

50%

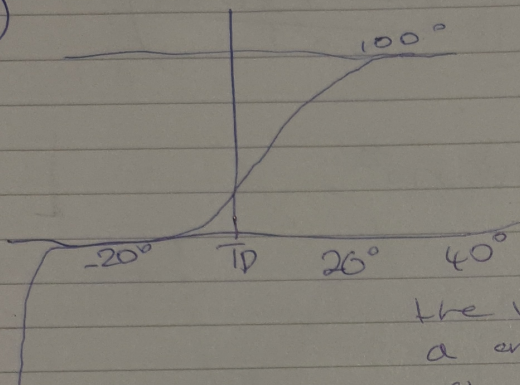
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Question One

Weibull function $-a \left(\frac{\theta - \theta_0}{\Delta \theta} \right)^{m+1}$

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

b)



The function is used to determine the mass fraction of air/fuel mix burned over degree between 0% and 100%.

The value of the constant a and m control the shape of the function hence the burn profile.

c)

a) shows the compression relationship between pressure and volume and it shows the polytropic process.

b) n is the polytropic index.

c) If you change n you will increase or decrease the compression.

d) n increases ~~decreases~~ during combustion.

e) 0 to ∞

d) because manufacturers are cheating
because they add a very small electric
motor (1)

b) it's part of a wide range of solutions
but not on its own because there
is not enough electricity. (1)

c) it can be used in a fuel cell
and combustion engines ~~but~~ but fuel cells are
d) more efficient (2)

d) bio fuel is dirty but it's renewable (1)

e) synthetic fuels are made in a lab
from coal or biological waste (1)

/ (10)

Question two

$$\begin{aligned} F_c - k(x + x_0) &= mg \\ F_c &= k(x + x_0) + mg \\ &= 18.8(8 + 4) + 0.172 \end{aligned}$$

$$\begin{aligned} 18.8(8 + 4) \div 0.172 &= \cancel{2255.83 \text{ m}^2\text{s}^{-2}} \\ &= 1311.63 \\ &= 1602.1637 \end{aligned}$$

Units
3

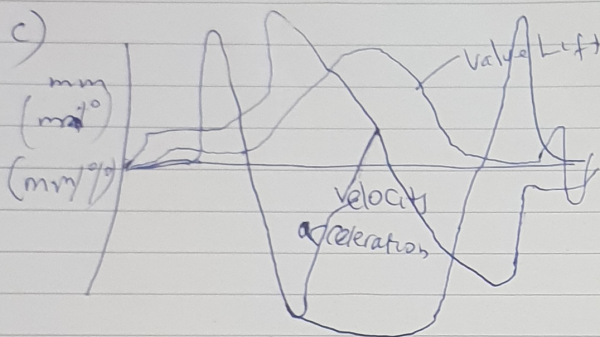
4

~~cam~~	~~angle~~	~~valve lift~~
cam	angle	valve lift
110		
111		
112		
113		
114		
115		
116		

b) ~~cam angle~~ ~~valve lift~~ ~~valve acceleration~~

(mm/s²)

b)	cam	angle	valve lift (mm)	valve velocity (mm/s)	valve accel
	110		10.651		
	111		10.654	3×10^{-3}	-3×10^{-3}
	112		10.658	4×10^{-3}	1×10^{-3}
	113		10.660	2×10^{-3}	-2×10^{-3}
	114		10.656	2×10^{-3}	1×10^{-3}
	115		10.654	4×10^{-3}	2×10^{-3}
	116		10.651	3×10^{-3}	1×10^{-3}



well is! (2)

d)

from the max acceleration is 1×10^{-3}

$$= 1 \times 10^3 \times \frac{(6 \times 3100)^2}{1000}$$

How?

$$= 345.76$$

what?

$$e) 1000 \times (1602.37)^2 = 1 \times 10^{-9} \times (6 \times 10^3)^2$$

$$(6 \times \text{rpm})^2 = \frac{1602.37 \times 1000}{1 \times 10^{-9}}$$

$$\text{rpm}_{\text{cm}} = \left(\sqrt{\frac{1602.37 \times 1000}{4 \times 10^{-9}}} \right)^6$$

$$6.428 \times 10^{22}$$

RAM??

Come on!!

7

Powertrain and control

Question ~~two~~

a)

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

wave duration: 330°

start of map: 150°

$$150 - 107 = 73^\circ$$

$$\frac{2n(L + 0.06)}{330} =$$

$$\frac{111.5}{360} \times \frac{60}{13,800} = \frac{2n(L + 0.06)}{330}$$

$$L + 0.06 = \frac{330}{2n} \times \frac{111.5}{360} \times \frac{60}{13,800}$$

$$L = \frac{0.232}{0.06}$$

$$L = 0.16$$

Units!

$$L = n_1 = 0.16 \text{ m}$$

$$n_2 = 0.05 \text{ m} \quad n_2 = 0.05$$

$$n_2 = 0.05 \text{ m}$$

6

b)

$$\frac{111.5}{360} \times \frac{60}{10,000} \times \frac{330}{2\pi} = L + 0.67$$

$$n_1 = 0.24 \text{ m}$$

$$n_2 = 0.093$$

$$n_1 = 2000 - 0.093 \text{ m}$$

$$n_2 = 1.5$$

$$n_3 = 0.96 \text{ m}$$

15h.

Packaging for $n=1$ on a motorcycle does not seem viable

$$\text{So } n_2 = 1.5$$

~~2-0.5~~ 5mm to 60mm

2

c)

	0.05	0.08
n1 =	27875 rpm	21901.28 rpm
n2 =	13137.5 rpm	10450.89 rpm
n3 =	9211.6 rpm	7350.595 rpm
n4 =	6968.75 rpm	5475.46 rpm
n5 =	5575 rpm	~~4380.86 rpm~~

(4)

$$\text{rpm} = \frac{111.5}{360} \times \frac{60 \times 3200}{2\pi(L + 0.08)}$$

~~0.08~~
0.05

for a fast intake there is not much difference benefits will be smooth read delivery 0.05 will give you a better spread.

d)

a larger expansion will create
a stronger ~~pull~~ pull

the -ve pulls should get back between T₁
and closing to minimise flow revers

①