Outcome 1c:

Force:

- Force is a **push** or a **pull** on an object.

- In order for force to transfer energy to an object, that object must move a distance or be displaced

- "An object in motion will stay in motion, and an object at rest will stay at rest, unless an outside force acts on it"

- This is Newton's First Law of Motion

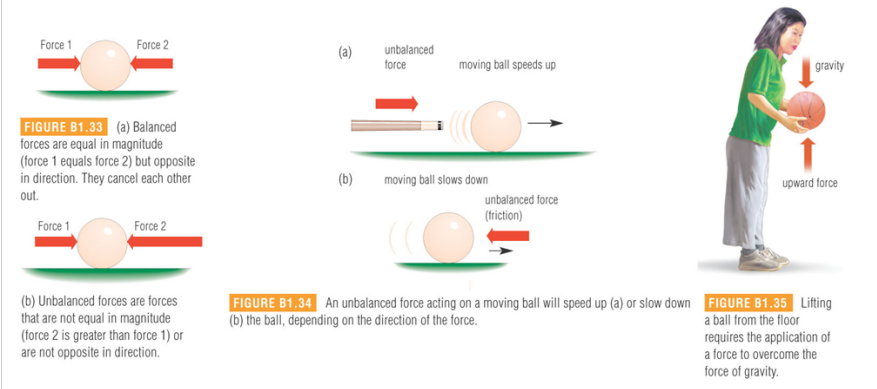

FIGURE B1.33 (a) Balanced forces are equal in magnitude (force 1 equals force 2) but opposite in direction. They cancel each other out. (b) Unbalanced forces are forces that are not equal in magnitude (force 2 is greater than force 1) or are not opposite in direction.

FIGURE B1.34 An unbalanced force acting on a moving ball will speed up (a) or slow down (b) the ball, depending on the direction of the force.

FIGURE B1.35 Lifting a ball from the floor requires the application of a force to overcome the force of gravity.

-The formula for force is:

Force = mass x acceleration **F = ma**

- Force is measured in a unit called a **Newton**.

- 1 N = $\frac{1kg * m}{s^2}$

Example: Calculate the force needed to accelerate a mass of 12 kg at 4.5 m/s^2.

m: 12kg
a: 4.5m/s^2
F: ?

F = ma
= (12kg)(4.5m/s^2)
= 54 N
= 54 $\frac{kg \cdot m}{s^2}$

Example: A force of 80 N accelerates an object at 16m/s^2. Find the objects mass.

F: 80N
a: 16m/s^2
m: ??

F = ma
80N = m(16 $\frac{m}{s^2}$)

m: 5.0kg

Work:

Whenever a **force** moves an object through a **distance** that is in the direction of the force then **work** is done on the object.

Three conditions have to be met for work to be done on an object: Give an example of each condition.

1. There must be movement.

2. There must be a force.

3. The force and the distance the object travels must be in the same direction.

Energy: The ability to do work

- Change in energy of an object (ΔE) = Work done on an object (W)

- Energy and work are interchangeable words. Both mean the same thing and have the Joule (J) as the unit of measure.

Calculating Work:
The formula for work is:

Work = Force x distance **W = Fd**

F = ma

We know that F = ma, so we can expand the Force Formula to be:

Work = mass x acceleration x distance

W = mad

W = Fd
W = (ma)d

Example: A bulldozer moved a large rock that has a mass of 1250kg. The rock accelerated to 12m/s^2 for a distance of 6.0m. What was the work input of the bulldozer?

W = mad
m = 1250kg
a = 12 m/s^2
d = 6.0m
W = (1250kg)(12m/s^2)(60m)
= 90000 J
= 9.0×10^4 J
= 90kJ

Example: A Sky diver with a mass of 75kg jumped from an airplane. He traveled a distance of 150m before touching the ground. What was the magnitude of the work accomplished?

W = ??
m = 75kg
a = 9.81m/s^2
d = 150m
W = (75kg)(9.81m/s^2)(150m)
= 110362.5 J
= 1.1×10^5 J 1.1×10^2 kJ

Practice Sheet 6

1. A tugboat is towing a tanker through the Panama Canal. Calculate the work done by the tugboat if it applies a force of 6.50×10^3 N for a distance of 150 m.

2. A large crane did 2.2×10^4 J of work to lift a demolition ball a distance of 9.5 m. Calculate the force exerted by the crane.

3. Find the acceleration of a car whose mass is 2300 kg, and whose engine exerts a force of 9200 N.

4. A 1050 g ball was being pushed with a force of 25 N from the right and 65 N from the left. What is the net force being applied. What would be the acceleration of the ball? (Don't forget direction)

5. A small airplane with a mass of 1200 kg touches down on a runway at a speed of 24 m/s. It slows down to a stop in 16 s.

a. Calculate the force required to stop the plane.

b. If it took 150 m for the plane to stop, what amount of work was done by the breaks?

6. A car with a driver has a combined mass of 2100kg, and is traveling at 90km/h. The driver makes an emergency stop by slamming on the brakes. It takes 3.50s over a distance of 54.0m to bring the car to a full stop. How much work was done by the brakes?