

# Assignment 5

October 29, 2022

Q1 Draw the free body diagram of the bold object:

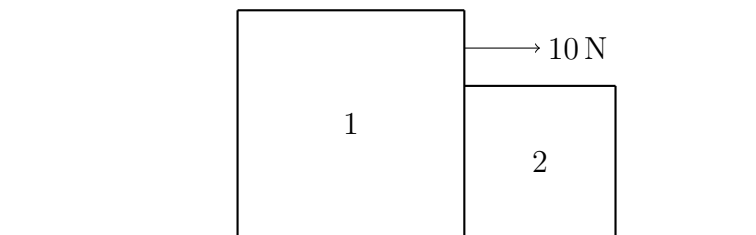
- (a) **a block** that has a mass of 30 kg being dragged by a person using a rope with 10 N [30° above ground] of force on a smooth surface.
- (b) **A person** with a mass of  $m$  free falling before opening his parachute. The person has reached his terminal velocity. Take into account air resistance. You do not need precise numeric values of all forces.
- (c) **A car** of a train that weighs 2 tonnes is being lead by a locomotive applying 25 kN. The cars are connected via a steel rope, and  $\mu = 0.1$ .

Q2 Jeff attempted to push on a block that weighs 60 kg with 150 N of force. The static coefficient of friction is 0.2, and the dynamic coefficient of friction is 0.15

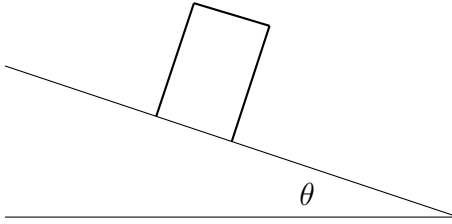
- (a) Will Jeff successfully move this block?
- (b) If he can move this block, what would the acceleration on this block be? If he cannot move this block, how much more force does he need to apply to move this block?

Q3 There are two blocks. Block 1 weighs 10 kg and block 2 weighs 5 kg. They are directly contacting each other on a surface with  $\mu_{stat} = \mu_{dyn} = 0.03$ . An illustration below shows the layout. If an applied force of 10 N[Left] is applied to block 1

- (a) What is the acceleration on each block?
- (b) What are the friction forces acting on each block?
- (c) What is the force acting on the block 2 that is posed by block 1?



Q4 A block with a mass of 5 kg is lying on a ramp with an angle of  $\theta$  to the ground. If  $\mu_{static} = 0.1$ , at which angle of  $\theta$  would the block start sliding?



Bonus A Cessna 172 plane has a wing span of  $16.17 \text{ m}^2$ , and weighs  $1.157 \text{ kg}$ . It has a drag coefficient of  $0.0341$ , and a lift coefficient of  $0.8$ . If this plane travels at an altitude with air density of  $1 \text{ kg/m}^3$ , how much thrust force does it need to maintain a steady level flight?

Hint: Recall the lift and drag force equations. Also what conditions does a steady level flight require in terms of force balancing?