Charles Darwin University

Final Examination

Family Name						
Given Name/s						
Student Number						
Teaching Period	Semester 1, 2018					

ENG151 – Statics	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes

INSTRUCTIONS TO CANDIDATES

1. Read all questions carefully.
2. Answer all questions.
3. Show all working.
4. This exam constitutes 50% of the total marks for this unit.
5. Total marks available on this exam is 100.
6. Questions are not of equal value
7. Use dark blue or black ink.

EXAM CONDITIONS

You may begin writing from the commencement of the examination session. The reading time indicated above is provided as a guide only.

This is a CLOSED BOOK examination

Any non-programmable calculator is permitted

No handwritten notes are permitted

No dictionaries are permitted

ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED
No additional printed material is permitted	1 x 20 Page Book

THIS EXAMINATION IS PRINTED DOUBLE-SIDED.

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Question 1. (20 Marks)

1.1 (2 Marks)

Explain why friction is important in how a wedge works.

1.2 (2 Marks)

In this unit you learned about flexible belts. Give an example of a situation where this flexible belt theory may be used.

1.3 (2 Marks)

Write the equation which defines the moment caused by a force **F** acting at a perpendicular distance *d* from the point at which the moment is measured.

1.4 (2 Marks)

When analysing trusses, the weight of the truss itself is often ignored. Why is this done, and what effect does this have on the results of the analysis of the truss?

1.5 (8 Marks)

Figure 1 shows an 80kg platform supported by three uniform links, each with a mass of 10kg. You were taught two distinctly different methods which can be used to find the force F required to keep the platform in equilibrium.

Name each method and briefly describe the steps involved for both methods of solution (in relation to Figure 1).

Note you are not required to actually solve this problem.

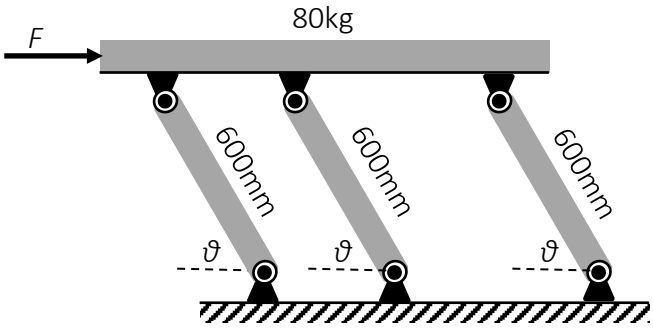


Figure 1

1.6 (4 Marks)

Referring to Figure 1 above (and the platform description given in Question 1.5), draw the FBD for:

a the 80kg platform
b one of the 600mm long links

Question 2. (14 Marks)

For the loaded truss shown in Figure 2, determine the force in member *BE*.

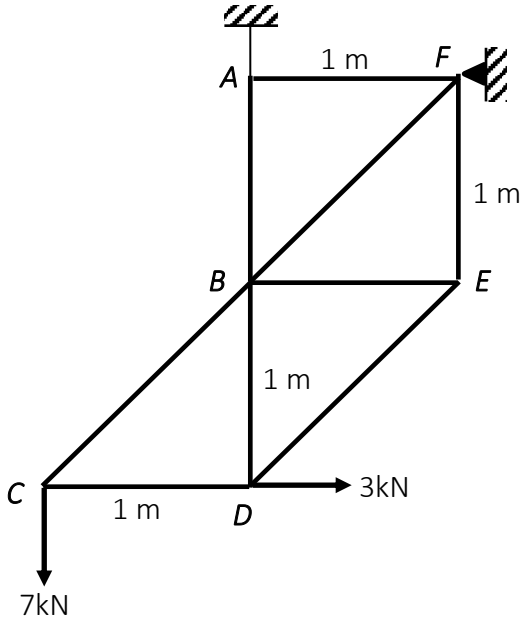


Figure 2

Question 3. 16 Marks)

For the beam with the loading shown in Figure 3, draw the shear force and bending moment diagrams. Include the location and value of the maximum bending moment.

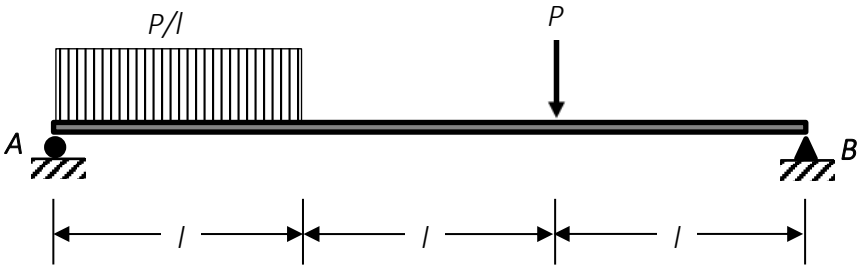


Figure 3

Question 4. (16 Marks)

A uniform plank rests on an overhead rack. The position of the plank is adjusted by pulling on a rope attached to the end of the plank, as shown in Figure 4. Determine the value of the force *P* required to slide the plank to the left across the supports. (*P* acts down and to the left as shown.)

The plank has a mass of 100kg, and the coefficient of kinetic friction between the plank and each support is 0.5.

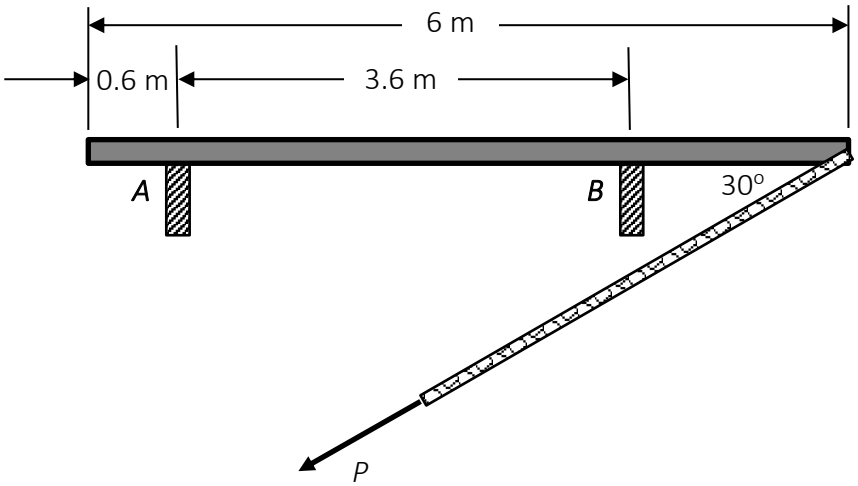


Figure 4

Question 5. (20 Marks)

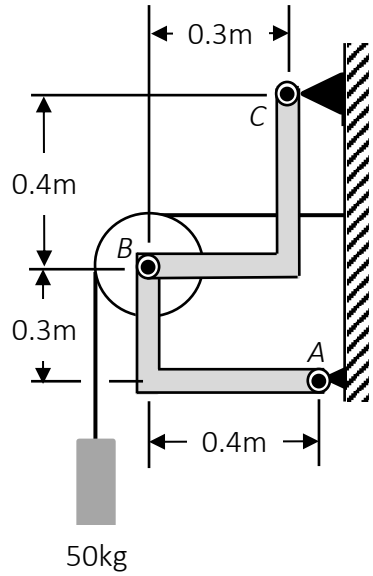


Figure 5

The frame shown in Figure 5 is made up of two right angled components *AB* and *BC* which support a pulley at *B*. For the loading shown, determine the forces at *A* and *C*.

Question 6. (14 Marks)

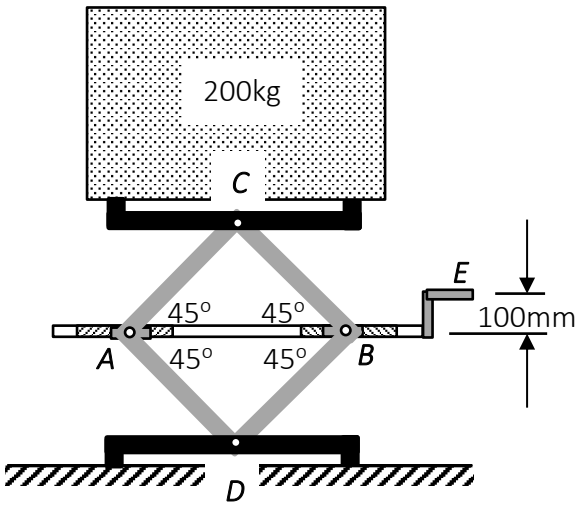


Figure 6

The jack shown in Figure 6 is used to lift the 200kg box. Determine the perpendicular force required to turn the jack handle *E*.

Each single threaded screw has an average diameter of 25mm, a lead of 7.5mm and a coefficient of static friction of 0.25.

Formula Sheet

$$\Sigma M_O = 0$$
$$\Sigma F_V = 0$$
$$\Sigma F_H = 0$$

$$A\bar{y} = \int y dA$$
$$A\bar{x} = \int x dA$$

$$A\bar{y} = \Sigma A_n \bar{y}_n$$
$$A\bar{x} = \Sigma A_n \bar{x}_n$$

$$I_x = \bar{I}_x + Ad_x^2$$
$$I_y = \bar{I}_y + Ad_y^2$$

$$m + 3 \le 2j$$

$$dV = -wdx$$
$$dM = Vdx$$

raise

$$M = Wr\tan(\phi + \alpha)$$

lower

$$M = Wr\tan(\phi - \alpha)$$

$$\mu = \frac{F_{\max}}{N}$$
$$\varphi = \tan^{-1}\mu$$

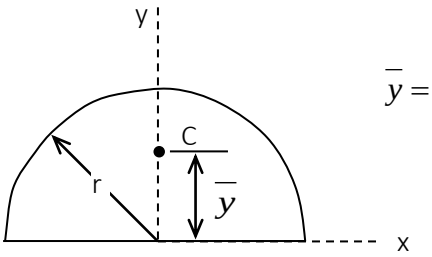
if $M_O = r \times F$

$$\tan\alpha = \frac{L}{2\pi r}$$

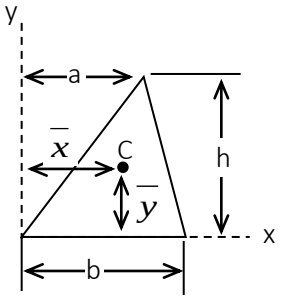
then

$$M_O = \begin{matrix} i & j & k \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{matrix}$$

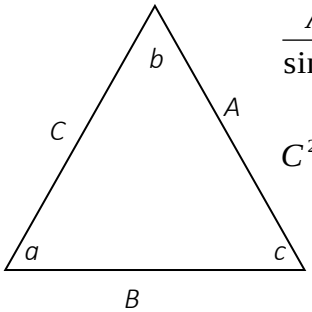
$$T_2 = T_1 e^{\mu\beta}$$



$$\bar{y} = \frac{4r}{3\pi}$$

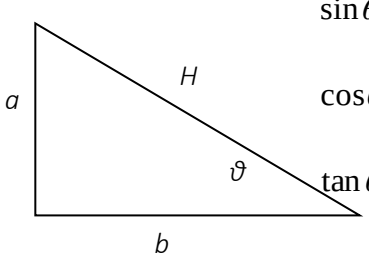


$$\bar{x} = \frac{a+b}{3}$$
$$\bar{y} = \frac{h}{3}$$



$$\frac{A}{\sin a} = \frac{B}{\sin b} = \frac{C}{\sin c}$$

$$C^2 = A^2 + B^2 - 2AB\cos c$$



$$\sin\theta = \frac{a}{H}$$
$$\cos\theta = \frac{b}{H}$$
$$\tan\theta = \frac{a}{b}$$