1. Chapter 16, question 29
2. Chapter 16, question 30
3. Chapter 16, question 31
4. Chapter 16, question 34

5. **Neutron decay**: In a process known as β-decay, an isolated neutron (i.e. a neutron isolated in vacuum that is not incorporated into a nucleus) will decay into a proton. We can write this process symbolically as

\[ n \rightarrow p + XX, \]  

(1)

where \( XX \) are other particles that result from the decay.

(a) Explain why a negatively charged particle (e.g. an electron) must also be produced in this decay.

(b) In fact, the neutron decays into a proton and an electron. What other particle must be produced in this process, and why?

(c) How much energy is released by this decay? Express it both in terms of Joules, and as a fraction of the rest-mass energy of the initial neutron [Hint: you will need to look up accurate masses for the particles involved.]

(d) In what forms is this energy released?

(e) Explain why an isolated proton cannot spontaneously decay into a neutron.