8 Oxygen-15 ($^{15}_{8}O$) is radioactive and has a half-life of 2.04 minutes.

The decay of oxygen-15 produces positrons. For this reason, oxygen-15 is sometimes used as a tracer in positron emission tomography (PET scanning).

(a) State what is meant by a tracer.

.....

.....

..... [2]

(b) The equation for the decay of oxygen-15 is

$$^{15}_{8}O \rightarrow {}^{P}_{Q}X + {}^{R}_{S}\beta^{+} + Z$$

where X is the nucleus formed during the decay and Z is another particle.

(i) State the values of the integers *P*, *Q*, *R* and *S*.

P = ... *R* = ...

Q = ... *S* = ...

[2]

(ii) State the name of particle Z.

..... [1]

(c) **(i)** Define the activity of a sample.

.....

..... [1]

(ii) Calculate the decay constant of oxygen-15. Give a unit with your answer.

decay constant = ... unit ..... [2]

(iii) Determine the rate at which positrons are produced in a sample of oxygen-15 that has a mass of 2.85×10^{-6} kg.

rate = ... s^{-1} [4]

(d) The particles that are emitted from the body and detected outside it during PET scanning are not positrons but another type of particle.

(i) State the name of the particles that are detected.

..... [1]

(ii) Explain how these particles are formed inside the body.

.....

.....

.....

..... [2]

[Total: 15]