

Liam Brandy P150310, M6x02209

11/5/20

Q1 a) $70 \text{ kph} = \frac{70000}{3600} = 19.44 \text{ m/s}$

$$F_g = Mg \sin \theta = Q_n$$

$$F_{nc} = m_n = 1500 \times 0 = 0 \text{ N}$$

$$F_{fr} = Mg C_r = 1500 \times 9.81 \times 0.013 = 191.3 \text{ N}$$

$$F_{kro} = 0.5 \times A_r \times C_d \times \rho \times v^2$$

$$= 0.5 \times 3 \times 0.5 \times 1.2 \times 19.44^2$$

$$F_{kro} = 340.122 \text{ N}$$

$$\Sigma \text{ Forces} = 0 + 0 + 191.3 + 340.12$$

$$= 531.42 \text{ N}$$

$$P = F \times v$$

$$\text{Power} = 531.42 \times 19.44$$

$$= \underline{\underline{10330.8 \text{ W}}} \text{ or } 10.33 \text{ kW}$$

b) $5000 \text{ W} \times \frac{1}{0.8} = 6250 \text{ W} @ \text{ ICE}$

$$700 \text{ g/kWh} @ 6250 \text{ W} = \frac{6250}{0.700} = 8928.5 \text{ g}$$

$$0.755 \text{ kg per litre} = 755 \text{ g/l}$$

$$\frac{8928.5}{755} = \underline{\underline{11.826}}$$

$$11.826 \text{ litres}$$

c) ~~$P = I \times V$~~ ~~$P = T \times \omega$~~

$$1.2 \text{ m}^3 = 1200000 \text{ g} = \rho \times v$$

$$P = \frac{1200000}{0.9}$$

$$= \underline{\underline{1333333.3 \text{ W}}}$$

11/5/2020

$\omega = \text{Solus/second.}$

(2) $55,000 \text{ m} = 55,000 \text{ years/second}$,
 from $1c = \frac{1333333.3}{55,000} = \underline{\underline{24.24 \text{ seconds}}}$.

(c) 100 W active power

$$1.2 \text{ MJ} = 1200000 \text{ J} \times 0.9 \times 0.8$$

$$= 864000 \text{ J reaches wheels}$$

$$\frac{864000}{8000} = \underline{172.8} \text{ seconds for } P_2$$

$$\sum P_1 + P_2 = 24.24 + 172.8 = 197.04 \text{ Sevens}$$

$$\frac{3600}{197.04} = 18.27 \text{ cycles}$$

∴ 19 whole cycles.

g

55 km @ 255 g/km^h ~~km~~ 18.27 x 24.245
= 442.86 Seconds ¹/_{hr}

~~km~~

$\frac{442.86}{3600} = 0.123018$

$$= 255 \times 0.123018 \times 55$$
$$= 1725.3$$
$$+ 18.22 \text{ (Residual)}$$
$$= 1743.5 \text{ (continued)}$$

Combined

Page 2

Liam Randall P150310, M6X02209

11/5/20

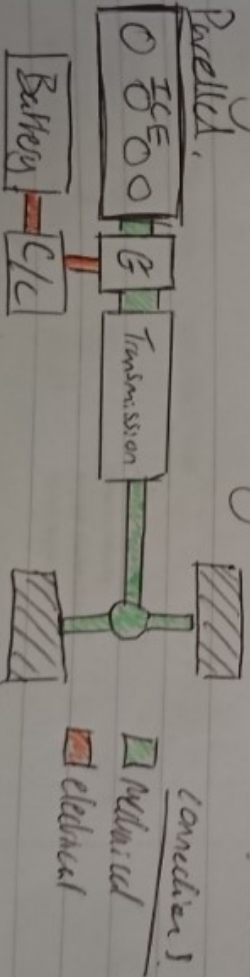
Q1 g) continued... 1743.5g to 11km

$$\frac{1743.5}{755} = 2.309 \text{ litres.}$$

h)

Q3 a) Alternative systems include - Series hybrid
Parallel hybrid
Electric (BEV)
Hydrogen (PEM)

Comparing Parallel and Series hybrid Architectures.



Series

ICE

Battery

C/C

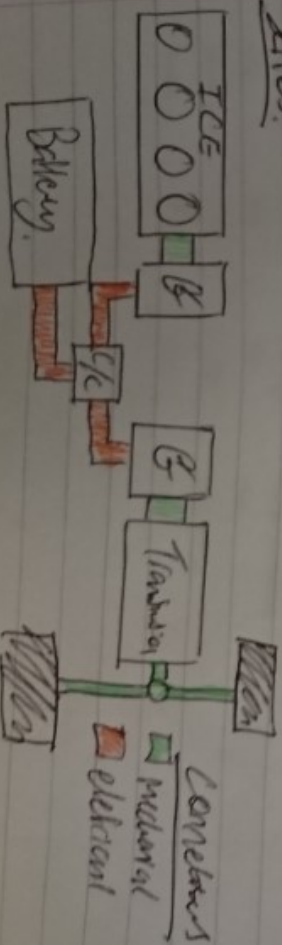
Generator

Transmission

mechanical

electrical

Generator / Controller



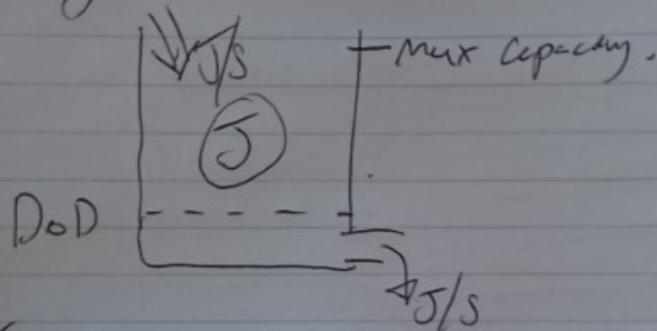
Liam Sanding P150310 MX02209

11/5/2020

Q3 B) Energy Storage ①②③

Alternative technologies include; Battery, Supercapacitors & Flywheel.

Batteries storage of energy is limited by volume storage. as seen below.

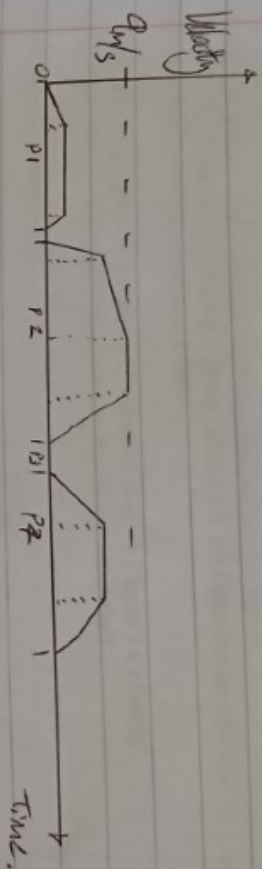


True Depth of Discharge of a battery is limited as energy has to remain. Super capacitors can be completely discharged as well as Flywheels. The efficiency of each is limited by time. Flywheels have the highest decay relative to kg/s and batteries and capacitors have relatively small efficiency losses. Flywheels are limited by max velocity of the flywheel, supercapacitors are limited by low amps and batteries by the chemical reaction. Changing based on battery composition such as Lead, Lithium ion or NiMH.

Man Standing P180310 MEX02204

11/5/2020

Q3 c).



Developed duty cycle.

P1 Shows the slow acceleration and speed while within secure location. Between P1 and P2 vehicle stops for junction waiting etc. Acceleration starting in P2 is high to get in to gap in road, creating picks up slowly towards q_{max} and once city traffic speeds up speed maintains and then drops to traffic signal at P3. P4 is repeated within city under location is reached.

Overall; low speed inner city
- short duration of constant velocity

Q3d) Hybrid Solution

with low speeds max Tractive effort would be assumed @ $F = m a + F = m \times g \times C_{wR}$

$$= (2600 \times 900) \times \left(\frac{9.81}{10}\right) + (2600 + 900) \times 9.81 \times 0.03$$

$$= 3180 + 1030.05$$

$$= 4180 \text{ N} \times 9 \text{ m/s} = 37620 \text{ W}$$

Supply via a series hybrid.

Page 5