## Motion and Force in a Gravitational Field

## **Revision Problems 5: Torque and Equilibrium**

Due:		

Name: ANSWERS

(20 marks total)

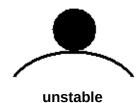
1. We say that objects are more stable if they have a wide base and a low centre of gravity. Explain this using the concept of torque. (3 marks)

Objects with a low centre of mass and wide base have a large restoring torque when tilted.

Due to wide base, centre of mass is some distance from the edge of the base so torque tends to rotate object back to centre. [1 mark]

Object has to rotate through a large angle before centre of mass is beyond base which would then provide a torque to tip object over. [1 mark]

2. Label the following diagrams as stable, unstable or neutral. (3 marks)







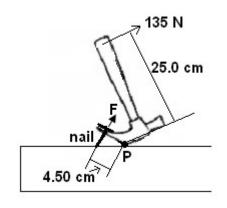
neutral

stable [3 marks]

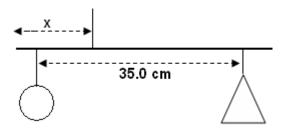
3. A claw hammer is be used to remove a nail from a piece of wood as shown. Calculate the pulling force, F, in the situation shown? (2 marks)

 $\Sigma$ CM =  $\Sigma$ ACM 135 x 0.25 = F x 0.045 [1 mark] 33.75 = 0.045F F = 750 N

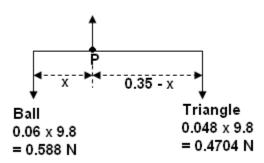
 $F = 7.50 \times 10^2 \text{ N}$  [1 mark]



4. A child's mobile has different shapes at each end of a 35.0 cm rod (assume mass of rod is insignificant). The mass of the ball is 60.0 g and the mass of the triangle is 48.0 g. How far from the triangle should the rod be suspended to hang horizontal? (4 marks)



1



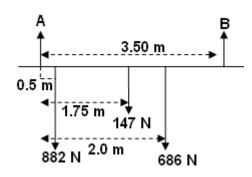
$$\Sigma$$
CM =  $\Sigma$ ACM  
0.470 x [0.35 - X] = 0.588 x X [2 marks]  
0.1645 - 0.47X = 0.588X  
0.1645 = 1.058X  
X = 0.1554 [1 mark]

attach string to rod 0.155 m from ball [1 mark]

5. In order to paint a wall, two men are standing on a supported uniform plank of mass 15.0 kg as shown. (diagram not to scale). Man A, who has a mass of 90.0 kg is 1.00 m from one end while man B, who has a mass of 70.0 kg is 2.00 m from the other end. The supports are 0.500 m from each end of the plank. Calculate how much of the total weight each of the trestle stands supports.

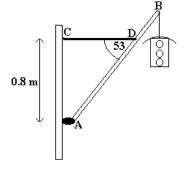
0.5m 3.5m 0.5m

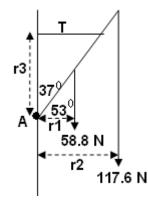
(4 marks)



Take moments about A 
$$\Sigma$$
CM =  $\Sigma$ ACM (882 x 0.5) + (147 x 1.75) + (686 x 2.0) = B x 3.5 441 + 257.25 + 1372 = 3.5 B 2070.25 = 2.5 B B = 592 N up [2 marks]

6. A traffic light hangs from a structure as shown. The uniform metal pole AB is 5.50 m long and has a mass of 6.00 kg. The mass of the traffic light is 12.0 kg. The cable CD is attached 0.800 m from point A. Determine the tension in the horizontal cable CD. (Assume the cable has no mass itself.) (4 marks)





## **Calculate perpendicular distance:**

## Take moments about A

$$\Sigma$$
CM =  $\Sigma$ ACM (58.8 x 1.655) + (117.6 x 3.31) = T x 0.80) [1 mark] 97.314 + 389.256 = 0.80T 486.57 = 0.8T  $T = 608 \text{ N}$  [1 mark]