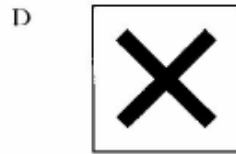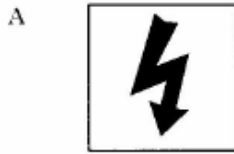# Homework 5: Radiation

1. Which sign is used to indicate the presence of radioactive material?

2. A sample of tissue is irradiated using a radioactive source.
   A student makes the following statements.
   The equivalent dose received by the tissue is

   I   reduced by shielding the tissue with a lead screen
   II increased as the distance from the source to the tissue is increased
   III increased by increasing the time of exposure of the tissue to the radiation.

   Which of the statements is/are correct?

   A   I only
   B   II only
   C   I and II only
   D   II and III only
   E   I and III only

3. A patient's thyroid gland is exposed to radiation. Information about the radiation and the dose received by the gland is shown.
   Absorbed dose = 500 µGy
   Energy absorbed = 15 µJ
   Radiation weighting factor = 20

   The mass of the thyroid gland is

   A   0·01 kg
   B   0·03 kg
   C   0·04 kg
   D   0·33 kg
   E   0·75 kg

4. A sample of tissue receives an absorbed dose of 16 µGy from alpha particles.
   The radiation weighting factor for alpha particles is 20.
   The equivalent dose received by the sample is

   A   0·80 µSv
   B   1·25 µSv
   C   4 µSv
   D   36 µSv
   E   320 µSv.

5. A worker in a nuclear power station is exposed to 3·0 mGy of gamma radiation and
   0·50 mGy of fast neutrons.
   The radiation weighting factor for gamma radiation is 1 and for fast neutrons is 10.
   The total equivalent dose, in mSv, received by the worker is

   A   3·50
   B   8·00
   C   30·5
   D   35·0
   E   38·5.

6. Which of the following statements is **FALSE**?

   A   The harm that ionising radiation can do to living cells depends on the exposure time.
   B   The harm that ionising radiation can do to living cells depends on the type of radiation
        used.
   C   The harm that ionising radiation can do to living cells depends on the mass of the tissue
        irradiated.
   D   The harm that ionising radiation can do to living cells does not depend on the material
        between the source and the cells.
   E   The harm that ionising radiation can do to living cells is minimised if the exposure time is
        kept as short as possible.

7. The activity of a sample of a radioactive substance is 80 Bq. The half-life of the substance is
   4 hours.
   The time for the activity to fall to 10 Bq is

   A   4 hours
   B   6 hours
   C   8 hours
   D   12 hours
   E   20 hours

8. The activity of a radioactive source drops from 200 kBq to 25 kBq in 6 years.
   The half-life of the source is

   A   1 year
   B   1.5 years
   C   2 years
   D   2·5 years
   E   3 years

9. The letters **X, Y** and **Z** represent missing words from the following passage.

*During a nuclear **X** reaction two nuclei of smaller mass number combine to produce a nucleus of larger mass number. During a nuclear **Y** reaction a nucleus of larger mass number splits into two nuclei of smaller mass number. Both of these reactions are important because these processes can release **Z** .*

Which row in the table shows the missing words?
X Y Z

A   fusion fission electrons
B   fission fusion energy
C   fusion fission protons
D   fission fusion protons
E   fusion fission energy

10. A student makes the following statements about the fission process in a nuclear power station.

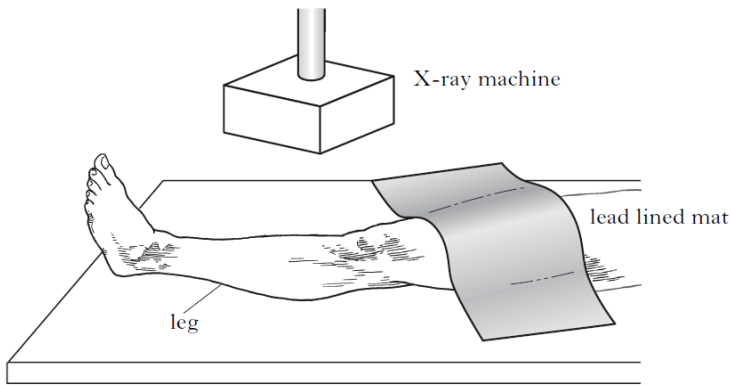I Electrons are used to bombard a uranium nucleus.
II Heat is produced.
III The neutrons released can cause other nuclei to undergo fission.

Which of these statements is/are correct?

A   I only
B   II only
C   III only
D   I and II only
E   II and III only

11. A football player injures his leg while playing in a match.

In hospital the player has three X-rays, each producing an absorbed dose of 50 μGy.

(a) The mass of the player's leg is 6 kg.
Calculate the energy absorbed by the leg from the X-rays.

(b) State why is the rest of the player's leg covered with a lead lined mat.

*(c)* Apart from absorbed dose, name **one** other factor that contributes to biological harm.

12. An airport worker passes suitcases through an X-ray machine.

(a)   The worker has a mass of 80 kg and on a particular day absorbs 7·2 mJ of energy from the X-ray machine.

(i)   Calculate the absorbed dose received by the worker.
(ii)   The radiation weighting factor for X-ray is 1.
Calculate the equivalent dose received by the worker.

(b) The worker wears a badge containing photographic film.
Explain how this can indicate if the worker has been exposed to radiation.

13. A paper mill uses a radioactive source in a system to monitor the thickness of paper.
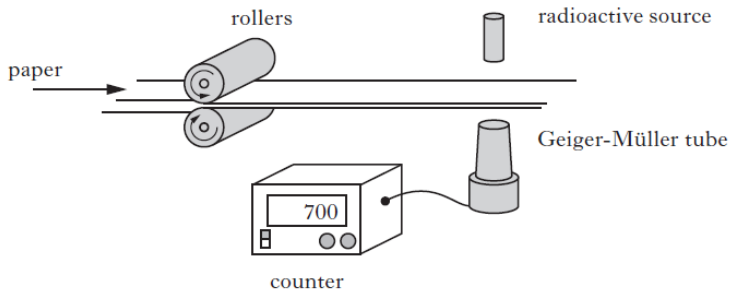

Radiation passing through the paper is detected by the Geiger-Müller tube.
The count rate is displayed on the counter as shown. The radioactive source has a half-life that allows the system to run continuously.

(a) State what happens to the count rate if the thickness of the paper decreases.
(b) The following radioactive sources are available.

| Radioactive Source	Half-life	Radiation emitted
W	600 years	alpha
X	50 years	beta
Y	4 hours	beta
Z	350 years	gamma

(i) State which radioactive source should be used? You **must** explain your answer.
(ii) Explain the term *half-life*?

(c) The graph below shows how the activity of another radioactive source varies with time.
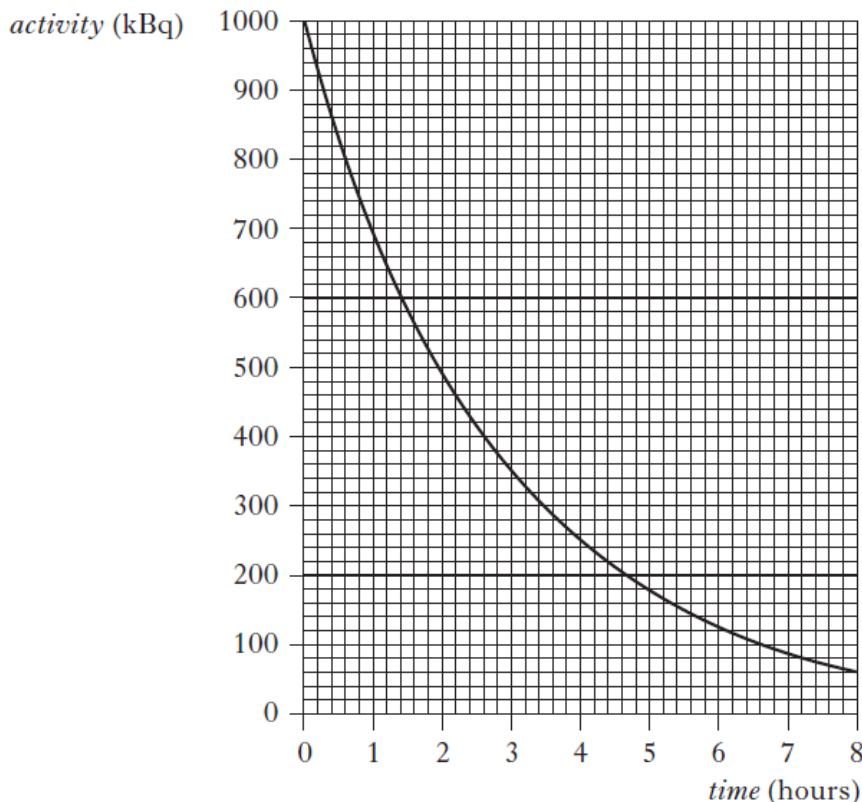
(i)   Determine the half-life of this radioactive source.
(ii)   State **two** factors that can affect the background radiation level.

14. In the reactor of nuclear power station a uranium nucleus is bombarded by a slow neutron as shown below.

slow neutron

uranium nucleus

smaller nuclei
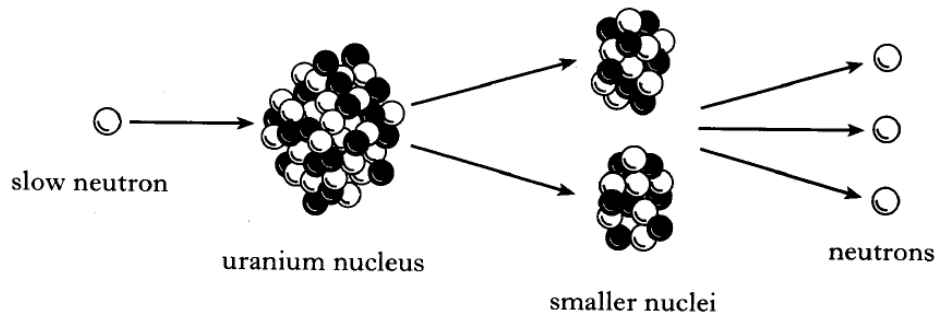
neutrons

(a) State the name of this type of reaction.

(b) In this reaction neutrons are released.
   Explain why these neutrons are important to the operation of the reactor.

(c) The reactor also contains boron control rods.
   Explain the purpose of these rods.

(d) State **one** advantage of using nuclear fuel for the generation of electricity.

(e) State **one disadvantage** of using nuclear fuel for the generation of electricity.