PHYSICS
FAB FIVE (FOR TUTORS TO USE)

F=ma
w=mg

Name Pd 7

UNIT 2 PROBLEM SET

1. A 70 kg object is accelerated by a force of 20 N. Calculate the acceleration.

$F = ma$ so $a = \frac{F}{m} = \frac{20\,N}{70\,kg} = .29\ m/s^2$

2. A 500 kg boat starts from rest and accelerates over a distance of 270 m in 12 seconds. Assuming uniform acceleration, calculate the force applied by the engine on the boat.

2nd $F = ma$ 1st $s = \frac{1}{2}at^2$

$F = (500kg)(3.8\,m/s^2)$ $a = \frac{2s}{t^2} = \frac{2(270m)}{144\,s^2} = 3.8\ m/s^2$

$F = 1900\,N$

3. An 800 kg dragster is uniformly accelerated from rest by a force of 12,000 N.
   a. Calculate the dragster's velocity after 3 seconds.

1st $F = ma$ $a = \frac{F}{m} = \frac{12000N}{800kg} = 15\ m/s^2$

2nd $a = \frac{v_f}{t}$ $v_f = at = (15\,m/s^2)(3s)$ $v_f = 45\ m/s$

   b. How far does the dragster travel during this time?

$s = \frac{v_f^2}{2a} = \frac{2025\,m^2/s^2}{30\,m/s^2} = 67.5\,m$

4. A 65 kg high diver dives down from a 10 m high board.
   a. Calculate the diver's velocity when he enters the water.

5th. $v_f = \sqrt{2gs} = \sqrt{2(9.8\,m/s^2)(10m)}$ $v_f = 14\ m/s$

Key use v_f from Part a as v_i for Part b. Then find acc. Then F=ma

   b. If the diver comes to a stop 2 m below the water surface, calculate the net force exerted by the water on the diver to bring him to a stop.

1st $a = \frac{v_f^2 - v_i^2}{2s} = \frac{-(14\,m/s)^2}{2(2m)} = \frac{-196\,m^2/s^2}{4m}$ $a = -49\ m/s^2$

$F = ma$ $F = (65kg)(-49\,m/s^2) = -3{,}185\,N$

5. a. Determine your own weight in Newtons.

1N = .22 lb

   b. A large crate has a mass of 30 kg. Determine its weight in Newtons.

$W = mg = (30kg)(9.8\,m/s^2) = 294\,N$

6. An astronaut who weighs 700 N on Earth takes a trip to planet Thrae where the gravitational acceleration is 3.7 m/s². Calculate the astronaut's weight on planet Thrae.

Key Find mass on Earth $w = mg$, $g = 9.8\,m/s^2$. Same mass on Thrae. Then $w = mg$ with new g

E

$w = mg$ $m = \frac{w}{g} = \frac{700N}{9.8\,m/s^2} = 71.4\,kg$ (Thrae)

$w = mg$ $w = (71.4kg)(3.7\,m/s^2)$ $w = 264.18\,N$

Formulas $F = ma$ $W = mg$ Pd 7

$1\ \text{Newton} = (1\ \text{Kg})(1\ \frac{m}{s^2})$ where $g = 9.8\ m/s^2$

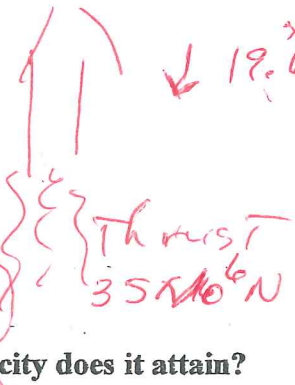
7. The space shuttle has a total mass of 2.0×10^6 kg. At liftoff, the engines exert a total thrust of 35×10^6 N.

a. Calculate the shuttle's weight. (IN NEWTONS)

$w = mg = (2.0 \times 10^6\ kg)(9.8\ m/s^2)$

$w = 19.6 \times 10^6\ N$

must subtract weight from Thrust



b. Calculate the shuttle's acceleration at liftoff.

$F = ma$

$a = \frac{\Sigma F}{m} = \frac{(35 - 19.6) \times 10^6\ N}{2.0 \times 10^6\ kg} = 7.7\ \frac{m}{s^2}$

c. If the acceleration averages 13 m/s² over the first 10 minutes, what velocity does it attain?

$t = 10\ min \cdot \frac{60\ s}{1\ min} = 600\ s$ $v_i = 0\ m/s$

#2 $a = \frac{v_f}{t}$ so $v_f = at = (13\ \frac{m}{s^2})(600\ s)$ $v_f = ?$

$v_f = 7800\ m/s$

8. The maximum force a grocery sack can withstand and not rip is 250 N. If 20 kg of groceries are lifted from the floor to a table with an acceleration of 5 m/s², will the sack hold or break?

$w = mg$

$w = (20\ kg)(9.8\ m/s^2)$

$w = 196\ N$ if you lift it with no acceleration

bottom can hold 250 N

$\Sigma F = F_g + F_w$

SO SACK will BREAK

$F_a = ma$ Caused by the acceleration

$F_a = (20\ kg)(5\ m/s^2)$

$F_a = 100\ N$

9. A student conducts a physics experiment by standing on a bathroom scale in an elevator. The scale reads 836 N when at rest.

$W = mg$ $m = \frac{w}{g} = \frac{836\ N}{9.8\ m/s^2} = 85.3\ kg$

a. As the elevator starts to go up, the scale reading increases to 936 N before returning to 836 N. Calculate the acceleration as the elevator speeds up.

$\Sigma F = ma$ $a = \frac{\Sigma F}{m}$ $a = \frac{936\ N - 836\ N}{85.3\ kg} = 1.17\ m/s^2$

b. Later, as the elevator approaches the floor above and slows down, the scale reading drops to 736 N before returning to 836 N when the elevator stops. Calculate the acceleration as the elevator slows down.

$\Sigma F = ma$ Then $a = \frac{\Sigma F}{m} = \frac{736\ N - 836\ N}{85.3\ kg} = -1.17\ m/s^2$

10. A force of 30 N is needed to slide a 12 kg crate across the floor at constant velocity. Calculate the coefficient of kinetic friction between the crate and floor.

$f = \mu N$

$\mu = \frac{f}{N} = \frac{30\ N}{(12\ kg)(9.8\ m/s^2)} = .255$

$w = mg$

117.6 N