MATEUSZ DAMEL SKOCZYLAS (1704045)
POWERTRAIN (MSX00404)
12/05/2020 1PM-3PM PAGE 1/8

Q2) a) variable - 10,000 - 14,475 RPM

91.6%

$\frac{300}{2} = 150°$ MOP start

180 - 107 = 73°

Rocking!

$\frac{73 + 150}{2} = 111.5°$

60mm intake

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

time for 111.5° of crank rotation

$111.5 \times \frac{60}{13800} = 1.35 \times 10^{-3}\ s$

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

$L_{manifold} = \left(\frac{330}{2N} \times \frac{111.5}{360} \times \frac{60}{13800}\right) - 0.06$

n	Lenght (L)	
1	0.16 m	← (both will fit on the bike, ~~but~~ n=1 should be used)
2	0.05m	

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12/05/2020 (1PM - 3PM)

Q2) b) 10800 RPM

$$L = \left(\frac{330}{2N} \times \frac{111.5}{360} \times \frac{60}{10800}\right) - 0.06$$

n	L (10800 RPM)	L (13800 RPM)	ΔL
1	0.22 m	0.16 m	0.06 m
(2)	0.08 m	0.05 m	(0.03 m)

Because of size constraints on packaging and because of constraints on the movement of trumpets, n = 2 should be chosen in this particular case. could probably get away with n = 1 on a big bike but not knowing the constraints n = 2 is a safer bet. ΔL of 0.03m at n = 2 is more suitable for fast system response, hence I chose it as opposed to n = 1.

3

Q2) c)

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

harmonic (N)	0.08 m	0.05 m
1	21,901 RPM	27,875 RPM
2	10,951 RPM	13,938 RPM
3	7301 RPM	9,292 RPM
4	5475 RPM	6969 RPM
5	4380 RPM	5575 RPM

5

Both lenghts are not the best as the spread is rather large on both, with both only having one usefull harmonic in the 10000 to 14,475 RPM powerband, but 0.08m is more usefull as it will provide more power down low RPM on corner exits

Q2)d)

- There is more space available thus $n=1$ is possible more often

- The temperature spread in the exhaust is much bigger than the intake so use average EGT (exhaust gas temperature) for calculating exhaust pulse tuning

- Pulse leaves ~20° after opening

↳ Speed of sound $\propto \sqrt{T_{ABS}}$

✓ 4

/19

MATEUSZ DANIEL SKOCZYLAS (1704045)
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12/05/2020 (1PM - 3PM)

Q3) a) (mislabbelled as q^2 on the exam question paper)

$F_c - k(x + x_0) = ma$

$F_c = 0\ N$
$k = 18,800\ N/m$
$x_0 = ~~0.004\ m~~\ 4 \times 10^{-3}\ m$
$x = 10.66 \times 10^{-3}\ m$
$m = 0.172\ kg$

~~$= 18800 \times (110$~~

$= k(x + x_0) + ma$

$-(k(x + x_0)) = ma$

$$\frac{-(k(x+x_0))}{m} = a = \frac{-(18800 \times ((10.66 \times 10^{-3}) + (4 \times 10^{-3})))}{0.172}$$

$= -1602\ m/s^2$

↑ float

4

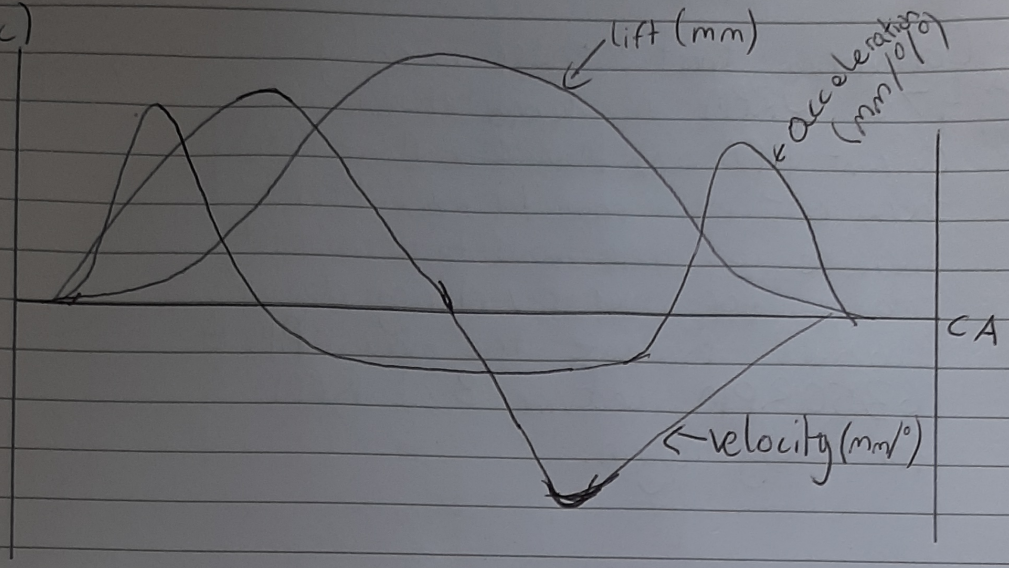
Q3) b)

lift mm	cam angle ATDC °	lift mm	Velocity (mm/°)	Acceleration (mm/°/°)
~~10.651~~	110	10.651	~~0.003~~	
~~10.654~~	111	10.654	0.003	
	112	10.658	0.004	-0.001
	113	10.660	0.002	-0.002
	114	10.658	-0.002	-0.004
	115	10.654	-0.004	-0.002
	116	10.651	-0.003	-0.001

3

MATEUSZ DANIEL SKOCZYLAS (1704045)
POWERTRAIN (M5X00404)
12/05/2020 (1PM-3PM)

Q3) c)



3

Q3) d) @ 6200 RPM

max accel from table → -0.004 m/°/°

in m/s² → $\frac{-0.004 \times (6 \times 3100)^2}{1000} = -1383.84 \text{ m/s}^2$

So;

max rpm a_{valve} accel = 1383.84 m/s²

float valve accel = 1602 m/s²

thus

this is 86.38% of max a_{valve} acceleration before float.

5

Q3) e)

The crank float would occur at;

$RPM_{cam} =$

$1000 \times (-1602) = -0.004 \times (6 \times CAM_{RPM})^2$

$(6 \times CAM_{RPM})^2 = \frac{-1602 \times 1000}{-0.004}$

$CAM_{RPM} = \frac{\sqrt{\frac{-1602 \times 1000}{-0.004}}}{6} = 3335 \text{ cam RPM}$

Thus float occurs at 6671 RPM @ crank

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POWERTRAIN (MSX00404)
12/05/2020 (1PM-3PM)

Q3)e) continued. Considering that there is only 471 RPM headroom between max current RPM and ~~Max flo~~ float RPM, there isnt much room for max RPM increase, as there needs to be a safety margin for over-rev during downshifts. I would increase the max RPM to 6350RPM, leaving 321 RPM for safety margin.

float max
6671 - 6200
= 471 RPM

5/20

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12/05/2020 (1PM-3PM)

Q1) a)

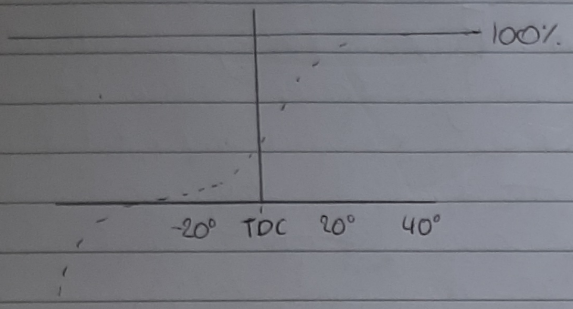
$$MFB = 1 - e^{-a\left(\frac{\theta-\theta_0}{\Delta\theta}\right)^{m+1}}$$

↑ mass fraction burn

shape curve adjustment

2

Q1) b)



The weibe function can be used to determine the mass fraction of air and fuel mix burned away degree between 0% and 100%.

3

It can be noted, that the a and m values in the function control the shape of the function curve, thus changing the burn profile

Q1) c)

$$PV^n = Constant$$

- This represents the gas compression and (mainly) expansion process in engines, with
- The n value represents the polytropic index which shows up heat losses eg through cylinder wall during the power stroke.
- During compression, changing n value represents heat losses
- During combustion phase, the n value jumps erratically, giving a non-usable value
- The combustion proces is between isobaric and isothermic, $n \sim n = 1.3$

4

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12/05/2020 (1PM-3PM)

Q1) d)

- hybrids have ~~been to~~ now been mentioned in the ban as the government wants "net zero emissions" ~~which actually still won't be achievable even after the ban unless all energy is gained through~~ 1
- I don't believe all electric is viable solution at the moment. Energy density of lithium ion battries is significantally lower than of petrol/diesel making vehicle mass higher. Not to mention a lot of ~~one~~ electrical energy does not come from renewable sources, ~~Fossil~~ Powerline transmission losses are high, and charging takes a lot of time as opposed to filling vehicle with petrol/diesel 2

- Hydrogen can be used in traditional (adapted) ~~combus~~ internal combustion engines as well as fuel cell through electrolysis process. - water as emissions 2

- Biofuels disadvantages - ~~not~~ might not leave enough crops for food to eat, takes up a lot of farm land
  advantages - ~~cleaner~~ sustainable energy source. 1

- Synthetic fuels provide a way of capturing CO_2 and turning that into fuel. greenhouse gas becomes raw material. 1

16