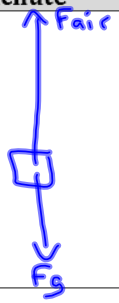
SPH3U: 4.1 Gravitational Force near Earth

1. Air resistance and free fall

Which piece of paper will reach the ground first? Flat paper Crumpled paper

Free fall:	when a falling object only experiences gravity, no other forces (not common).
air resistance	a force that prevents falling objects from falling. depends on 2 factors: ① cross-sectional area of object. ② the speed of the object.
terminal speed	maximum speed of a falling object.

Skydiver:

First leaving the plane	Falling for a while	No longer accelerating
		Terminal speed.  $F_{net} = 0$.
Open parachute	**Slowed down a bit**	**Falling constant speed**
Slow down 		Terminal speed (slower than above).  $F_{net} = 0$

~~Drag force:~~	
$F_D = \frac{1}{2}\rho v^2 C_D A$	F_D is the drag force, ρ is the density of the fluid, v is the speed of the object relative to the fluid, A is the cross sectional area, and C_D is the drag coefficient – a dimensionless number.

2. Gravitational field strength

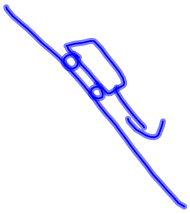
Force field:	a region of space where objects experience a force.
gravitational field strength	the force per kilogram that an object experiences in a gravitational field. $g = \frac{F_g}{m}$. Units: N/kg.
g in Toronto	9.807 N/kg.
g 6,371 km above Earth's surface	2.45 N/kg.

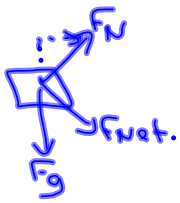
3. The difference between mass and weight

Mass:	quantity of matter in an object (particles).
Weight:	force of gravity acting on an object.
"weightlessness" or "microgravity"	when no normal force is holding you up. for instance Drop Zone (free fall).
International Space Station (ISS)	g = 8.69 N/kg. 400 km above Earth. they seem weightless because of freefall.

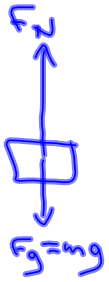
4. Normal force: not always equal to gravity

A cart rolls down an incline. Assume that friction is negligible. Draw an FBD for the cart. In which directions do the normal force and the force of gravity act on the cart?





A 50 kg person is standing on a bathroom scale inside an elevator. The scale is calibrated in newtons. What is the reading on the scale when the elevator is accelerating up at 2.2 m/s^2?

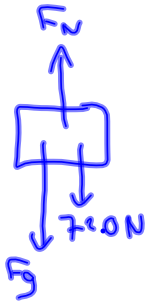


$F_{Net} = ma$
$= 50(2.2)$
$= 110N$

$F_{Net} = F_N - F_g$
$110N = F_N - 50(9.8)$

$F_N = 110 + 50(9.8)$
$= 600\ N.$

A 60.0 kg person is standing on a bathroom scale calibrated in newtons. A friend pushes down on the person with a force of 72.0 N. What is the reading on the scale?



$F_{Net} = 0$
$= F_N - F_g - 72.0N.$

$F_N = mg + 72.0N$
$= (60)(9.8) + 72.0N$
$= 660\ N.$

Homework: page 167: #1-3, 5-7