

Answer the following questions.

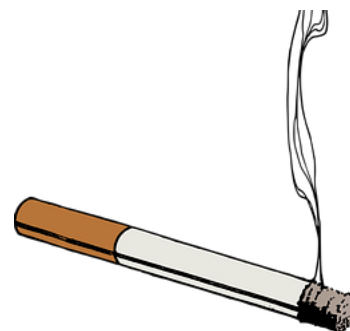
Paper thickness

1. How can radioactivity be used to measure the thickness of paper?
2. Why is beta radiation better than alpha for measuring the thickness of paper?
3. Which source of radiation would be suitable for measuring the thickness of aluminium?



Detecting smoke

4. Why are alpha particles used to detect smoke?
5. Describe how alpha radiation is used to detect smoke.
6. Name a radioactive source used to detect smoke. Why is it important that it has a very long half-life?



Detecting faults in pipe welds

7. How can radioactivity be used to detect faults in welds in pipes?
8. Which source of radiation would be suitable for detecting faults in welds in pipes?



Using radioactivity in medicine

9. What is technetium-99 used for in medicine?
10. What is the half-life of technetium-99? Why is this useful when used in the human body?
11. Which type of radiation is used to sterilise surgical equipment, why?
12. Which kind of radiation is used to kill cancer cells, why?

Answers

Paper thickness

1. Rollers are connected to a GM tube or some other form of count-rate detector. A beta source is put on the other side of the paper to the detector. When the paper is too thick the signal detected will be weaker and then the rollers will be brought closer together. The opposite happens for paper that is too thin.
2. A beta source is used (paper would stop alpha particles as they are not very penetrative, gamma would not be affected significantly by different thicknesses)
3. Gamma radiation

Detecting smoke

4. Because they are easily blocked by smoke particles.
5. Alpha is able to ionise air and a current passes over a small gap. Alpha is not very penetrative and it is blocked and absorbed by smoke. The current is stopped and an alarm is sounded.
6. Americium-241 - a long half-life means that it remains constant for a long period of time.

Detecting faults in pipe welds

7. A source is passed down the pipe and photographic film is wrapped around the weld. When the film is developed, faults will show up as black spots on the film.
8. Gamma

Using radioactivity in medicine

9. It is used as a tracer
10. It has a half-life of 6 hours. To minimise the length of time that the body and internal organs are exposed to harmful ionising radiation. High exposure could lead to abnormal cell growth and cancer or tumours.
11. Gamma radiation - e.g. cobalt 60, as it will kill bacteria, at room temperature without damaging the equipment (unlike using boiling water)
12. Gamma- it kills living cells.

Suggested webpages for research

<http://www.frankswebpace.org.uk/ScienceAndMaths/physics/physicsGCSE/usesNuclearRadiation.htm>

<http://www.darvill.clara.net/nucrad/uses.htm>