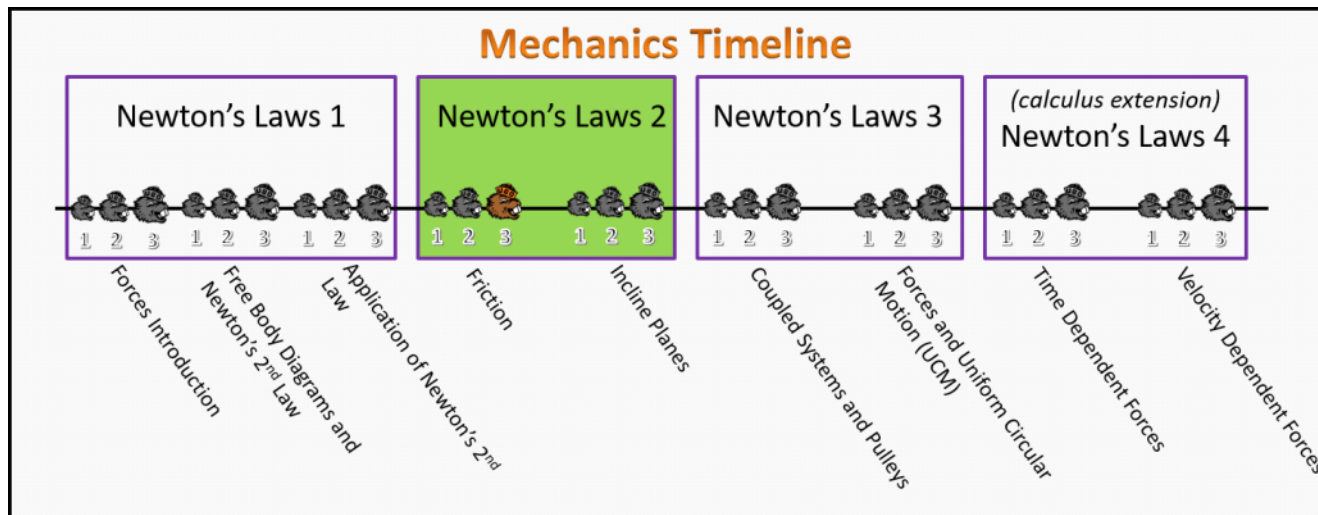


Newton's Laws 2 Foundation Stage (N2.L1.3)

Post-Lecture 1 Friction



Questions

N2.L1.3-01

Description: Direction of kinetic friction.

Learning Objectives: [?]

Problem Statement: Which of the following situations is the friction on a block **not** in the opposite direction of the velocity of the object? There may be more than one correct answer.

- (1) A block slides to rest on a table.
- (2) A block initially at rest in the bed of a stationary pick-up truck begins to slide to the back of the truck as the truck accelerates and moves forwards.
- (3) A block initially at rest in the bed of a stationary pick-up truck does not slide but begins to move forwards with the truck as the truck accelerates and moves forwards.
- (4) A car initially at rest does a burnout and begins to accelerate and move forwards as the wheels spin on the ground.

N2.L1.3-02

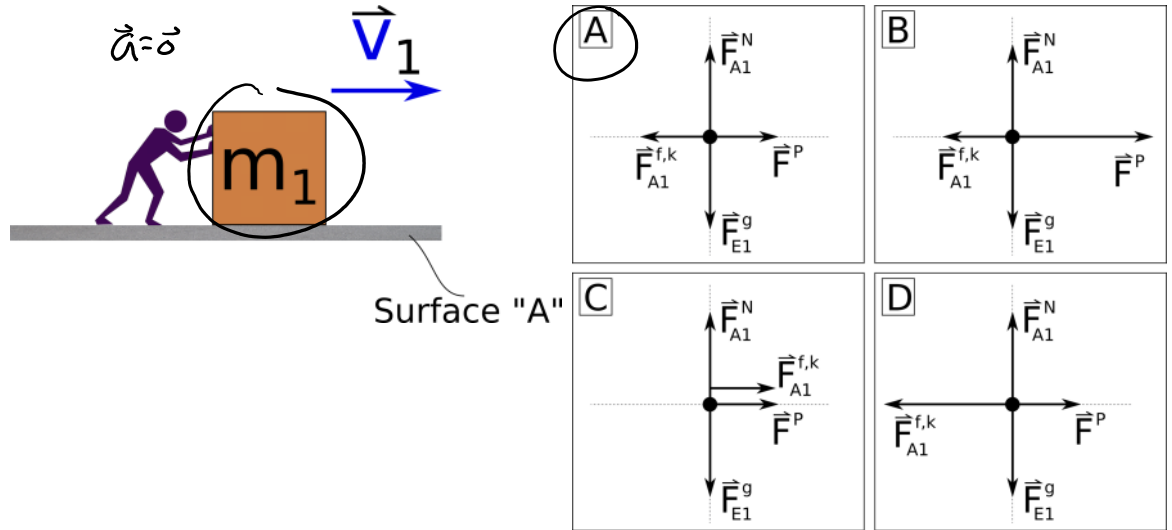
Description: Calculate push force on box sliding across a floor with non-negligible friction.

Learning Objectives: [?]

Problem Statement: An 70.0-kg person is pushing horizontally on a 40.0-kg box that slides across the level floor at a constant velocity of 4.00 m/s. The coefficient of kinetic friction between the box and the floor is 0.20. See the figure below for a picture for this system. Use $g = 9.80 \text{ m/s}^2$.

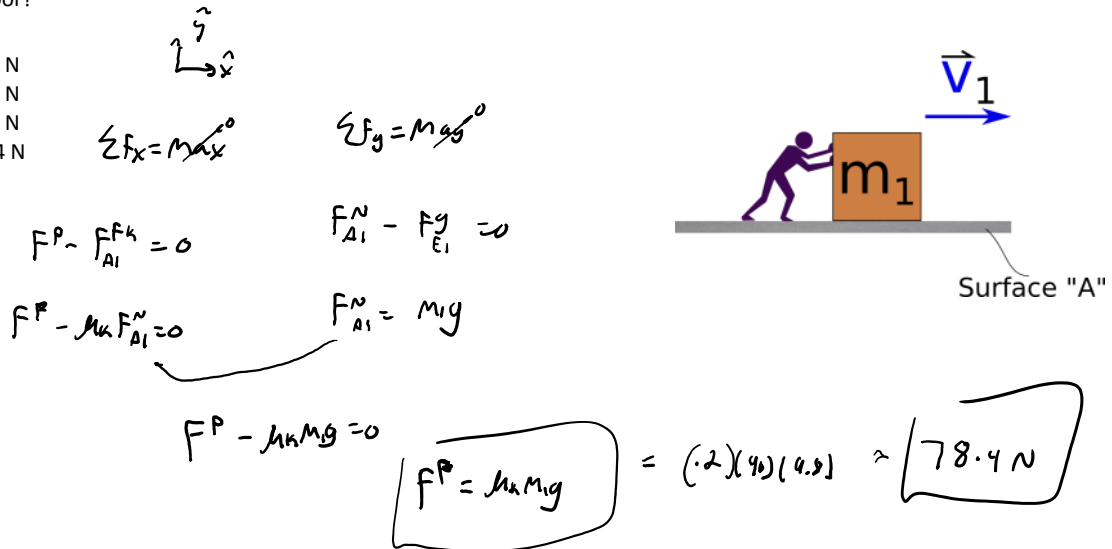
(a) Which of the free body diagrams below best represents the system of the box?

- (1) A
- (2) B
- (3) C
- (4) D



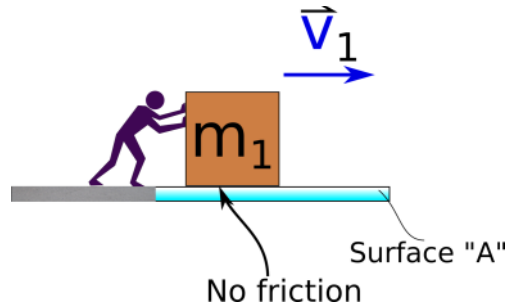
(b) What is the magnitude of force that the person must push with to keep this box sliding at the constant 4.00 m/s constant velocity across the floor?

- (1) 686 N
- (2) 392 N
- (3) 137 N
- (4) 78.4 N
- (5) 0 N



(c) What is the magnitude of force that the person must push with to keep the box sliding at a constant 4.00 m/s constant velocity across the floor if there is no friction between the box and the floor?

- (1) 686 N
- (2) 392 N
- (3) 137 N
- (4) 78.4 N
- (5) 0 N**



N2.L1.3-03

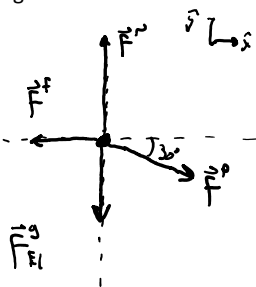
Description: Given mass, μ_s , μ_k , and magnitude of applied force with angle, determine the acceleration of the box on a horizontal surface.

Learning Objectives: [?]

Problem Statement: A 1.40 kg block is at rest on top of a horizontal table. The coefficient of static friction between the table and the block is 0.40, and the coefficient of kinetic friction between the two is 0.10. A person then applies a 6.00 N force to the right at an angle of 30.0° downwards relative to the horizontal. Use $g = 9.80 \text{ m/s}^2$ and a standard coordinate system.

(a) What is the magnitude of the friction force between the block and table?

- (1) 1.37 N
- (2) 5.20 N**
- (3) 5.49 N
- (4) 6.69 N



$$\sum F_y = m a_y$$

$$F^N - F_{ki} - F^p \sin 30 = 0$$

$$F^N - mg - F^p \sin 30 = 0$$

$$F^N - (1.4)(9.8) - (6) \sin(30) = 0$$

$$F^N = 16.72 \text{ N}$$

$$F_{s \max} = \mu_s F^N$$

$$= (0.4)(16.72)$$

$$= 6.688 \text{ N}$$

so Box @ rest

$$\sum F_x = m a_x$$

$$F^p \cos 30 - f = 0$$

$$6 \cos 30 = f$$

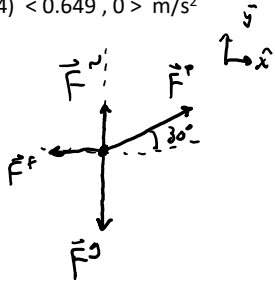
$$f = 5.19615 \text{ N}$$

(b) What is the acceleration of the block?

- (1) $\langle 0, 0 \rangle \text{ m/s}^2$**
- (2) $\langle 2.51, 0 \rangle \text{ m/s}^2$
- (3) $\langle 2.95, 0 \rangle \text{ m/s}^2$
- (4) $\langle 0.649, 0 \rangle \text{ m/s}^2$

(c) What is the acceleration of the block if the person had applied the 6.00 N force at a 30.0° upwards relative to the horizontal?

- (1) $\langle 0, 0 \rangle \text{ m/s}^2$
- (2) $\langle 2.51, 0 \rangle \text{ m/s}^2$
- ③ $\langle 2.95, 0 \rangle \text{ m/s}^2$
- (4) $\langle 0.649, 0 \rangle \text{ m/s}^2$



$$\sum F_y = may$$

$$F_N + F_P \sin 30 - F_g = 0$$

$$F_N + 6 \sin 30 - (1.4)(4.9) = 0$$

$$F_N = 10.72 \text{ N}$$

$$F_P \sin \theta = \mu_s F_N$$

$$= (1.4)(10.72)$$

$$= 15.008 \text{ N}$$

$$F_x^P = 6 \cos 30 > 4.288 \text{ so } a \neq 0$$

$$\sum F_x = max$$

$$- F_f + F_P \cos 30 = max$$

$$- \mu_k F_N + F_P \cos 30 = max$$

$$- (1)(10.72) + 6 \cos 30 = 1.4 max$$

$$a_x = \underline{\underline{2.94582 \text{ m/s}^2}}$$