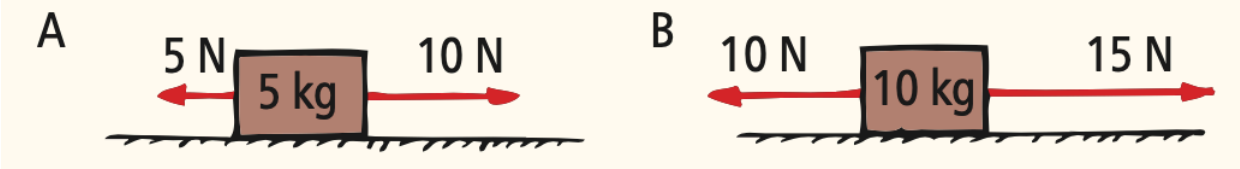
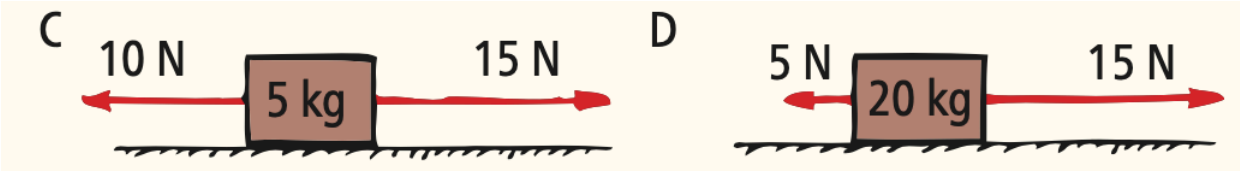
Ch. 4 HW Newton's 2nd Law

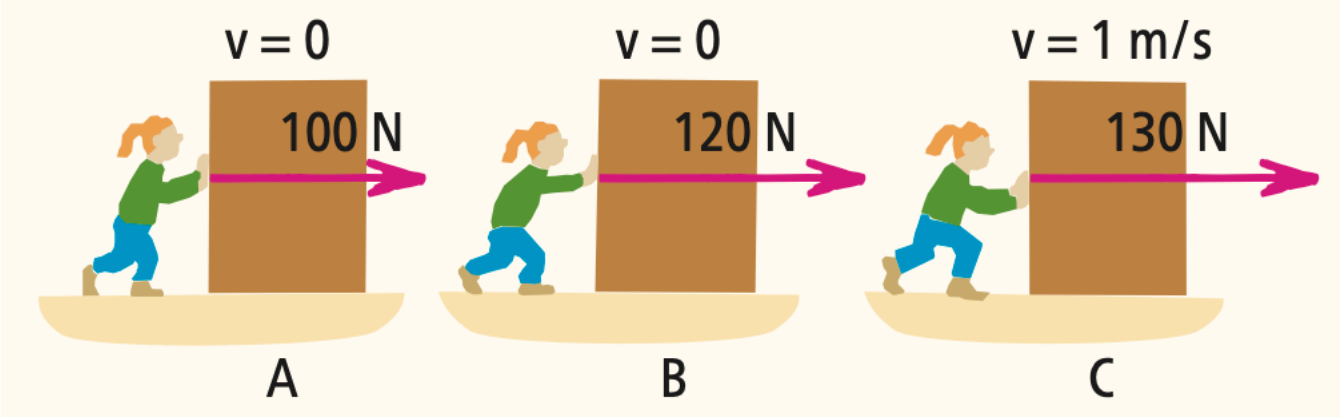
Extra Credit Option: Each student may obtain up to +5 points extra credit from this HW set to be added towards Exam I. (see Syllabus "Extra Credit' for details)

1) **(5 pts)** Boxes of various masses are on a friction-free level table. Calculate the (i) net force (draw magnitude+direction) and (ii) acceleration on each of the boxes.

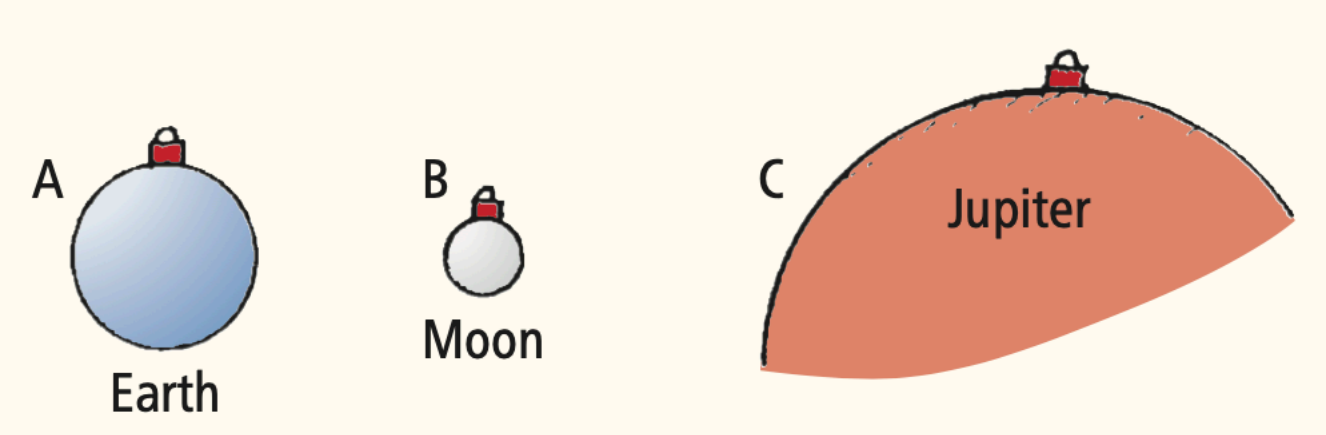




2) **(5 pts)** The crate is pushed and remains at equilibrium (no acceleration) in all three cases, A, B and C. Calculate (magnitude+direction) the amount of friction force between thee crate and the floor for each case



3) **(5 pts)** A 100-kg tool box is in locations A, B, and C. Rank from greatest to least the (a) masses of the 100-kg box and (b) weight of the 100-kg box



least		greatest	(masses)
least		greatest	(weights)

4) **(20 pts)** A 150-kg person stands on a scale inside an elevator. (*hint*: think and draw the direction of the net force in each case as well as what would the individual forces acting on the person have to be)

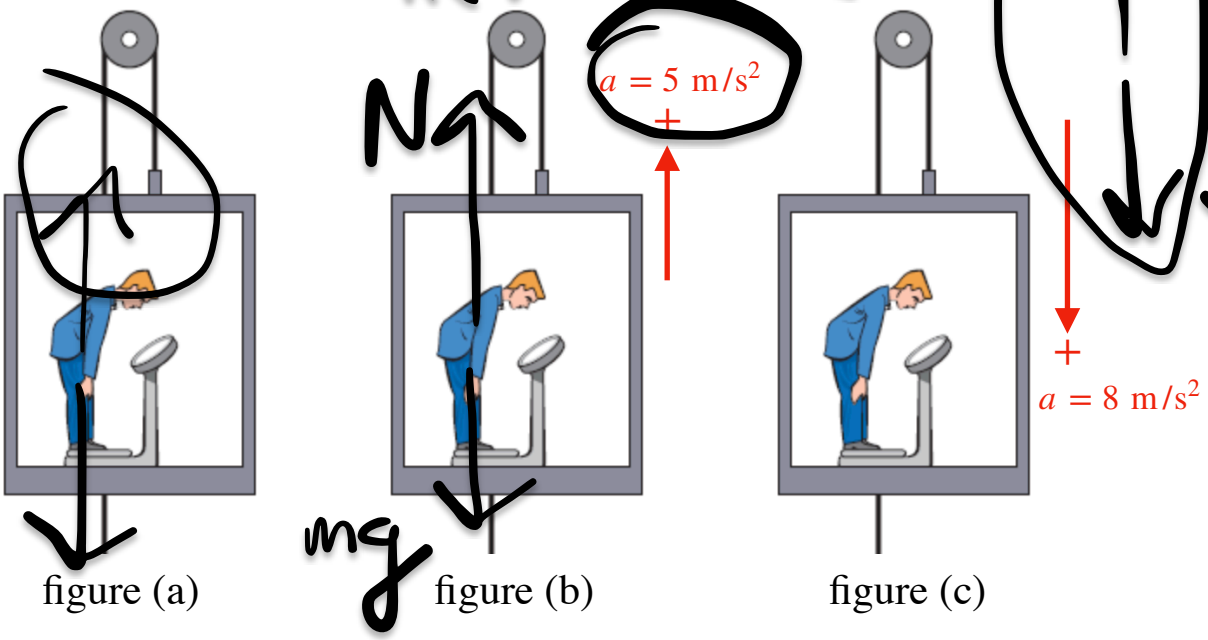


figure (a) figure (b) figure (c)

a) **(5 pts)** In **figure (a)** , the elevator is moving at a constant speed. What is the reading on the scale (normal force) in this case ?

b) **(5 pts)** In **figure (b)** , the elevator suddenly accelerates upward at 5 m/s^2 What is the reading on the scale (normal force) in this case ?

$$F_{net} = N - mg = ma$$

c) **(5 pts)** In **figure (c)** , the elevator suddenly accelerates downward at 8 m/s^2 What is the reading on the scale (normal force) in this case ?

d) **(5 pts)** In the scenario where the rope of the elevator is cut-off and the elevator goes into *free-fall* (a = 10 m/s^2), how much would the person weight according to the scale in this case ?

5) **(20 pts)** A box of mass m = 2 kg sits in a table

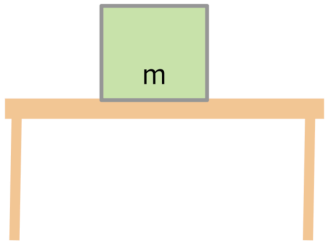


figure (a)

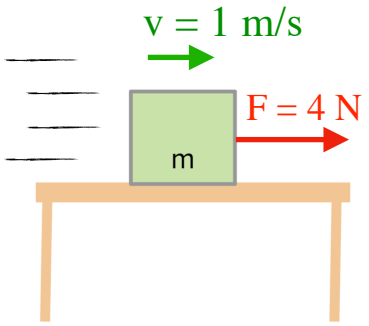


figure (b)

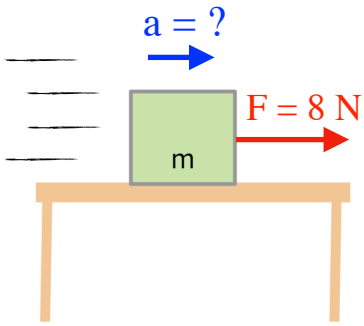


figure (c)

a) **(5 pts)** Draw all forces acting on the box at rest in **figure (a)**

b) **(5 pts)** The box in **figure (b)** is pushed with a force of 4 N and it moves at a *constant velocity* of 1 m/s to the right. Draw the friction force (magnitude+direction) exerted by the table on the box.

c) **(5 pts)** The box in **figure (c)** is now pushed with a force of 8 N to the right which causes it to accelerate. Calculate the horizontal net fore, $\mathbf{F}_{net}$ (*hint:* same friction force determined in part (b) is present)

d) **(5 pts)** Calculate the acceleration of the box in **figure (c)**

6) **(20 pts)** A parachutist of mass m = 60 kg deploys his parachute:
(take the downward direction as "+" positive)

figure (a)

figure (b)

figure (c)

a) **(5 pts)** Draw all forces (magnitude+direction) acting on the parachutist assuming no air resistance (e.g., *free-fall*) in **figure (a)**

b) **(5 pts)** After the parachutist has gained enough speed, the air resistance now becomes 200 N. Draw all forces (magnitude+direction) acting on the parachutist and calculate net force, $\mathbf{F}_{net}$, in **figure (b)**

c) **(5 pts)** Calculate the acceleration of the parachutist in **figure (b)**

d) **(5 pts)** The parachutist air resistance has now increased to 600 N in **figure (c)** Draw all forces (magnitude+direction) acting on the parachutist and calculate the net force $\mathbf{F}_{net}$, and acceleration.

7) **(15 pts)** A 20-kg crate is pushed by a person in three scenarios

figure (a)

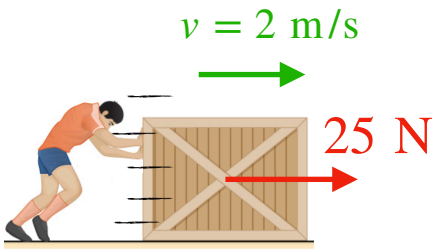


figure (b)

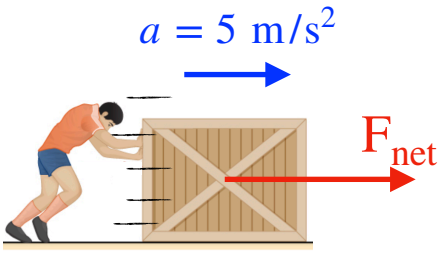


figure (c)

a) **(5 pts)** In **figure (a)**, the person applies a force of 20 N force, but the crate remains at *rest*. Draw all *forces* acting on the crate (specify magnitude and direction of each force)

b) **(5 pts)** In **figure (b)**, the person applies 25 N of force to get the crate moving at a *constant velocity* of 2 m/s. Draw the magnitude and direction of the frictional force in this case.

c) **(5 pts)** In **figure (c)**, calculate the *net force* required to *accelerate* the crate by 5 m/s^2.

8) **(20 pts)** Nelly Newton, who has a mass of m = 30 kg, sky-dives from a high-flying helicopter (take the downward direction as "+" positive)

figure (a)

figure (b)

figure (c)

a) **(5 pts)** Draw all forces (magnitude+direction) acting on the Nelly initially during her fall, assuming no air resistance (e.g., *free-fall*) in **figure (a)**

b) **(5 pts)** After Nelly has gained enough speed, the air resistance now becomes 200 N. Draw all forces (magnitude+direction) acting on the Nelly and calculate net force, $\mathbf{F}_{net}$, in **figure (b)**

c) **(5 pts)** Calculate the acceleration of Nelly in **figure (b)**

d) **(5 pts)** Nelly's air resistance has now increased to 300 N in **figure (c)** Draw all forces (magnitude+direction) acting on her and calculate the net force $\mathbf{F}_{net}$, and acceleration.