PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2011

College of Sciences

Section 4 Quiz 3 13 October 2011

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

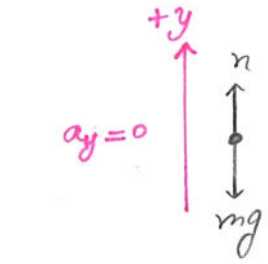
An 80 kg man stands on a scale in an elevator. What does the scale read when the elevator is
(a) ascending – going up -- at a constant velocity of 3 m/s?
(b) ascending at a constant acceleration of 1 m/s^2?
(c) descending at a constant velocity of 3 m/s?
(d) descending – going down -- at a constant acceleration of 1 m/s^2?
(e) in free fall because the cable has broken?

$m = 80$ kg

a) $v_y = \text{constant} \Rightarrow a_y = 0$

$\Rightarrow \Sigma F_y = ma_y = 0 \Rightarrow n - mg = 0 \Rightarrow n = mg = 80 \times 9.8$

$\Rightarrow n = 784$ N



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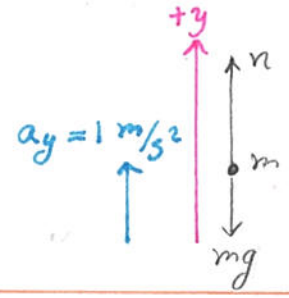
b) $\Sigma F_y = ma_y \Rightarrow n - mg = ma$

$\Rightarrow n = m(g+a) = 80(9.8+1)$

$\Rightarrow n = 864$ N



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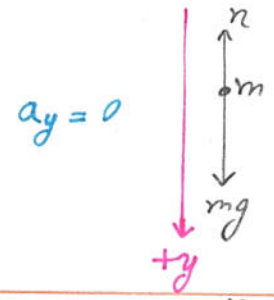
c) $v_y = 3\ m/s = \text{constant} \Rightarrow a_y = 0$

$\Sigma F_y = ma_y = 0 \Rightarrow mg - n = 0 \Rightarrow n = mg = 80 \times 9.8$

$\Rightarrow n = 784$ N



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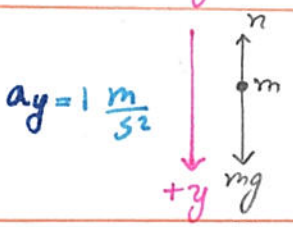
d) $\Sigma F_y = ma_y \Rightarrow mg - n = ma$

$\Rightarrow n = m(g-a) = 80(9.8-1)$

$\Rightarrow n = 704$ N



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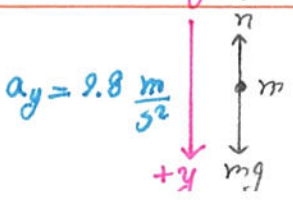
e) $\Sigma F_y = ma_y \Rightarrow mg - n = mg \Rightarrow n = 0$



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College of Sciences

Section 3 **Quiz 3** **13 October 2011**

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Quiz duration: 15h minutes

Name: **Student ID:** **Signature:**

A force of 50 N is used to pull a 5 kg ball up a frictionless plane that is inclined at 30 degrees with the horizontal.
How much time is needed to pull the ball for 40 m starting from rest?
Draw the free-body diagram before analyzing the motion.

$F = 50\ N$

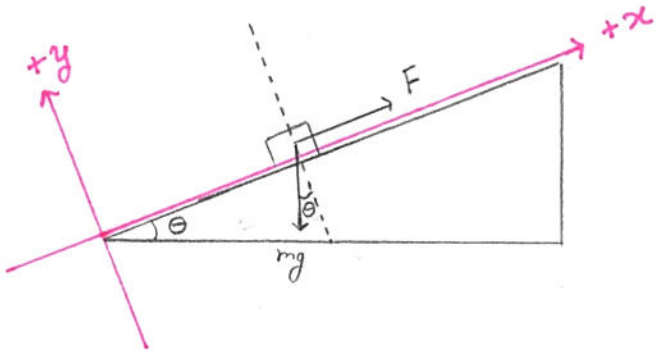
$m = 5\ kg$

$\theta = 30^\circ$

$t = ?$

$x - x_0 = L = 40\ m$

$v_{0x} = v_{0y} = 0$



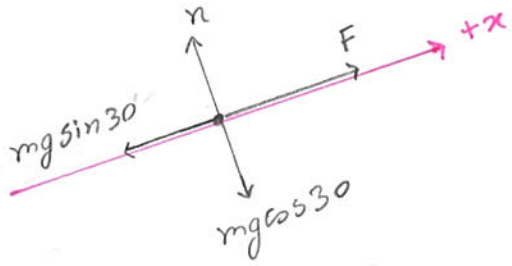
• To find time we need to find a_x first:

$\sum F_x = m a_x$

$\Rightarrow \quad +F - mg\sin 30 = ma_x$

$\Rightarrow \quad a_x = \frac{F}{m} - \frac{g}{2} = \frac{50}{5} - \frac{9.8}{2}$

$\Rightarrow \quad a_x = 5.1\ m/s^2$



$x = \frac{1}{2} a_x t^2 + v_{0x} t + x_0$ ($v_{0x} = 0$, $x_0 = 0$)

$\Rightarrow \quad L = \frac{1}{2} a_x t^2$

$\Rightarrow \quad t^2 = \frac{2L}{a_x} \quad \Rightarrow \quad t = \pm\sqrt{\frac{2L}{a_x}} = \pm\sqrt{\frac{2\times 40}{5.1}} = \pm 3.96\ s \approx \pm 4\ s$

since we don't have negative time; thus,

$t = 4\ s$

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Section 2 Quiz 3 13 October 2011

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

An 80 kg woman stands on a scale in an elevator. When the elevator starts to move, the scale reads 700N.
(a) Is the elevator moving upward or downward?
(b) Is its velocity constant? If so, what is it? If not, what is the elevator's acceleration?
Draw the free-body diagram before analyzing the motion.

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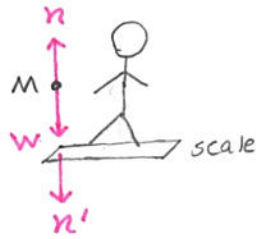
a)

$M = 80\ kg \Rightarrow W = Mg = 80 \times 9.8 = 784\ N$

$n = 700\ N$

since $n < W$, intuitively we know that elevator is moving downward.

(n and w are applied to woman but n' is the reaction of n exerted on scale. So, when elevator is accelerating downward our pressure on scale will decrease according to the inertia property of objects.)



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b) since $n \neq W$, the velocity is not constant.

$\Sigma F_y = ma_y$

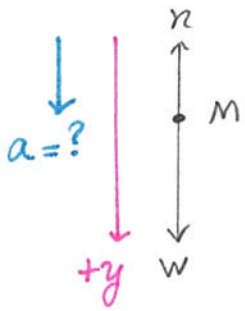
$\Rightarrow W - n = Ma$

$\Rightarrow Mg - n = Ma$

$\Rightarrow a = \frac{1}{M}(Mg - n) = g - \frac{n}{M}$

$\Rightarrow a = 9.8 - \frac{700}{80}$

$\Rightarrow a = 1.05\ m/s^2$



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Section 1 Quiz 3 13 October 2011

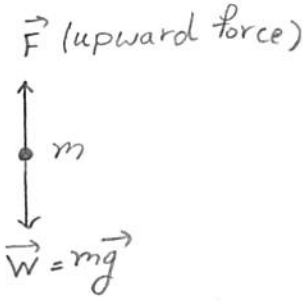
Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

How much upward force is needed
(a) to support a 20 kg object at rest?
(b) to give it an upward acceleration of 2 m/s^2?
(c) to give it a downward acceleration of 2 m/s^2?
Draw the free body diagrams for each case.

a) To be at rest, $\vec{F}$ should equal to the weight of object:

$F = mg = 20 \times 9.8 = 196\ N$

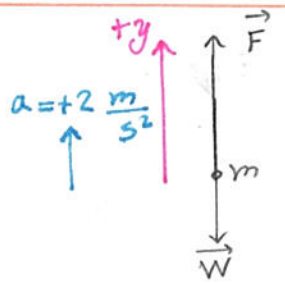


b) This time F should be larger than W. Take positive y axis in the direction of motion. Then, we have:

$\Sigma F_y = ma_y \Rightarrow +F - W = ma$

$\Rightarrow F = W + ma = mg + ma = m(g+a)$

$\Rightarrow F = 20(9.8+2) = 236\ N$



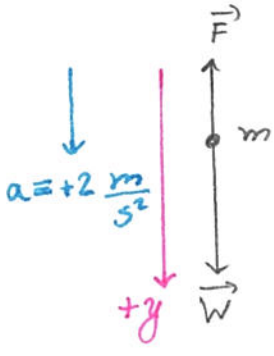
*Note that the sign of g was included in W before. So, never put the negative sign for g twice.

c) Now F<W, then we have:

$\Sigma F_y = ma_y \Rightarrow +W - F = ma$

$\Rightarrow F = W - ma = mg - ma = m(g-a)$

$\Rightarrow F = 20(9.8-2) = 156\ N$



PHYS 101: General Physics 1 **KOÇ UNIVERSITY** **Fall Semester 2011**

College of Sciences

Section 5 **Quiz 3** **13 October 2011**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: **Student ID:** **Signature:**

(a) A.22 rifle bullet, travelling at 350 m/s, strikes a large tree, which it penetrates to a depth of 0.130 m. The mass of the bullet is 1.80 g. Assume a constant retarding force.
(i) How much time is required for the bullet to stop?
(ii) What force, in newtons, does the tree exert on the bullet?

(b) Since action and reaction forces are always equal in magnitude and opposite in direction, how can anything ever be accelerated?

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a) $v_0 = 350$ m/s
$\Delta x = 0.13$ m
$m = 1.8$ g
$v_{final} = 0$

i) $t = ?$

ii) $F = ?$

i) we should first find a_x which is in opposite direction of motion and therefore negative:

$$v_x^2 - v_{ox}^2 = 2a_x \Delta x$$

$$\Rightarrow v_f^2 - v_o^2 = 2 a_x \Delta x$$

$$\Rightarrow 0 - (350)^2 = 2 a_x \times 0.13 \Rightarrow a_x \approx -4.7 \times 10^5 \ \frac{m}{s^2}$$

$$v_x = a_x t + v_{ox}$$

$$0 = -4.7 \times 10^5 \ t + 350$$

$$\Rightarrow t = \frac{350}{4.7 \times 10^5} \approx 7.45 \times 10^{-4} \ s$$

$$\Rightarrow t = 0.745 \ ms$$

ii) $\vec{F} = m\vec{a} \Rightarrow F_x = m a_x$

$$\Rightarrow F_x = (1.8 \times 10^{-3})(-4.7 \times 10^5)$$

$$\Rightarrow F_x = -846 \ N$$ in the opposit direction of motion

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b) Action-reaction forces are not applied to the same object but to two objects with different masses, therefore the net force applied to each object is not zero causing each object to be accelerated.