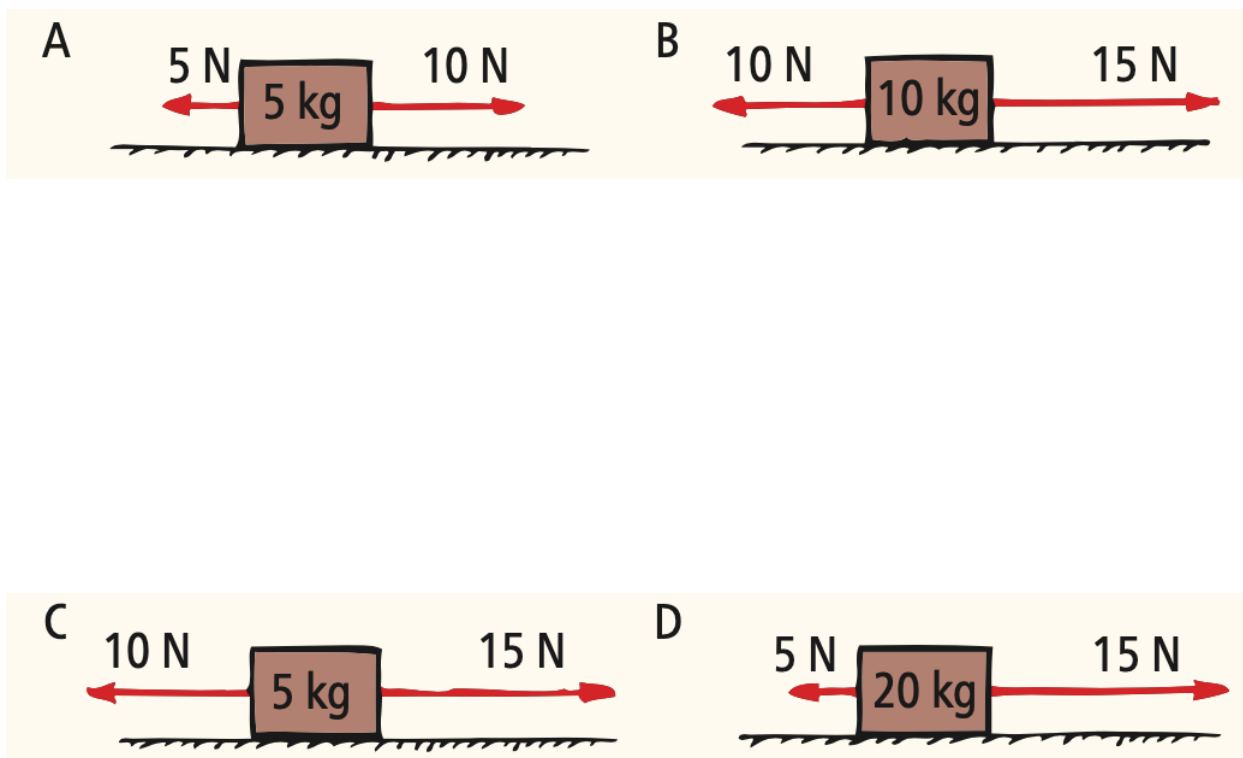


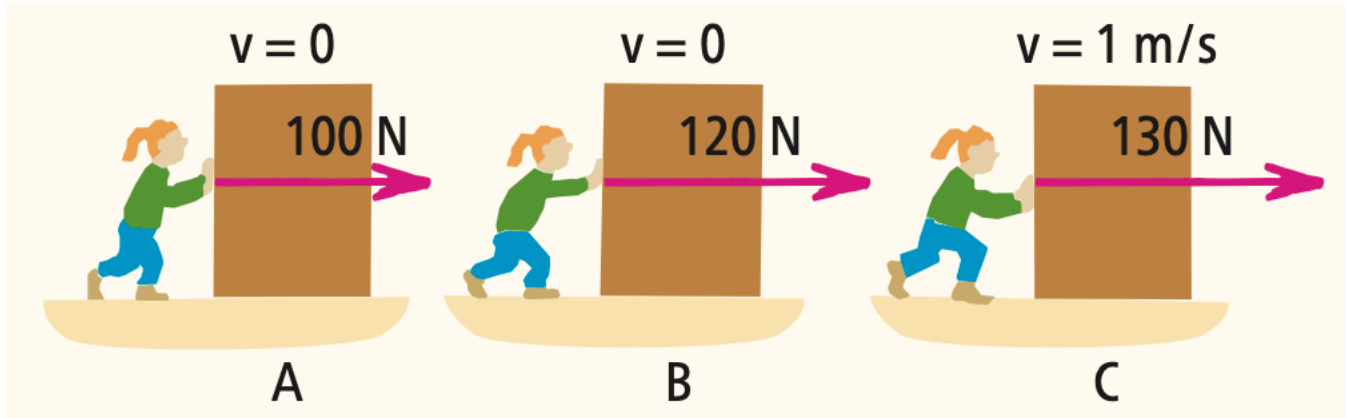
Ch. 4 HW Newton's 2nd Law

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)

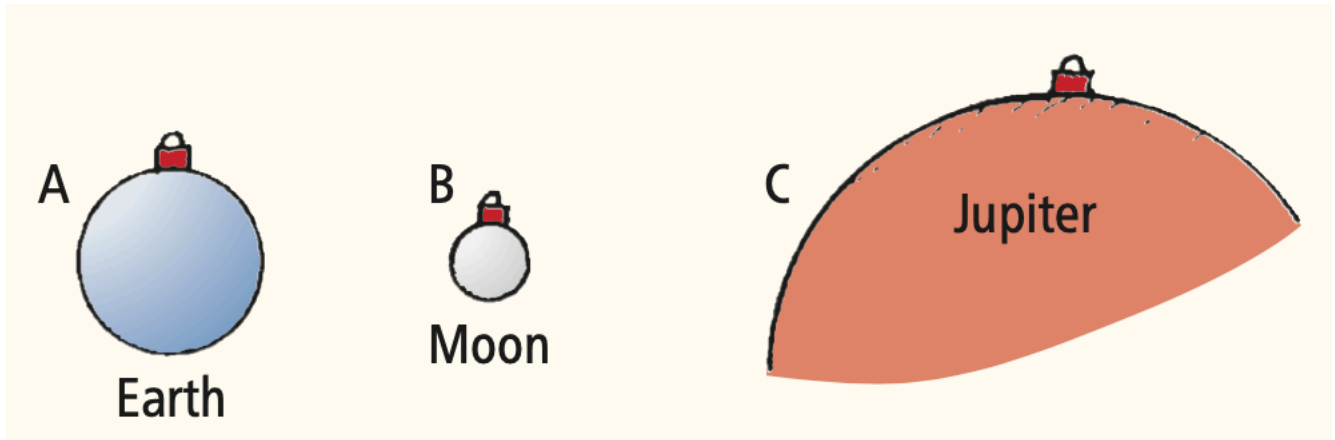
- 1) (**5 pts**) Boxes of various masses are on a friction-free level table. Calculate the (i) net force (draw magnitude+direction) and (ii) acceleration on each of the boxes.



- 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 the 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

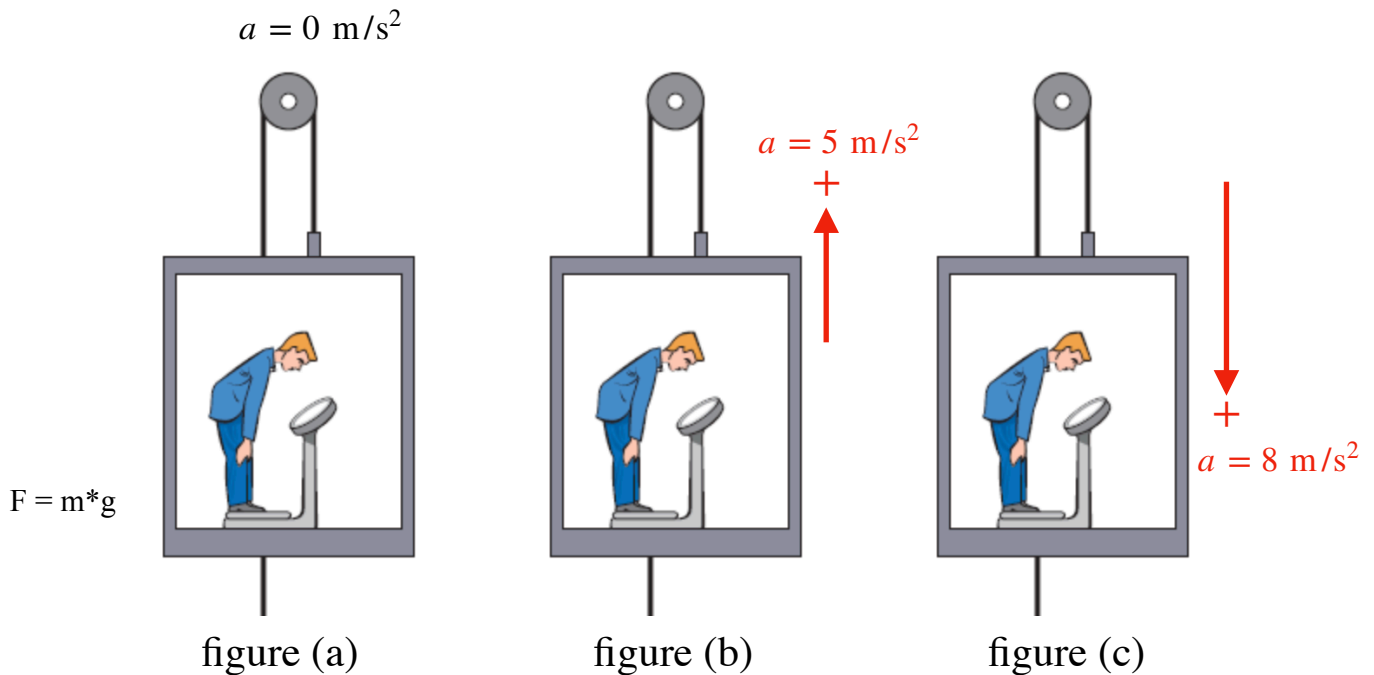
(masses)

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*)



- 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 ?
- 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* ($a = 10 \text{ m/s}^2$), how much would the person weight according to the scale in this case ?

5) (20 pts) A box of mass $m = 2 \text{ kg}$ sits in a table

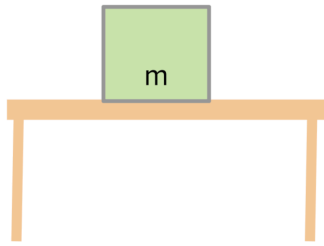


figure (a)

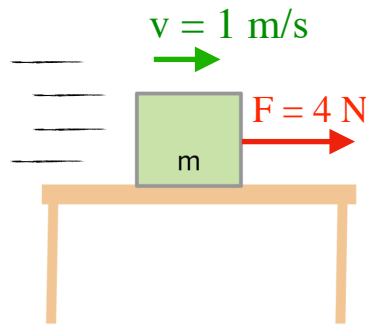


figure (b)

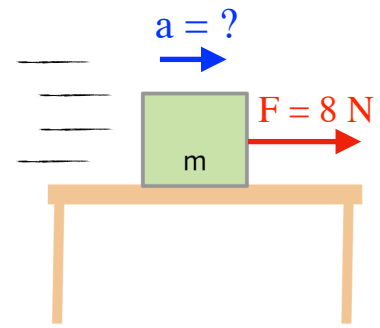


figure (c)

- 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 force, 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 $m = 60 \text{ kg}$ deploys his parachute:
(take the downward direction as “+” positive)



figure (a)



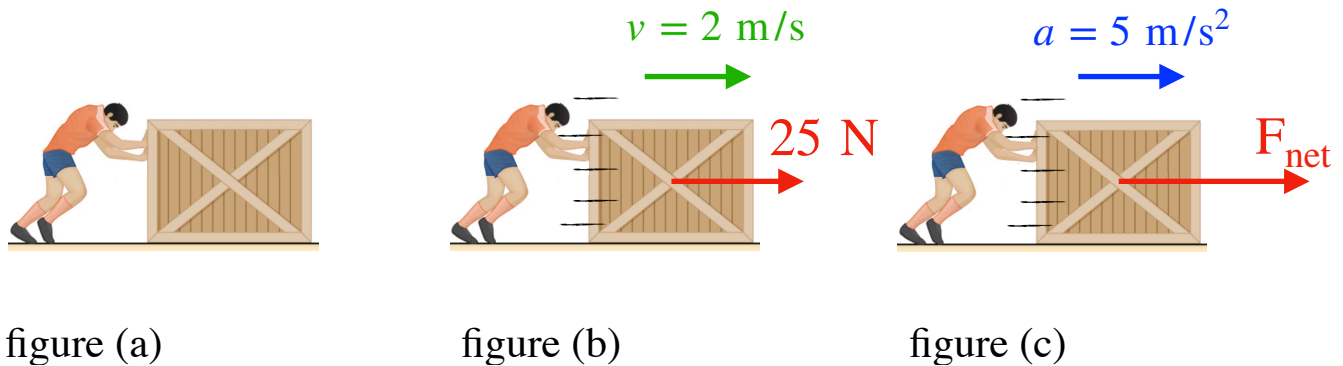
figure (b)



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



- 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 $m = 30 \text{ kg}$, 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.