



ALL SAINTS' COLLEGE

Ewing Avenue, Bull Creek, Western Australia

Year 12 Physics 3A 3B

Structures Practice Test

Student Name: _____

Time allowed: 45 minutes

Total marks available: 45

Show calculation answers to 3 significant figures

1. Explain with reference to the concepts of 'centre of mass' and 'torque' why it is essential that the boy pictured needs to lean forward to avoid falling. He is carrying a very heavy rucksack.



(2)

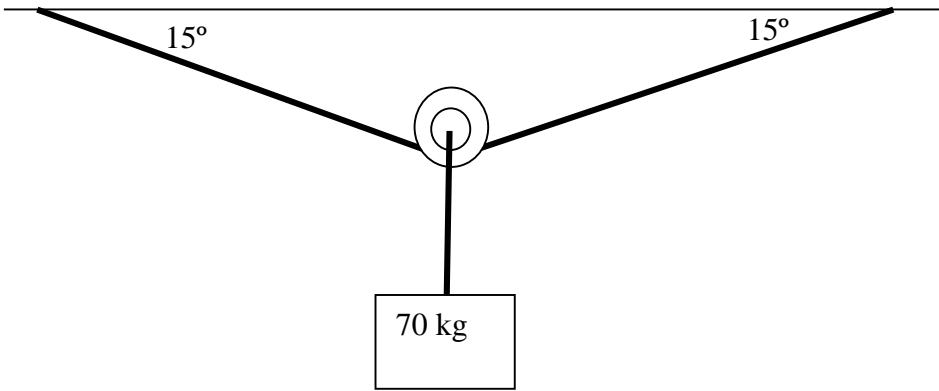
2. Explain, referring to the conditions for stability, why it is more difficult to balance the broom as pictured with the brush head up, compared to balancing the broom with the brush head resting on your hand.



(2)

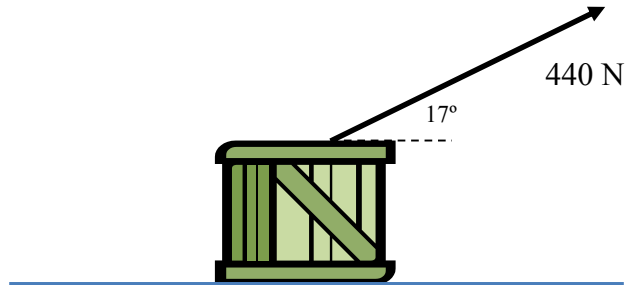
3. Calculate the tension in the wire that is supporting a load of 70 kg. Each end of the wire makes an angle of 15° with the horizontal.

(3)



4. A Crate is being pulled across flat ground by a rope with a tension of 440 N acting at 17° to the horizontal. The crate has a mass of 60.0 kg and is moving at a constant velocity.

- a. Calculate the force of friction acting on the crate to keep it in equilibrium.

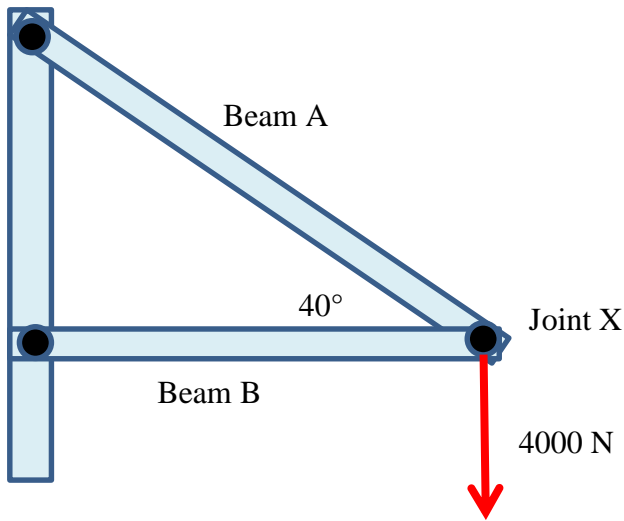


(2)

- b. Calculate the total normal reaction force acting from the ground onto the crate

(2)

5. A truss system of pinned beams supports a load of 4000 N which acts vertically down from joint X. In this question you can assume that the joints are frictionless and that all forces are transmitted along the line of the beams.



- a. State whether the beams are in compression or tension.

(2)

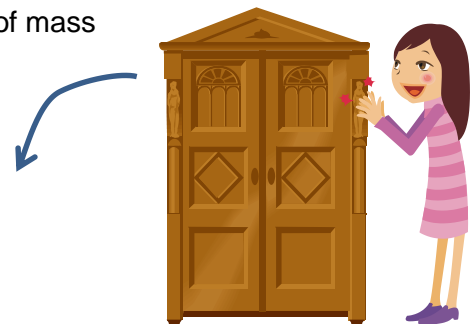
Beam A : _____ Beam B: _____

- b. Calculate the forces transmitted by Beam A and Beam B, show your working in the space to the right of the diagram above.

(3)

Force from Beam A : _____ Force from Beam B : _____

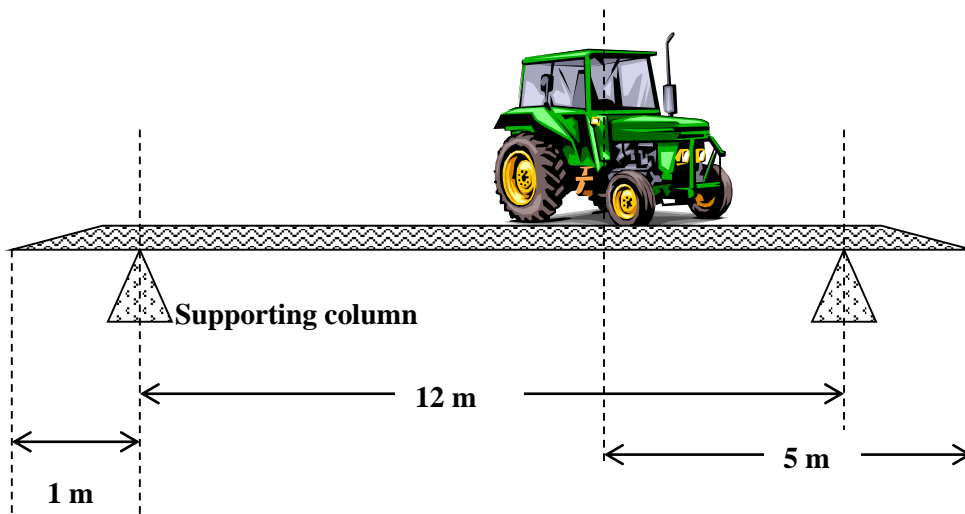
6. Estimate the force the lady requires to tip over the wardrobe of mass 40 kg as shown in the diagram. It will tip over the bottom left edge.



(4)

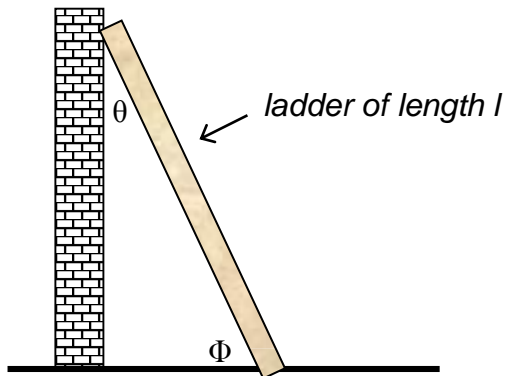
7. A tractor of mass 4,000 kg is crossing a rigid 14 m long steel bridge of mass 7,000 kg. The centre of mass of the tractor is 5.00 metres from the right hand side of the bridge. Calculate the reaction forces that act on the bridge from the supporting columns at the left and right hand side of the bridge. (Note- all forces act in the vertical in this question)

(4)

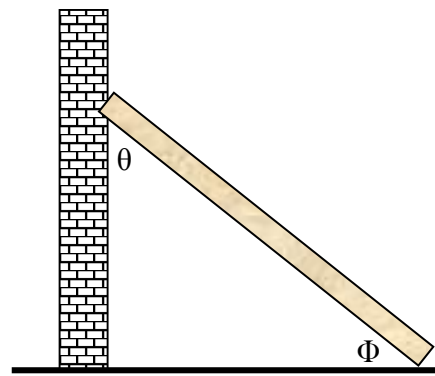


Continued on next page

8. The diagram shows a ladder in 2 different positions. The ladder of mass m and weight \mathbf{W} is resting on a smooth vertical wall, which provides a perpendicular reaction force \mathbf{F}_{wall} onto the ladder. The ground is able to provide a friction force $\mathbf{F}_{\text{friction}}$ horizontally on the bottom of the ladder. Beyond a certain threshold the force of friction ceases to exist and the ladder will collapse. The normal reaction force \mathbf{N} is acting vertically upwards on the bottom of the ladder from the ground.



Ladder in position A



Ladder in position B

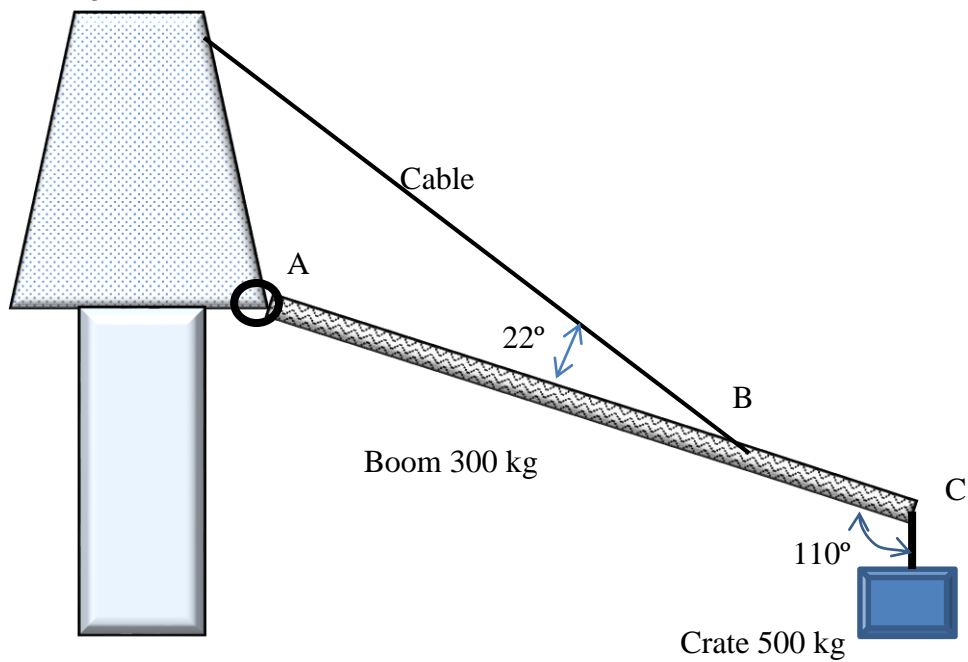
- a) Indicate, on one of the diagrams, the 4 forces acting on the ladder.

(1)

- b) Explain clearly which ladder is more prone to collapse.

(3)

9. The 300 kg boom of a crane is pivoted at point A. The length of the boom AC is 8.00 m. A crate of mass 500 kg is lifted by a rope from C. A flexible cable is attached at point B where the length AB is 6.00 m. The cable makes an angle of 22° with the boom. The rope lifting the crate makes an angle of 110° with the boom.



- a. Demonstrate by calculation that the tension in the cable is 2.13×10^4 N

(4)

- b. Construct a vector diagram (approximately to scale) to show that $\Sigma F = 0$ when considering the weight of the boom, the weight of the crate, tension in the cable and reaction force from the pivot.

(1)

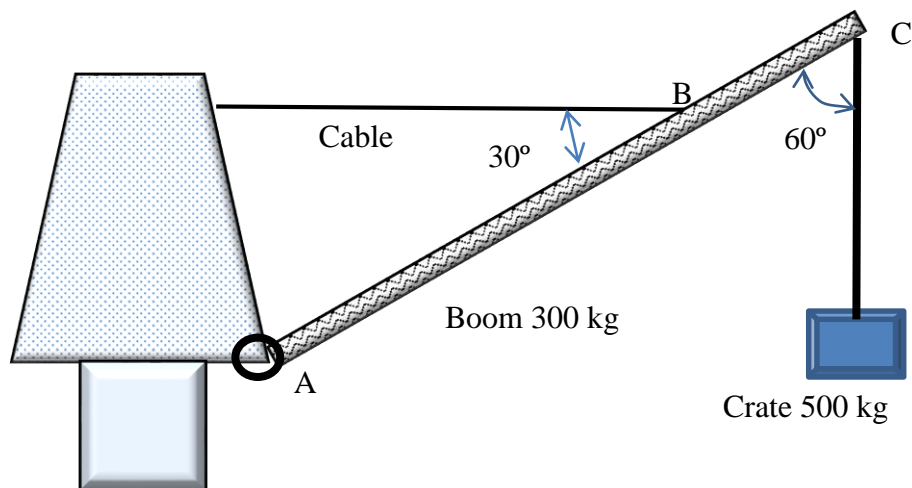
c. Calculate the magnitude of the reaction force from the pivot.

(3)

d. Calculate the direction for the reaction force relative to the vertical (note that it acts below horizontal) and show this angle on your vector diagram.

(2)

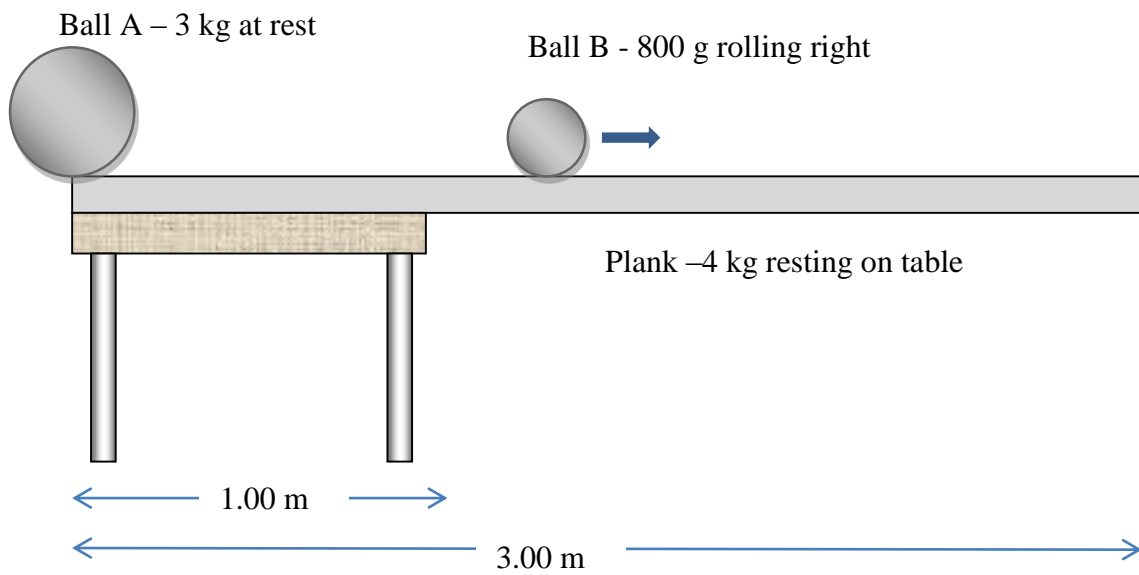
The crane lifts the crate into a new position as shown in the diagram below.



e. Explain whether the tension in the cable has increased or decreased in this new position. You are not permitted to re-calculate the tension in this position. You must discuss how and why the the clockwise and anticlockwise torques have changed.

(3)

10. A plank of length 3.00 m and mass 4.00 kg is resting on top of a 1.00 m wide table. The left hand side of the plank and the table are in line. Ball A of mass 3.00 kg is at rest at the left hand side of the plank. Ball B of mass 800 g is rolling to the right.



The plank will fall from the table when Ball B has reached a certain position. Determine the distance from the left edge of the plank of this position.

(4)