Review For Dynamics Test

#1) Weakest to strongest Forces

gravity ⇒ weak nuclear → electromagnetic ⇒ strong nuclear

#2) a) leaf falling from tree ⇒ gravity

b) holding nucleus of silver atom together → strong nuclear

c) spring returns to original shape ⇒ electromagnetic

#10) "Universal" indicates that the force of gravitational attraction exists between all objects with mass and the force has infinite range.

#14) Gravitational field strength of a body with mass M and radius r is given by:

$$g = \frac{GM}{r^2}$$

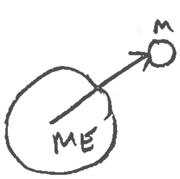
So the field strength is directly proportional to mass ($g \propto M$).

#15) a) $m = 9.6\ kg$

$M_E = 5.97 \times 10^{24}\ kg$

$r = 1.5 \times 10^4\ km = 1.5 \times 10^7\ m$

$F_G = ?$



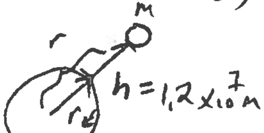
$$F_G = \frac{GmM_E}{r^2}$$

$$= \frac{(6.67 \times 10^{-11}\ \frac{Nm^2}{kg^2})(9.6\ kg)(5.97 \times 10^{24}\ kg)}{(1.5 \times 10^7\ m)^2}$$

$= 16.989\ N$

$\sim 17\ N$

b)



$r = r_E + h$

$= 6.38 \times 10^6\ m + 1.2 \times 10^7\ m$

$= 1.838 \times 10^7\ m$

$$F_G = \frac{GmM_E}{r^2}$$

$$= \frac{(6.67 \times 10^{-11}\ \frac{Nm^2}{kg^2})(9.6\ kg)(5.97 \times 10^{24}\ kg)}{(1.838 \times 10^7\ m)^2}$$

$= 11.316\ N \sim 11\ N$

#16

$M_S = 5.69 \times 10^{26}$ kg

$r_S = 6.03 \times 10^{7}$ m

$g_S = ?$

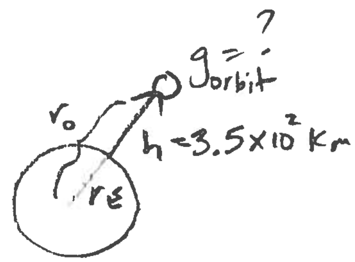
$$g_S = \frac{G M_S}{r_S^2}$$

$$= \frac{(6.67 \times 10^{-11} \frac{Nm^2}{kg^2})(5.69 \times 10^{26} kg)}{(6.03 \times 10^{7} m)^2}$$

$$= 10.4377$$

$$\sim 10.4 \ N/kg$$

#35



$$g_{orbit} = \frac{G M_E}{r_o^2}$$

$$= \frac{(6.67 \times 10^{-11} \frac{Nm^2}{kg^2})(5.97 \times 10^{24} kg)}{(6.73 \times 10^{6} m)^2}$$

$$= 8.79 \ N/kg$$

$r_o = r_E + h$

$= 6.38 \times 10^{6} m + 3.5 \times 10^{5} m$

$= 6.73 \times 10^{6} m$

$M_E = 5.97 \times 10^{24}$ kg

Comparing g_{orbit} with g on surface!

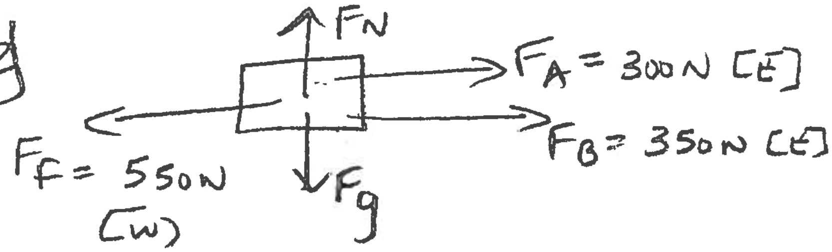
$$\frac{g_{orbit}}{g} = \frac{8.79 \ N/kg}{9.81 \ N/kg} = 0.896$$

$\therefore$ g_{orbit} is ~ 90% of g on surface

and the astronauts will experience gravitational force of 90% of what they experience on the launching pad (Although they feel "weightless" in orbit!! :))

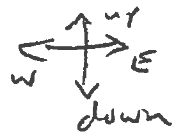
Chapter 5 Review   pg 154-155 # 2, 7, 11, 12, 15, 16, 21, 23ab   (3)

#2)



m = 2000 kg

* assume 2 sig digs.



$\vec{F}_{net} = ?$
$\vec{a} = ?$

Horizontally: $\vec{F}_{net} = \vec{F}_A + \vec{F}_B + \vec{F}_F$ [E] = +

$= 300N + 350N - 550N$
$= 650N - 550N$
$= 100N$
$= 100N$ [E]

Find acceleration: $\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{100N\ [E]}{2000\ kg} = 0.050\ m/s^2$ [E]

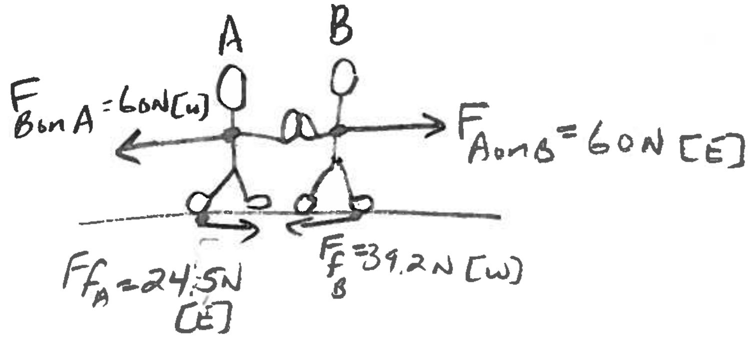
∴ the truck accelerates at $0.050\ m/s^2$ [E].

#7) No, the student is incorrect. We know that when you attempt to put a statisnary object into motion you can apply an increasingly larger force and the object will remain at rest until your applied force equals the maximum static friction force which can be developed. The static friction force thus varies but has a limiting value determined by the coefficient of static friction for the surfaces in contact and the normal force pushing the surfaces together.

$F_S \leq \mu_S F_N$.

#11) IF all the forces on an object are balanced, then you can conclude that the object is either in a state of rest or moving at a constant velocity. (Newton's 1st Law)

12)



Player A:

$m_A = 50\ kg$ [W = +]

$\vec{F}_{net\ A} = \vec{F}_{B on A} + \vec{F}_{fA}$

$= 60N - 24.5N$

$= 35.5N$

$= 35.5N[W]$

$\vec{a}_A = \dfrac{\vec{F}_{net\ A}}{m_A}$

$= \dfrac{35.5N\ [W]}{50\ kg}$

$= 0.71\ m/s^2 [W]$

Player B

$m_B = 80\ kg$ [E] = +

$\vec{F}_{net\ B} = \vec{F}_{A on B} + \vec{F}_{fB}$

$= 60N - 39.2N$

$= 20.8N$

$= 20.8N\ [E]$

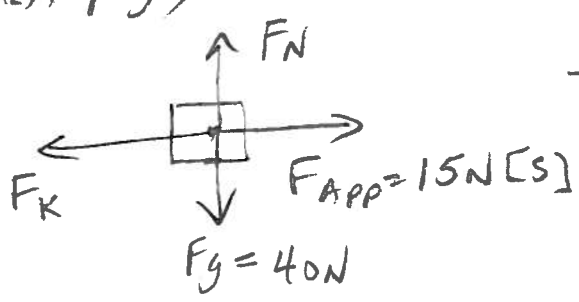
$\vec{a}_B = \dfrac{\vec{F}_{net\ B}}{m_B}$

$= \dfrac{20.8N\ [E]}{80\ kg}$

$= 0.26\ m/s^2 [E]$

(#15 on next page)

#16)



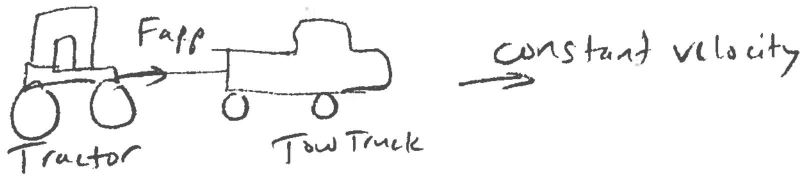
→ constant velocity

$\mu_K = ?$ Horizontal forces balanced → ∴ $F_K = F_{App} = 15N$

Vertical forces balanced → ∴ $F_N = F_g = 40N$

∴ $\mu_K = \dfrac{F_K}{F_N} = \dfrac{15N}{40N} = 0.375 \sim 0.38$

#15]

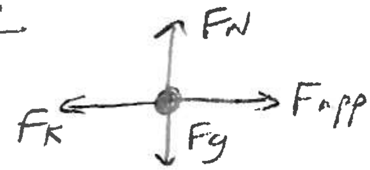


$F_{app} = 1.0 \times 10^4 N [F]$

$m_{Tractor}, m = ?$

μ_K (rubber on wet concrete) $= 0.5$

FBD Tractor:



Vertical forces balanced:

$F_N = F_g$
$= mg$

Horizontal forces balanced:

$F_K = F_{app}$
$= 1.0 \times 10^4 N$

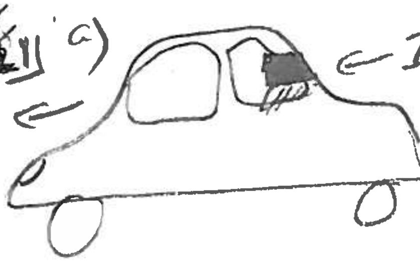
$\therefore F_K = \mu_K F_N$

$F_K = \mu_K mg$

$\therefore m = \dfrac{F_K}{\mu_K g} = \dfrac{1.0 \times 10^4 N}{(0.5)(9.80 N/kg)} = 2040.82 kg$

$\approx 2.0 \times 10^3 kg$

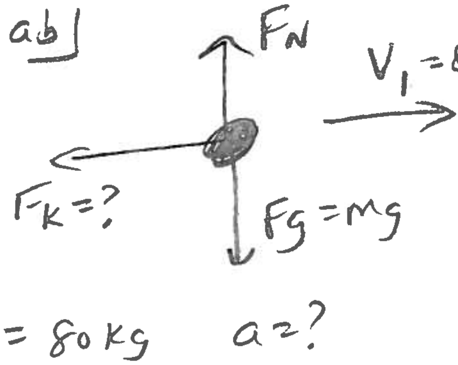
#11 a)



← It is unsafe for drivers to place objects on the ledge of their rear window without attaching these objects to the car because these objects have inertia and will tend to stay in motion if the car is brought to a sudden stop (as in an accident or emergency). These items will continue in a forward direction if the car stops suddenly since their is no net force acting on them and they maintain their state of constant velocity as stated in Newton's First Law. They thus become hazards that could injure car occupants.

b) Open cargo areas could be made safer by adding nets or straps or some other means by which to fasten cargo to the car so that it will not be free to move. A strap will attach the cargo to the car and will be able to transmit an unbalanced force on the cargo to accelerate it along with the car according to Newton's 2nd Law.

23 ab)



Vertical forces balanced:
$F_N = F_g = mg$

$F_K = \mu_K F_N$
$= (0.70) mg$

Horizontally: $F_{net} = F_K = ma$

$m = 80$ kg $a = ?$
$\mu_K = 0.70$

$a = \frac{F_K}{m} = \frac{\mu_K \cancel{m} g}{\cancel{m}} = (0.70)(9.81\ \frac{N}{kg})$
$= 6.9\ m/s^2$

∴ his acceleration is $6.9\ m/s^2$

b) $\Delta t = ?$

$\vec{a} = 6.867 m/s^2$ [B]

$\vec{v}_1 = 8.23 m/s$ [F]

$\vec{v}_2 = 0.0 m/s$

$$\Delta t = \frac{\vec{v}_2 - \vec{v}_1}{\vec{a}} = \frac{0.0 m/s - 8.23 m/s}{-6.867 m/s^2}$$

$$= 1.198 s$$

$$\doteq \underline{\underline{1.20 s}}$$

∴ the player slides for 1.20 s before stopping.