

Question 17**(14 marks)**

Positron emission topography (PET) is a high resolution gamma ray medical imaging technique and is useful for scanning soft tissue of the human body.

Fluorine-18 is a radioisotope commonly used in PET. Fluorine-18 is produced via the proton bombardment of the stable isotope oxygen-18 in a cyclotron.

The unstable fluorine-18 used in PET decays back to oxygen-18 as shown in the equation below.



- (a) Use the equation above to describe how the nucleus of the fluorine-18 decays to produce oxygen-18. Name the other particles produced. (3 marks)

- (b) Name the force and force particle that mediate the interaction described in part (a). (2 marks)

Force: _____

Force particle: _____

- (c) Use your knowledge of the Standard Model to prove that this emission obeys the conservation of baryon number and charge. Assume all quarks have a baryon number equal to $\frac{1}{3}$. (4 marks)

One of the products from the decay of fluorine-18 then interacts with the electrons of the human body to create two gamma rays that travel in opposite directions to each other. These gamma rays are detected and used to form images of tissues in the human body.

- (d) Discuss the interactions that must occur to produce two gamma rays travelling in opposite directions to each other. (5 marks)
