

1. Please explain the following terminology in detail:

- a. *Rigid Body*;
- b. *Newton's Three Laws of Motion*.

2. Please complete the following:

- a. Clearly state the *Equations of Equilibrium* for a *Rigid Body*;
- b. Figure 1 shows the front portion of an aircraft. As the aircraft applies its brakes, the nose wheel exerts 2 forces on the end of the landing gear as shown in the Figure. Please determine the horizontal and vertical components of reaction at point C.

3. Please determine the functions for the Shear and Bending-Moment for the beam shown in Figure 2. Please plot the Shear and Bending-Moment diagrams for the beam using the functions you previously derived.

4. If a rigid cylinder rolls at a constant rate along a rigid surface, the normal force exerted by the surface on the cylinder acts at the tangent point of contact. To keep the cylinder in equilibrium, it is required that **N** be concurrent with a driving force **P** and the weight **W** with the following relationship: $P \approx \frac{Wa}{r}$. The term *a* is called the *Coefficient of Rolling Resistance* which is also the distance *a* shown in Figure 3. Please do the following:

- a. In detail explanations, please derive the relationship $P \approx \frac{Wa}{r}$.
- b. A 10 kg steel wheel shown in Figure 4, has a radius of 100 mm and rests on an inclined plane. If the angle θ is increased so that the wheel start to roll down in a constant rate when $\theta = 1.2^\circ$, determine the *Coefficient of Rolling Resistance*.

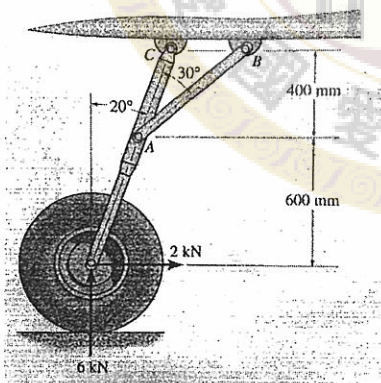


Figure 1



Figure 2

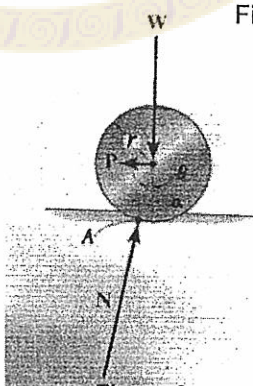


Figure 3



Figure 4