

Section B

Answer any **one** question in this Section in the spaces provided.

- 8 (a) A helicopter hovers at a height of 200 m above the sea. It then releases an emitter which emits radio waves in all directions, from rest. As the emitter drops towards the sea, a receiver on the helicopter detects a series of distinct minima and maxima. The variation of the intensity detected by the receiver with distance d between emitter and receiver is shown in Fig. 8.1.

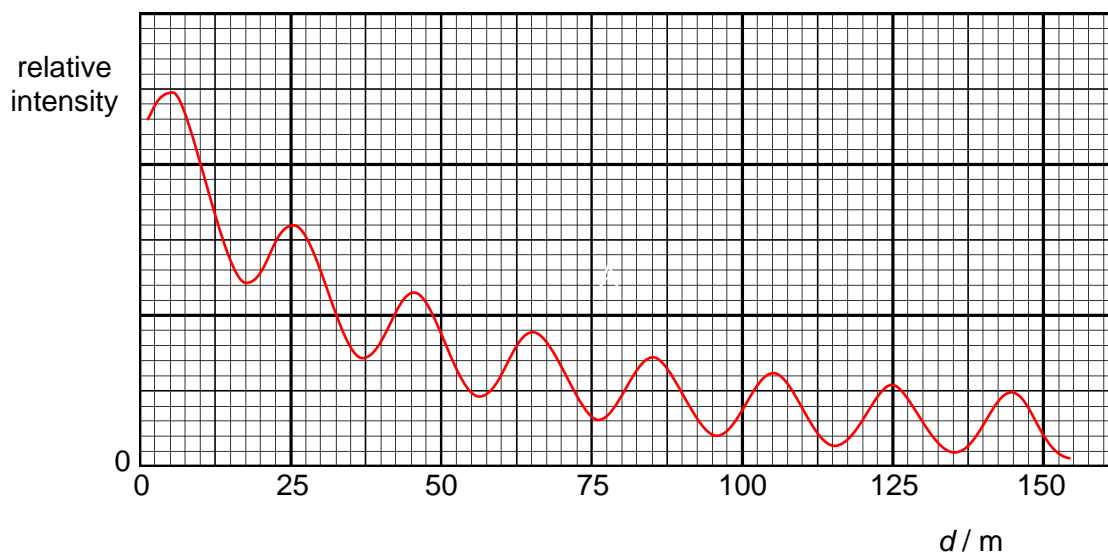


Fig. 8.1

- (i) State the *principle of superposition*.

.....

 [1]

- (ii) Explain the following features of the graph in Fig. 8.1:

1. the formation of alternating minima and maxima,

.....

 [3]

2. the intensity of the minima decreases with increasing d ,

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [2]

- (iii) Determine the wavelength of the radio wave.

wavelength = m [3]

(b) (i) Explain what is meant by *nuclear fission*.

.....

.....

..... [1]

(ii) State what is *radioactive decay*.

.....

.....

..... [1]

(iii) Describe the process of *nuclear fusion*.

.....

.....

..... [1]

- (c) When a uranium-235 nucleus ${}^{235}_{92}\text{U}$ is exposed to neutrons, it may absorb a neutron and then undergo fission. The percentage mass yield of the fission products varies with nucleon number as shown in Fig. 8.2.

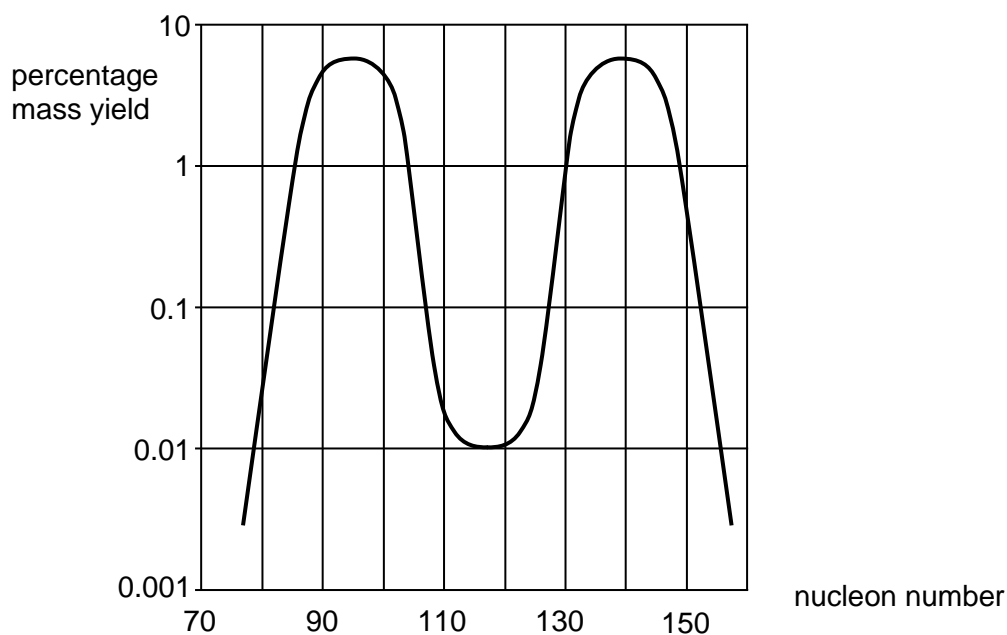


Fig. 8.2

- (i) Suggest why the percentage mass yield is shown on a logarithm scale.

.....
 [1]

- (ii) The nuclear process referenced in Fig. 8.2 results in two neutrons amongst the products. Explain why the graph is symmetrical about the nucleon number 117.

.....

 [3]

- (d) In a particular fission reaction, one of the products is iodine-140 $^{140}_{53}\text{I}$. A student suggests that the iodine-140 nucleus could decay by emitting either a neutron or a β^- particle.

Fig. 8.3 shows some relevant data:

		mass / u
electron	$^0_{-1}\text{e}$	0.0006
neutron	^1_0n	1.0087
iodine-139	$^{139}_{53}\text{I}$	138.8969
xenon-140	$^{140}_{54}\text{Xe}$	139.8919
iodine-140	$^{140}_{53}\text{I}$	139.9019

Fig. 8.3

For the iodine-140 nucleus, write an equation representing the radioactive decay involving

- (i) neutron emission

[1]

- (ii) beta emission

[1]

- (iii) Use Fig. 8.3 to show if the radioactive decay involving neutron emission is feasible.

.....
 [1]

- (iv) Use Fig. 8.3 to show if the radioactive decay involving beta emission is feasible.

.....
 [1]

[Total: 20]