

Physics 2414, Spring 2008

Group Exercise 4, Feb 14 ♡

Name 1: _____ OUID 1: solutions
Name 2: _____ OUID 2: _____
Name 3: _____ OUID 3: _____
Name 4: _____ OUID 4: _____

Section Number: _____

Identifying Forces

Notation \vec{F}_{12} - Force on 1 by 2.

Description

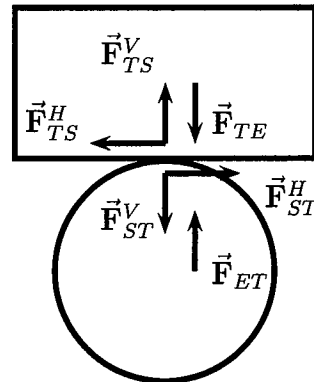
A truck is moving (with its engine shut off) on a level highway. The forces acting on the truck are:

(i) Weight force - $\vec{F}_{TE} = 50$ kN - (gravitational) force acting on truck by earth.

(ii) Normal force - $\vec{F}_{TS}^V = 50$ kN - vertical upward force on truck by surface of road. (This is a contact force and exists only when the truck is in contact with earth.)

(iii) Friction force - $\vec{F}_{TS}^H = 15$ kN - horizontal force on truck by surface of road. (This is also a contact force.)

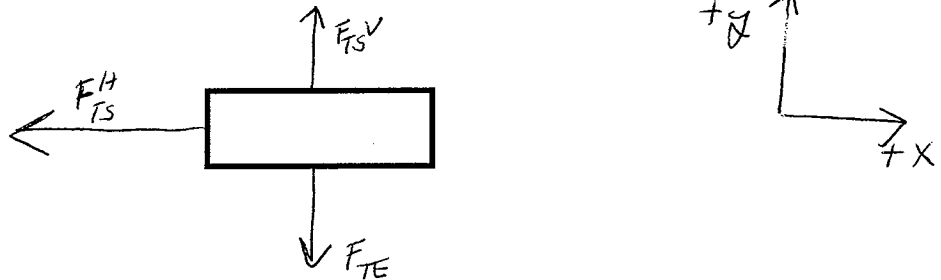
Fig: Schematic diagram showing the truck on earth.



Problems

1. Truck:

(a) Draw a free body diagram for the truck.



(b) Write the net force acting on the truck as the sum of all the forces acting on the truck.

$$\vec{F}_{\text{net on truck}} = \vec{F}_{TE} + \vec{F}_{TS}^V + \vec{F}_{TS}^H$$

(c) What is the magnitude of the net force acting in the vertical direction on the truck?

$$F_{TS}^V - F_{TE} = 50\text{KN} - 50\text{KN} = \boxed{0}$$

(d) What is the magnitude of the net force acting in the horizontal direction on the truck?

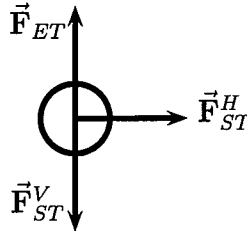
$$F_{TS}^H = \boxed{+15\text{KN}}$$

(e) If the mass of the truck is 10,000 kg, what is the magnitude and direction of the acceleration of the truck? (Hint: Use $\vec{F} = m\vec{a}$.)

$$F_{\text{net}} = ma \quad -15\text{KN} = 10,000\text{kg} a$$
$$a = \boxed{-1.5\text{ m/s}^2}$$

2. Earth:

(a) The free body diagram for the earth is



(b) What is the magnitude and direction of the net force acting on the earth?

$$F_{\text{Horizontal net on earth}} = F_{ST}^H = \boxed{15 \text{ kN}}$$

$$F_{\text{Vertical net on earth}} = F_{ET} - F_{ST}^V = 50 \text{ kN} - 50 \text{ kN} = \boxed{0}$$

(c) If the mass of the earth is 6×10^{24} kg, what is the magnitude and direction of the acceleration of earth? (Hint: Use $\vec{F} = m\vec{a}$)

$$15 \text{ kN} = 6 \times 10^{24} \text{ kg } a \quad \boxed{a = 2.5 \times 10^{-21} \text{ m/s}^2}$$

3. Action-reaction pairs:

(a) What is the action-reaction pair of the force corresponding to the weight of the truck (\vec{F}_{TE})? \vec{F}_{ET}

(b) What is the action-reaction pair of the force corresponding to the normal force acting on the truck (\vec{F}_{TS}^V)? \vec{F}_{ST}^V

(c) What is the action-reaction pair of the force corresponding to the friction force acting on the truck (\vec{F}_{TS}^H)? \vec{F}_{ST}^H