THE MARTIAN SOLUTION

Question 1

For this question we first have to find the equivalent sols supply for one person. Since NASA provided the team of 8 crew with food for 90 sols, we can find the equivalent supply duration for one person by multiplying by 8:

$$Sols\ supply\ =\ 8\ \times 90$$

$$Sols\ supply\ =\ 720$$

Watney rations out the food to last about 1.25 times longer than normal:

$$Rationed\ supply\ time\ =\ ration\ factor\ \times normal\ supply\ duration$$

$$Rationed\ supply\ time\ =\ 1.25\ \times 720$$

$$Rationed\ supply\ time\ = 900\ sols$$ ***(1 mark)***

Watney will need food for another 700 sols (he estimates it will be 1600 sols until rescue).

Mark needs 1500 calories per sol. We can calculate the remaining calories required:

$$Total\ extra\ calories\ required\ =\ sols\ left \times calories\ required\ per\ day$$

$$Total\ extra\ calories\ required\ =\ 700 \times 1500$$

$$Total\ extra\ calories\ required\ =\ 1050000$$

A single potato has about 130 calories. That means he needs to grow a total of:

$$Number\ of\ grown\ potatoes\ required\ =\ total\ calories\ required\ /$$

$$calories\ per\ potato$$

$$Number\ of\ grown\ potatoes\ required\ =\ 1050000\ /\ 130$$

$$Number\ of\ grown\ potatoes\ required\ = 8077$$ ***(1 mark)***

Question 2

The circular farm area has a radius of 6.27 metres, so we can calculate the total farming area:

$$Total\ farming\ area\ =\ \pi r^2$$

$$Total\ farming\ area\ = 123.5\ m^2$$ ***(1 mark)***

As the floor has a depth of 12 centimetres, the total soil required is:

$$Total\ soil\ required\ =\ farming\ area\ \times\ soil\ depth$$

$$Total\ soil\ required\ =\ 123.5\ m^2\ \times\ 0.12\ m$$

$$Total\ soil\ required = 14.8\ m^3$$

He calculates that he needs about 35 litres of water per cubic metre. In total he'll need:

$$Total\ farming\ water\ required$$
$$= number\ cubic\ metres\ soil \times water\ required\ per\ cubic\ metre$$
$$Total\ farming\ water\ required = 14.8 \times 35$$
$$Total\ farming\ water\ required = 518\ litres$$ ***(1 mark)***

Question 3

$$Oxygen\ required = water\ required \times water\ to\ oxygen\ ratio$$
$$Oxygen\ required = 518 \times 1 / 1.125$$
$$Oxygen\ required = 460.4kg$$

(1 mark)

$$Hydrogen\ required = water\ required \times water\ to\ hydrogen\ ratio$$
$$Hydrogen\ required = 518 \times 0.125 / 1.125$$
$$Hydrogen\ required = 57.56\ kg$$

(1 mark)

Question 4

Area required = battery charge required / (sunlight energy per square metre × solar panel efficiency × charging hours)

Area required = 20000 / (800 × .145 × 11)

Area required = 15.67 m^2

Now work out the number of 3 square metre panels required:

#panels = area required / area per panel

#panels = 15.67 / 3

#panels = 5.225

(2 marks)

Mark will need to bring along 6 solar panels (5 isn't quite enough). **(1 mark)**