

Problems

1. A model rocket of mass 4.80×10^2 g accelerates vertically upward at 34.0 m/s^2 during launch, overcoming both gravity and air resistance.
 - a) Draw a free-body diagram of the rocket once it has left the launch pad.
 - b) Calculate the thrust force applied by the rocket engine during launch if the air resistance acting on the rocket is 2.40 N.

2. A rocket of mass 8400 kg is fired directly upward.
 - a) Draw an FBD and determine what upward force must be supplied by its engine if the rocket is to accelerate at 3.8 m/s^2 .
 - b) If the engines suddenly stopped functioning, draw a new FBD and determine the acceleration of the rocket.

3. An elevator and its contents have a combined mass of 6500 kg. It is suspended by a single cable.
 - a) Draw a free-body diagram of the elevator.
 - b) What force must the cable exert on the elevator when it is at rest?
 - c) What force must the cable exert on the elevator when it is moving upward at 2.0 m/s^2 ?
 - d) What force must the cable exert on the elevator when it is moving downward at 2.0 m/s ?
 - e) What force must the cable exert on the elevator when it is moving downward at 2.0 m/s^2 ?
 - f) If the cable snapped, draw a new free-body diagram and determine the acceleration of the elevator.

4. A bowling ball of mass 2.0 kg strikes a stationary pin of mass 5.00×10^2 g. The collision lasts for 0.45 s after which the pin moves off with a velocity of 12.8 m/s [W]. Ignoring friction between the pin and the floor, calculate
 - a) the acceleration of the pin during the collision
 - b) the force exerted by the bowling ball on the pin (include a FBD)
 - c) the acceleration of the bowling ball during the collision

5. A person throws a 2.4 kg object vertically upward and it reaches a maximum position 4.1 m above the point of release.
 - a) What speed must the object have had upon release? Include a FBD of the object *after* release.

- b) If the process of throwing the object vertically from rest took 0.823 s until it was released, what was the acceleration of the object?
- c) What force must the person have exerted during the throw to reach the determined height? Provide a new FBD of the object *before* release.
6. A wagon of mass 2.4 kg is pushed along the ground at 1.2 m/s^2 [\rightarrow] against a frictional force of 1.22 N. What is the applied force that is acting?
7. If a 7.2 N force is required to accelerate a 3.4-kg object along a horizontal surface at a rate of 1.6 m/s^2 , what is the frictional resistance that is acting?
8. One 3.2-kg paint bucket is hanging by a massless cord from another 3.2 kg paint bucket, also hanging by a massless cord.
- If the buckets are at rest, what is the tension in each cord?
 - If the two buckets are pulled upward with an acceleration of 1.60 m/s^2 by the upper cord, calculate the tension in each cord.
9. A train is pulling two cars of the same mass behind it. Determine the ratio of the tension in the coupling between the locomotive and the first car (F_{T1}), to that between the first car and the second car (F_{T2}), for any non-zero acceleration of the train.



10. A window washer pulls herself upward using a bucket-pulley apparatus. The combined mass of the bucket and washer is 65 kg.
- How hard must she pull downward to raise herself slowly at a constant speed?
 - If she increases this force by 15%, what will her acceleration be?

