18 In 1935 Irène and Frédéric Joliot-Curie were awarded a Nobel Prize for the discovery of artificial radioactivity.

They bombarded an aluminium sheet with alpha particles to produce a radioactive isotope of phosphorus as in the nuclear equation below.

$$^{27}_{13}\text{Al} + ^{4}_{2}\alpha \rightarrow ^{30}_{15}\text{P} + ^{1}_{0}\text{X}$$

(a) (i) Identify particle X.

(1)

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(ii) Calculate the energy released, in joules, in this nuclear reaction.

Particle	Mass / GeV / c^2
^1X	0.9396
$^4\alpha$	3.7274
^{27}Al	25.1333
^{30}P	27.9206

(4)

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Energy released = ... J

(b) Radioactive phosphorus was one of the first artificially produced isotopes to be used in the diagnosis of cancerous tumours.

The isotope ^{32}P is injected into a person and collects in the tumour. Radiation is detected outside the person's body. ^{32}P is a positron emitter with a half-life of almost fifteen days.

Explain why ^{32}P is suitable for this procedure.

(4)

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(Total for Question 18 = 9 marks)