Marks

Question 21 (4 marks)

In his science fiction novel *From the Earth to the Moon*, Jules Verne describes how to launch a capsule from a cannon to land on the moon. To reach the moon, the capsule must leave the cannon with a speed of 1.06×10^4 m s^{-1}. The cannon has a length of 215 m, over which the capsule can be assumed to accelerate constantly.

(a) Calculate the magnitude of the acceleration required to achieve this speed using this cannon. **2**

$v^2 = u^2 + 2as$

$(1.06 \times 10^4)^2 = 0 + 2 \times 215 \times a$

$\therefore a = \frac{112360000}{430}$

$= 261302 \text{ ms}^{-2}$

(b) Referring to your answer in part (a), explain why Jules Verne's method is unsuitable for sending a living person to the moon. **2**

this acceleration would mean g-forces far too great for humans to survive: g-force is given by g-force = $\frac{g + a}{9.8}$, approximately 26700gs in this case. Humans can survive ~8 g-forces in the direction perpendicular to body length.

a) $v^2 = u^2 + 2as$

$(1.06 \times 10^4)^2 = 2 \times 215 \times a$

$a = \frac{(1.06 \times 10^4)^2}{430}$

$= 261302 \text{ ms}^{-2}$

$s = 215$, $v = 1.06 \times 10^4$

$a = ?$ $u = 0$