

55%

12/5/20 @ 13:00 Powertrain and Control (MSX00404)

$$1a) \quad MFB = 1 - e^{-a \left( \frac{\theta - \theta_0}{\Delta \theta} \right)^{m+1}}$$

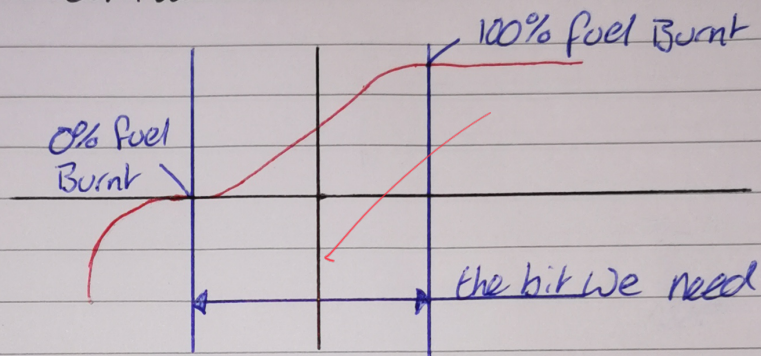
a is a constant

M is a constant

 $\theta$  is Crank Angle $\theta_0$  is the start of combustion $\Delta \theta$  is the Burn duration

(2)

1b)



(2)

1c)

a) Adiabatic

b) Poly tropic index

c) describes the rate of heat transfer

~~d) A should be greater than 1 during compression~~~~e) Increases then decreases~~

f) the system can't keep up with the rapid rate of heat transfer

(1)

(1)

1d) a) hybrid have been mentioned as any car that cannot do 50 miles solely on electric power will be banned under new rules

b) I do believe they are viable in the future although not within the deadline set out as more research and investment needs to be put into sustainable renewable energy i.e. Solar, wave, wind power and a lot more charge points

(2)

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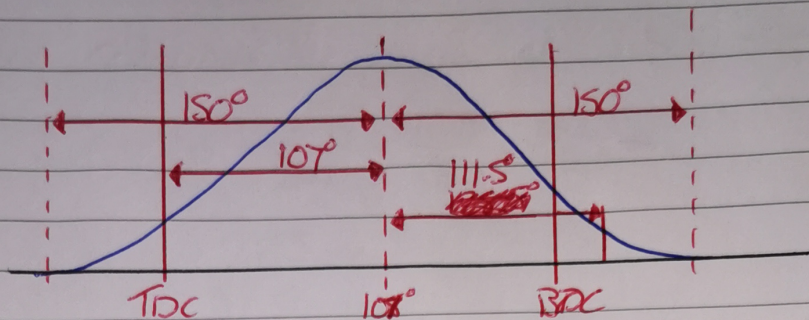
1d) c) hydrogen can be used as a sustainable source as it is abundant in the air although needs to be highly pressurised into liquid form to be used. It could be utilised with a 'carbon catcher' to produce hydrocarbons renewably

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2a)



$150^\circ + 107^\circ + 150^\circ$   
 $43/2 = 111.5^\circ$  Angle Between MOP and midway between BDC & closing

$$\frac{73 + 150}{2} = 111.5^\circ$$

$$\text{Port length} = 60 \text{ mm} = 0.06 \text{ m}$$

$$\text{time for 1 pulse} = \frac{2\pi(L + 0.06)}{330} \text{ m}$$

$$\text{Time for crank to turn} = \frac{111.5}{360} \times \frac{60}{13800}$$

$$\therefore \frac{111.5}{360} \times \frac{60}{13800} = \frac{2\pi(L + 0.06)}{330}$$

$$n@1 = L + 0.06 = \frac{330}{2\pi} \times \frac{111.5}{360} \times \frac{60}{13800} = 0.22$$

$$n@2 = 0.11$$

$$n=1 \rightarrow L = 162 \text{ mm}$$

$$n=2 \rightarrow L = 51 \text{ mm}$$

~~Using the second harmonic gives more room to package all the components in.~~

Using the second harmonic fits better into an already tight engine bay without taking up too much room

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2b) to calculate the length at 10800 RPM

$$L + 0.06 = \frac{330}{2n} \times \frac{111.5}{360} \times \frac{60}{10800} \text{ mm}$$

0.283

0.141

$$n=1 \rightarrow L = 223 \text{ mm}$$

$$n=2 \rightarrow L = 81.9 \text{ mm}$$

again using the second harmonic is ideally better as it gives a smaller package and with only 30.9 mm of variance could be offered as a variable intake system

2c)

|     | 51mm  | 81.9mm               |
|-----|-------|----------------------|
| n=1 | 27875 | 21609                |
| n=2 | 13938 | 10804                |
| n=3 | 9291  | 7203                 |
| n=4 | 6969  | <del>5402</del> 5402 |
| n=5 | 5575  | 4322                 |

$$\text{RPM} = \frac{111.5}{360} \times \frac{60 \times 330}{2n(L+0.06)}$$

I believe that for the best power band between 10,000 RPM and 14,475 RPM a length of 51mm offers the best selection although a variable with this length at the shortest up to around 70mm would offer interesting results to analyse

2d) the key differences with the Exhaust pulse tuning are that the ~~pos~~ +ve pulse is sent out from the engine and returned as a -ve pulse whereas with inlet pulse tuning the -ve pulse is sent out from the cylinder and returns as a +ve pulse. Exhaust pulse tuning also takes into account temperature at the manifold and the collector and therefore variable gas velocities.

2

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12/5/20@13:00 Powertrain and Control (MSX00604)

$$3a) F_c - k(y_0 + y) = Ma$$

$$F_c = k(y_0 + y) + Ma$$

$$0 = 18.8(4 + 10.66) + 0.172a$$

$$-275.6 = 0.172a$$

$$\frac{-275.6}{0.172} = a = -1602 \text{ m/s}^2 \text{ for float}$$

3b)

| Angle | Lift  | Velocity | Accel             |
|-------|-------|----------|-------------------|
| 106   | 7.988 |          |                   |
| 107   | 7.994 | 0.005    | <del>-0.002</del> |
| 108   | 7.998 | 0.004    | -0.002            |
| 109   | 8     | 0.002    | -0.002            |
| 110   | 8     | 0        | -0.002            |
| 111   | 7.998 | -0.002   | -0.002            |
| 112   | 7.994 | -0.004   | -0.002            |
| 113   | 7.988 | -0.006   | -0.002            |

3c) Lift  
Velocity  
Accel

