

# DYNAMICS – Additional Review

Name: TEACHERDate: 2014

## List of Potentially Useful Equations:

$$v_2 = v_1 + a\Delta t$$

$$\Delta d = v_1\Delta t + \frac{1}{2}a\Delta t^2$$

$$v_{av} = \frac{\Delta d}{\Delta t} = \frac{v_1 + v_2}{2}$$

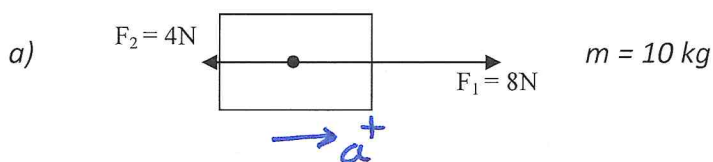
$$v_2^2 = v_1^2 + 2a\Delta d$$

$$F_{net} = \Sigma F = ma$$

$$F_f = \mu F_N$$

$$F_g = mg$$

1. From the following situations determine if the object in question will accelerate, and if so, in which direction and with what magnitude? *You do not need to worry about the normal force, weight or friction for this problem.*



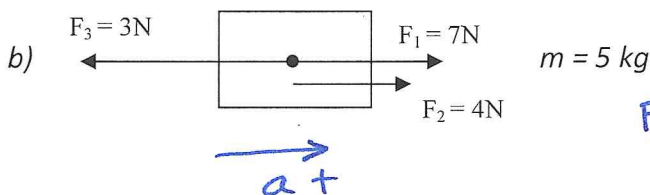
$$\Sigma F = ma$$

$$F_1 - F_2 = ma$$

$$\frac{F_1 - F_2}{m} = a$$

$$\frac{(8) - (4)}{(10)} = a$$

$$\therefore a = 0.4 \text{ m/s/s}$$

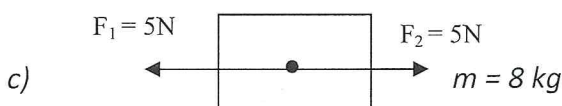


$$\Sigma F = ma$$

$$F_1 + F_2 - F_3 = ma$$

$$a = \frac{F_1 + F_2 - F_3}{m}$$

$$a = \frac{(7) + (4) - (3)}{(5)} = 1.6 \text{ m/s/s}$$



$$\Sigma F = ma$$

$$F_2 - F_1 = ma$$

$$a = 0 \quad \text{forces are balanced.}$$

2. **Defend or criticize** the following **two** statements.

- a) An object moving at *constant* speed (not accelerating) must have no forces acting on it.

FALSE  $\rightarrow$  it must have NO NET FORCE. There can be lots of forces acting on it, but if they all balance the object will not accelerate.

- a) An object at rest must have no forces acting on.

FALSE  $\rightarrow$  again if the forces balance ( $\Sigma F = 0$ ) then it will not accelerate, but there could be lots of forces acting on it.

3. An astronaut, standing on the surface of the moon, weighs 150 N. The acceleration due to gravity on the moon is 1/6 the acceleration due to gravity on earth.

- a) Calculate the astronaut's mass.

moon:  $g = a_g = \frac{1}{6}(9.8) = 1.63 \text{ m/s}^2$

$$F_g = Mg.$$

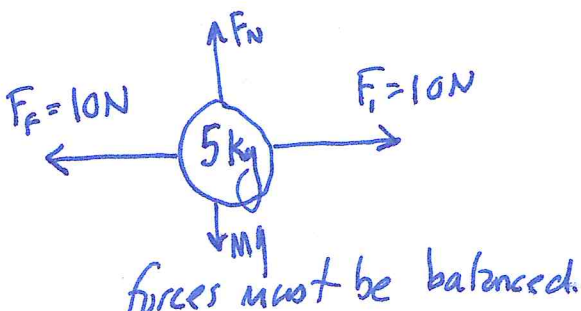
$$\frac{150}{1.63} = M \quad \rightarrow \quad \boxed{M = 92 \text{ Kg}}$$

- b) Is her mass different on the moon than it is on Earth?

No, her mass is still 92 Kg. Her weight would be higher though (902 N)

4. An applied force of 10 N keeps a 5 kg mass moving at constant velocity.

- a) Draw a free body diagram for this situation.



$a = 0$  (forces are balanced)

- b) Determine the frictional force. (*HINT: What does constant velocity imply?*)

$$F_f = 10\text{ N}$$

(see diagram on previous page)

- c) Calculate the coefficient of friction.

$$F_f = \mu F_N$$

$$F_N = F_g \\ = (5)(9.8)$$

$$\mu = \frac{F_f}{F_N}$$

$$F_N = 49\text{ N}$$

$$\boxed{\mu = \frac{10}{49} = 0.2}$$

5. A dragster reaches 350 km/h from rest in 6.2 s. If the car is 800 kg and generates a driving force of 16000 N, find the force of friction on the car. (Include an FBD).

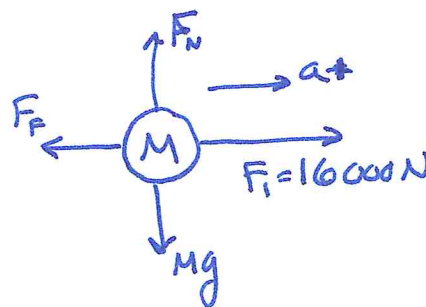
$$v_1 = 0$$

$$v_2 = 350\text{ km/h} = 97.22\text{ m/s}$$

$$\Delta t = 6.2\text{ s}$$

$$a = ?$$

$$F_f = ?$$



Find the acceleration...

$$a = \frac{v_2 - v_1}{\Delta t}$$

$$= \frac{(97.22) - (0)}{6.2}$$

$$a = 15.68\text{ m/s}^2$$

$$\Sigma F = ma$$

$$F_i - F_f = ma$$

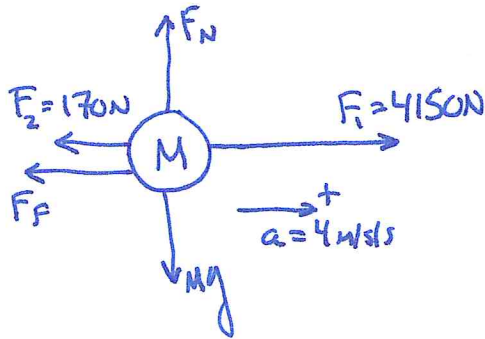
$$-F_f = ma - F_i$$

$$F_f = -ma + F_i$$

$$F_f = -(800)(15.68) + 16000\text{ N}$$

$$\boxed{F_f = 3455\text{ N}}$$

6. A 500 kg Quantum Banana Car is accelerating to the right at 4.0 m/s/s. The engine supplies a force of 4150 N to the right and air resistance was measured at 170 N. Determine the coefficient of friction,  $\mu$ , between the tires and the road. (Include an FBD).



$F_N = Mg$  since no other forces are acting vertically on this object.  
 $F_N = (500)(9.8)$   
 $F_N = 4900 \text{ N}$

$$\Sigma F = Ma$$

$$F_1 - F_2 - F_f = Ma$$

$$F_1 - F_2 - Ma = F_f$$

$$4150 - 170 - (500)(4) = F_f$$

$$\therefore F_f = 1980 \text{ N}$$

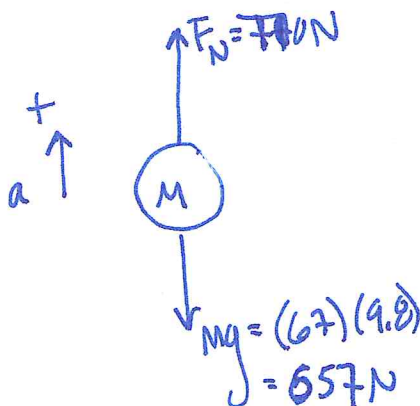
$$\text{so, } F_f = \mu F_N$$

$$\mu = \frac{F_f}{F_N}$$

$$\mu = \frac{1980}{4900}$$

$$\boxed{\mu = 0.40}$$

7. A 67 kg physics student is standing in an elevator. The student looks down at the elevator and (for some odd reason standing on a Newton scale) and reads that her weight is 710 N. Is the student accelerating up, down, or is she stationary or moving at a constant speed. How do you know. If she is accelerating, state the direction and calculate the acceleration. (A F.B.D. is necessary)



since  $F_N > F_g$  it means the elevator is accelerating upwards.

Two cases.

① moving upwards and accelerating upwards (speeding up)

OR

② moving downwards and accelerating upwards (slowing down)

$$\Sigma F = Ma$$

$$F_N - Mg = Ma$$

$$a = \frac{F_N - Mg}{M}$$

$$\boxed{a = \frac{710 - 657}{67} = 0.8 \text{ m/s}^2 \text{ (up)}}$$

Scale reading is the same as the normal force.