

1. Ideal gas Law

$$PV = NRT$$

one mole of ideal gas @ STP (273K, 1 atm)
has a volume of 22.4 L.

$$\therefore V \propto T,$$

\therefore 1 mole of H_2 @ (298K, 1 atm) has

$$\text{a volume of } 22.4L \frac{298}{273} = 24.45L$$

$$1 \text{ mole of } H_2 = 2 \text{ gram}$$

★ Therefore, the volumetric density @ 1 atm is

$$= \frac{0.002 \text{ kg}}{24.45} = 0.0000818 \text{ kg/litre}$$

$$★ \quad 3000 \text{ psi} = 3000 / 14.696 = 204.1 \text{ Atm}$$

$$\text{Vol. density} = 0.0000818 \cdot 204.1 = 0.0167 \text{ kg/litre}$$

$$★ \quad 5000 \text{ psi} :$$

$$\text{Vol. den.} = 0.0278 \text{ kg/litre}$$

$$★ \quad 7000 \text{ psi} :$$

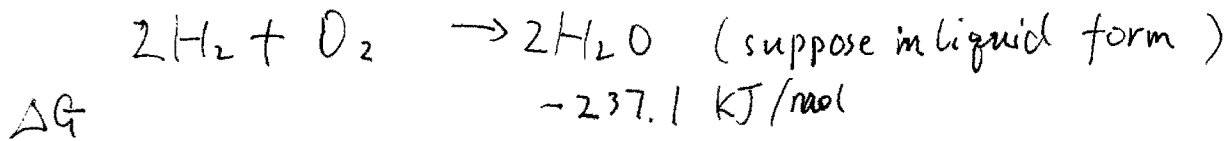
$$\text{Vol. den.} = 0.03896 \text{ kg/litre}$$

$$★ \quad 10060 \text{ psi} : \text{Vol. den} = 0.0557 \text{ kg/litre}$$

All are smaller than liquified H_2 density.

2. Total energy for 500 M @ 60 MPH and 5 KW

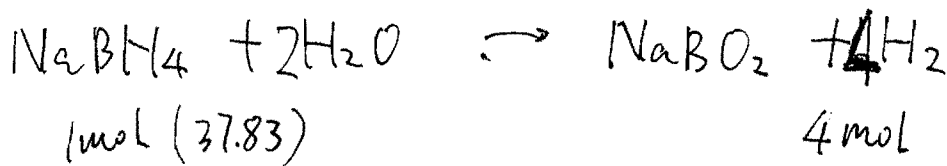
$$E = 5 \text{ kW} \times 3600 \times 500 / 60 \\ = 1,500,000,000 \text{ J} = 1500 \text{ MJ}$$



@ 50% efficiency. 2 mole of H_2 generate 237.1 kJ

Hence we need $\frac{1500 \text{ MJ}}{237.1 \text{ kJ/mol}} = 1265.2$ mole of H_2

which is $\boxed{2.53 \text{ kg}}$

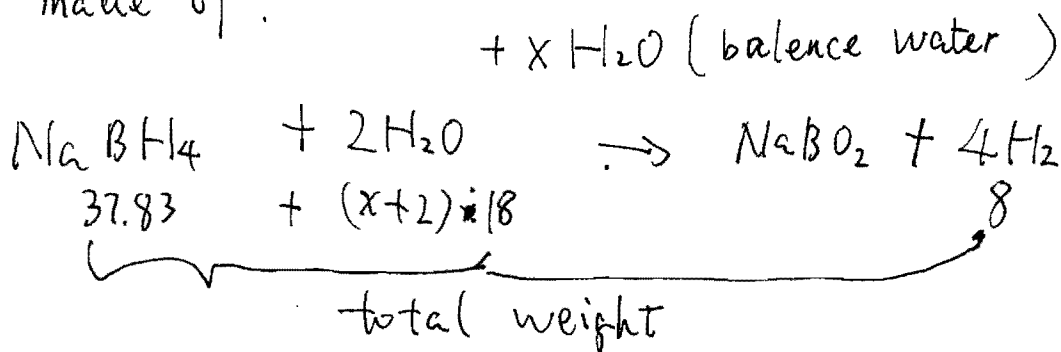


In order to make 1265.2 mole of H_2 we need

$$1265.2 / 4 = 316.3 \text{ moles of NaBH}_4$$

which is $316.3 \times 37.83 = 11966.4 \text{ g} = \boxed{11.966 \text{ kg}}$

Now need to find out what a 6% -H- content solution is made of.



So need to find out what x will make

$$\frac{8}{8 + 37.83 + 18(x+2)} = 6\%$$

Easily solvable:

$$\frac{8}{18x + 81.83} = 6\%$$

$$18x + 81.83 = 133.33$$

$$18x = 51.50$$

*

Hence $18x + 81.83 = 133.33$

or to make 8 grams of H_2 we need 133.33 gram of $NaBH_4$ solution.

Therefore, the total amount of $NaBH_4$ to drive the car is ~~2.53~~ 2.53 kg ~~133.33~~ $\frac{133.33}{8} = \boxed{42.167 \text{ kg}}$

The fuel only energy density of the f.c. system is

$$41.667 / 42.167 \approx \boxed{988 \text{ Whr/kg}}$$

so it's \sim one order of magnitude higher.

The End.