

Alternative Powertrain Technology Exam 2020

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page 1

module code: M6X02209

11th May 2020 1:00PM

Home Exam

P150782

Q1

$$m = 1500 \text{ Kg}$$

$$FA = 3 \text{ m}^2$$

$$CD = 0.5$$

$$\text{AirD} = 1.2 \text{ Kg/m}^3$$

$$\text{Density of road} = 0.755 \text{ Kg/litre}$$

$$rr = 0.013 \text{ N per applied Newton of vertical force}$$

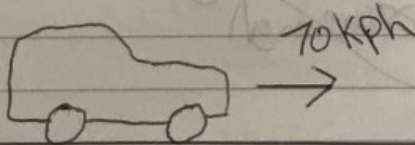
powertrain drives through a constant velocity transmission (CVT) = efficiency of 80% in each direction

$$ICE = 55 \text{ Kw}$$

$$\text{transmission to flywheel} = 90\%$$

↑
to driven wheels

a)



$$70 \div 3.6 = 19.4444$$

Kph $\Rightarrow$ m/s

$$\text{Tractive Effort} = \text{Mass} \times g \times rr = 1500 \times 9.81 \times 0.013 = 191.295 \text{ N}$$

$$\text{Aero Resistance} = 0.5 \times A \times CD \times \text{AirD} \times V^2$$

$$= 0.5 \times 3 \times 0.5 \times 1.2 \times (19.4444^2) = 340.276 \text{ N}$$

$$\text{Tractive Effort} + \text{Aero Resis} = \text{Total resistance}$$

$$191.295 + 340.276 \text{ N} = 531.571 \text{ N}$$

$$\text{Tractive Power required} = \text{Total resistance} \times V$$

$$531.571 \times 19.4444 = 10336.079 \text{ Watts}$$

$$\underline{\underline{10.34 \text{ kW}}}$$

Alternative Powertrain Technology Exam 2020

Oliver Gordon

P150782

M6X022009

11th may 2020

Page 2

Q1) b)

new track ^{kw} power = 5 kw

700g/kwh of fuel is being consumed

Allowing for transmission losses, what Volume of fuel will be used in one hour?

transmission ~~for~~ efficiency = 80%

$$5000 \times 0.8 = 1000 \text{ Watts lost}$$

6000 watts @ engine

$$6000 \times 60 = 360000 \text{ J}$$

$$0.755 \text{ Kg/litre} \Rightarrow 755 \text{ g/l}$$

$$755 \text{ g/l} \Rightarrow 755000 \text{ mg/l}$$

$$755000 \times 700 =$$

c)

Flywheel capacity = 1.2 MJ

~~55kw~~

~~90% efficiency~~

$$55000 \times 0.9 =$$

$$49500 \text{ Watts}$$

~~49500~~ watts used to charge the flywheel

$$\frac{1,200,000}{0.9} \div 60 = 22.22 \text{ kw}$$

d)

Secs = Joules / Watts

$$\text{kg / kw} = \frac{1200}{49.5} = 24.24 \text{ seconds}$$

$$\text{kg / kw} = \frac{1200}{22.22} = 54.01 \text{ seconds}$$

Alternative Powertrain Technology Exam 2020

Oliver Gordon

PI50782

M6X02209

11th May 2020

Page 3

Q1)

e)

1.2 mJ

90% efficiency

$1200/55 = \text{time till empty @ the Vehicles most efficient operating speed}$

$= 21.81 \text{ Seconds}$

f)

time in P1 = 54.01

time in P2 = 21.81

Seconds in 1 Hour = 3600

$\frac{3600}{75.82} = 47.48 \text{ cycles}$

47 full cycles

Alternative Powertrain Technology Exam 2020

Oliver Gordon

P150782

M6X02209

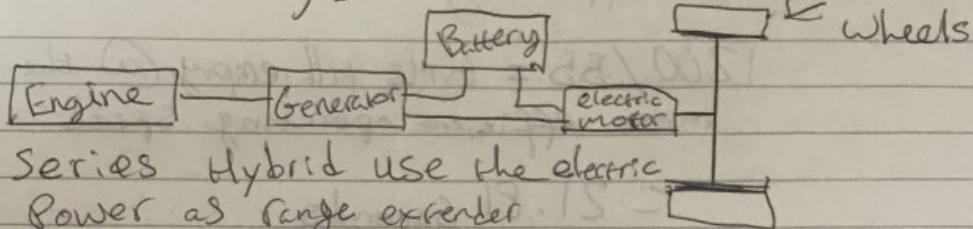
11th May 2020

Page 4

Q3)

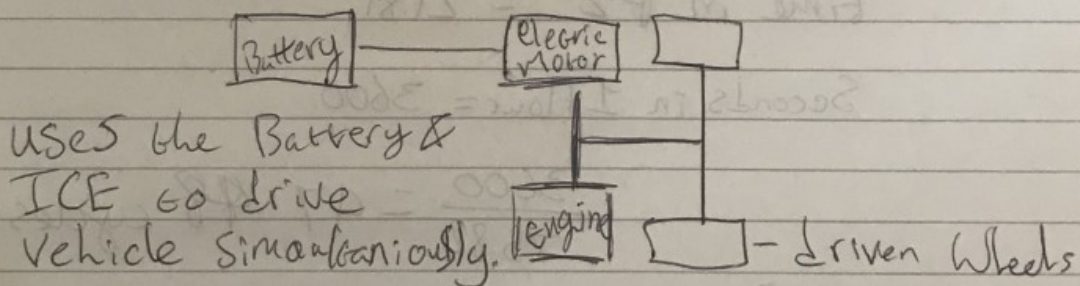
a) alternative vehicle architectures

Series Hybrid



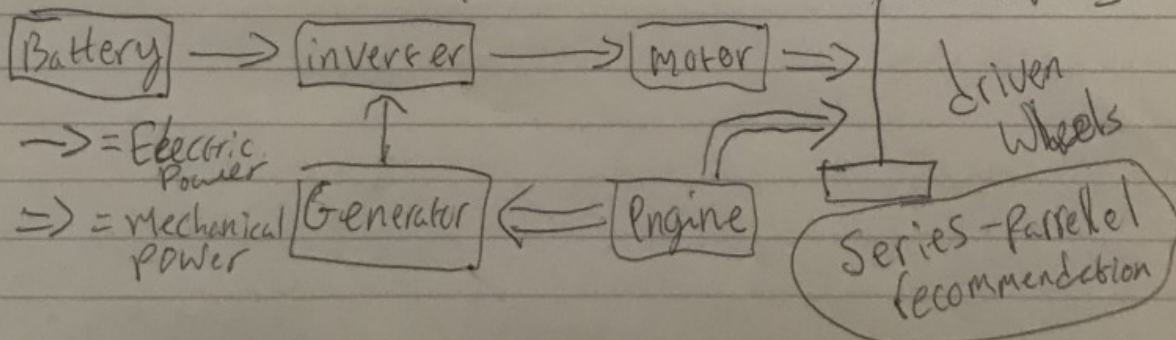
- Series Hybrid use the electric Power as range extender

Parallel Hybrid



Series-Parallel Hybrid

Series Parallel Hybrids can drive using electric or ICE Independently.



Alternative Powertrain Technology Exam 2020

Oliver Gordon

P150782

M6X02209

11th May 2020

page 5

Q3)b)

1) Energy Storage

• Batteries

↳ lithium-ion batteries

↳ lead acid batteries

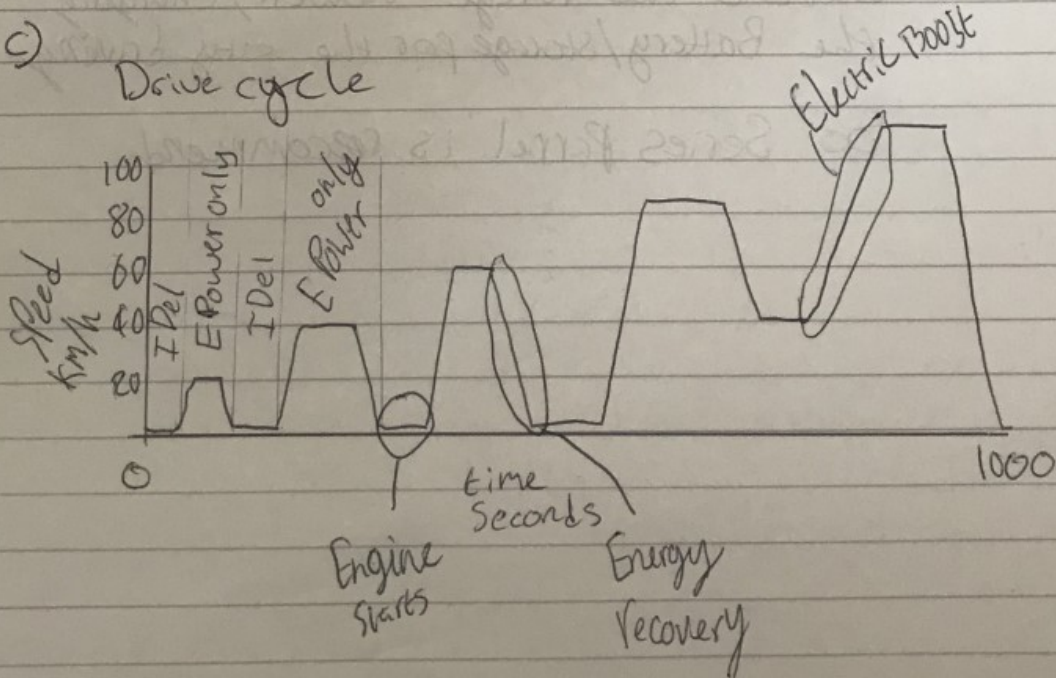
• Super capacitors

↳ good for short term storage

↳ discharge rate higher than lithiumion Batteries

c)

Drive cycle



Alternative Powertrain Technology Exam 2020

Oliver Gordon
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M6X02209

Page 6

Q3)



a Series parallel Hybrid System is recommended because of the ability to switch from Electric power for inner city driving in traffic for example and the ICE power for outer city / outskirts of Swansea driving. This would lower the fuel usage. the ability to run the electric & ICE together to extend the range as well, charging the Battery/storage for the city driving.

So Series Parallel is recommend.