Tick **one** box.

|  |  |
| --- | --- |
| It is a low frequency electromagnetic wave. |  |
| It causes the charge of the nucleus to change. |  |
| It causes the mass of the nucleus to change. |  |
| It has a very long range in air. |  |

**(1)**

The table below shows the half-lives of two of the radioactive isotopes that contaminated the environment.

|  |  |
| --- | --- |
| **Isotope** | **Half-life** |
| Caesium-137 | 30 years |
| Iodine-131 | 8 days |

(d)  A soil sample was taken from the area around Chernobyl in 1986

The soil sample was contaminated with equal amounts of caesium-137 and iodine-131

Explain how the risk linked to each isotope has changed between 1986 and 2018

Both isotopes emit the same type of radiation.

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

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**(4)**

(e)  Determine the year when the activity of the caesium–137 in the soil sample will be 1/32 of its original value.

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

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Year = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

**(Total 10 marks)**

Mark schemes

**Q1.**

(a)     (i)      neutron

**1**

(ii)     neutron  
proton

*both required, either order*

**1**

(iii)    2

**1**

number of protons

*do not accept number of electrons*

**1**

(b)     (i)      any **one** from:

•        beta

•        gamma

*accept correct symbols*

*accept positron / neutrino / neutron*

*cosmic rays is insufficient*

**1**

(ii)     electrons

**1**

(iii)    are highly ionising

**1**

(c)     (i)      mutate / destroy / kill / damage / change / ionise

*Harm is insufficient*

**1**

(ii)     much smaller than

**1**

**[9]**

**Q2.**

(a)  a type of electromagnetic radiation

**1**

(b)  a thick sheet of lead

**1**

(c)  to decrease the rate of decay of the food

**1**

to prevent food poisoning

**1**

(d)  gamma rays cause mutations

**1**

(e)  decrease the distance between the food and the radioactive source

**1**

increase the time for which the food is close to the radioactive source

**1**

**[7]**

**Q3.**

(a)  2 charged particles and 2 neutral particles

**1**

(b)  it is the type of radiation with a negative charge

**1**

(c)  it has a very long range in air

**1**

(d)  risk / activity associated with iodine-131 has decreased by a large amount

**1**

because of short half-life

*allow many half-lives have passed*

*allow half-life is only 8 days*

*2nd marking point dependent on 1st marking point*

**1**

risk / activity associated with caesium-137 will not have decreased by much

*allow activity has halved*

**1**

because of long half-life

*allow only one half-life has passed*

*4th marking point dependent on 3rd marking point*

**1**

(e)  5 half-lives

*allow any correct method*

*e.g. ½ × ½ × ½ × ½ × ½ = 1/32*

**1**

5 × 30 = 150

**1**

1986 + 150 = 2136

**1**

*any calculation using a value of 137 scores zero*

*an answer of 2136 scores* ***3*** *marks*

**[10]**