



12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

(see note 2 below)

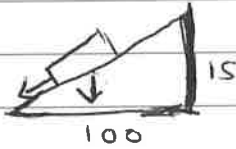
SURNAME: wilkinson

FORENAME(S): *Steven*

List the numbers of the questions you have attempted	Office Use
3	4 1/2
2	9
1	5
	18 1/2
Office Use	30.8

Q3

a.)



$$mg \sin \theta$$

$$1800 \times 9.81 \sin 15^\circ = 4570.22$$

$$= 4570.22 \text{ N}$$

8.53°

1/2
4

$$b) 900 \times 9.81 \times 0.1 = 882.9 \text{ N}$$

$$\frac{882.9}{1800} = 0.49 \text{ m/s}^2$$

1/4

$$c) 882.9 \times 3 = 2648.7 \text{ N}$$

$$\frac{2648.7}{1800} = 1.47 \text{ m/s}^2$$

1/3

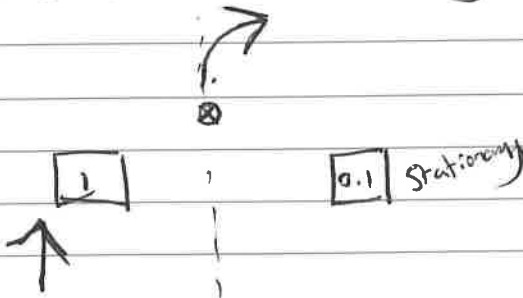
d.) ~~static friction~~

$$450 \times 9.81 = 4414.5 \text{ N}$$

$$F = ma \quad \frac{F}{m} = a \quad \frac{4414.5}{1800} = 2.45 \text{ m/s}^2$$

1/5

creates a moment as one wheel
is moving and another is stationary



1/4

E.)

$$KE = \frac{1}{2} mv^2$$

$$\frac{1}{2} \times 1800 \times 2.7^2 = 6561 \text{ J}$$

$$10 \div 3.6 = 2.7 \text{ m/s}$$

4/12
20

Q1

a.) ~~1500~~ $1500 \times 9.81 \times 1.2 = 17658 \text{ N}$
 $\frac{17658}{0.32} = 55181.25 \text{ Nm.}$

2/2

b.) $T = \frac{2}{3} M \cdot F \cdot \left(\frac{r_o^3 - r_i^3}{r_o^2 - r_i^2} \right)$

$\tan \theta = \frac{\text{opp}}{\text{adj}}$

$\tan \theta \times 0.08 = 0.61 \text{ mm.}$

?

2/6

One angle?

$F = \frac{3}{2} \cdot \frac{T}{M} \cdot \left(\frac{r_o^2 - r_i^2}{r_o^3 - r_i^3} \right)$

$\left(\frac{3}{2} \right) \cdot \left(\frac{3000}{0.2} \right) \cdot \left(\frac{0.10^2 - 0.095^2}{0.10^3 - 0.095^3} \right) = 153812.44 \text{ N}$

c.) A spring that has a stiffness of 3000 N/m to cause slit at 3000 and no less?

0/3

d.) $10,000 \times \frac{\pi}{60} = 1047 \text{ rad/s}$ ✓
 $\div 60 = 166 \text{ rps.}$

Rot in = $2 \times RE \div \text{rad/s.}^2$

$2 \times 1 \times 10^6 \div 1047^2 = 1.824 \text{ kgm}^2$

$M = 1.824 \times 0.35^2 = 14.88 \text{ kg}$

$K = 0.5 \times 0.707 = 0.3535$

$\frac{14.88 \text{ kg}}{(\pi \times 0.5^2) \times 7700} = 2.46 \times 10^{-3}$
 $\text{mass} \div \text{area} \times \text{density} = \text{thickness}$

This is exactly how we done it in past paper... This doesn't seem right???

1/4

F.) - Smaller diameter but heavier mass density to maintain performance?

9/2

44

5/20

Q2

mass

$$5500 + (20 \times 100) = 7500 \text{ kg total mass.}$$

$$40 \text{ kph} = 11.1 \text{ m/s.}$$

$$RR = 0.005 \times 7500 \times 9.81 = 367.87 \text{ N}$$

5.5 rot 11.1

$$AR = 0.5 \times 6 \times 0.7 \times 1.2 \times 123 = 309.96$$

$$\text{Total} = 677.83 \text{ N}$$

Total force.

$$a) F = ma \quad 7500 \times 11.1 = 83250 \text{ N} + 677.83 = 83927.83 \text{ N}$$

3/4 = seconds.

$$b) 677.83 \times 11.1 = 7523.91 \text{ W}$$

1 m/s takes 11.1 seconds to reach max accel
= 123 m in accel phase?

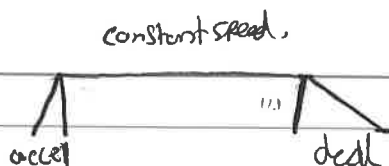
$$61.4 \times 11.1 = 681 \text{ m.}$$

$$c) F = ma \quad \frac{F}{m} = a \quad \frac{83927.83}{7500} = 11.1 \text{ m/s.}$$

$$KE = \frac{1}{2} mv^2$$

$$\frac{1}{2} \times 7500 \times 11.1^2 = 462037.5 \text{ J}$$

$$\frac{462037}{7523.91} = 61.4 \text{ seconds of charge.}$$



d.)

$$KE = \frac{1}{2}mv^2$$

$$\frac{1}{2} \times 7500 \times 11^2 = 461250 \text{ J} \quad \times 0.80 = ?$$

0/2

E.)

$$KE = \frac{1}{2}mv^2$$

$$\frac{1}{2} \times 7500 \times 11^2 = 461250 \text{ J} \quad \checkmark$$

$$\frac{1}{2} \times 7500 \times 11^2 = 461250 \text{ J}$$

$$\frac{1}{2} \times mv^2 \times 0.80$$

$$= 369000 \text{ J}$$

3/4

g.)

$$5000 \times \frac{2\pi}{60} = 523.59 \text{ rad/s} \quad \checkmark$$

$$\div 60 = 8.726 \text{ RPS.}$$

$$f = m \omega$$

$$\cancel{11.22 \text{ RPS}}$$

$$1.2 \times 10^6 / 523.59 \text{ rad/s}$$

$$= 2291.86 \text{ N/s}$$

$$2291 \times 60 = 137460 \text{ Nm}$$

2/5

9/20