

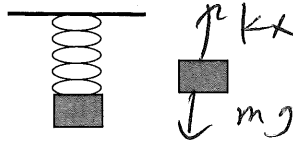
Your Name: \_\_\_\_\_

**PHY203**

**Exam #2**  
**Chapters 4-7**  
**Fri., 3/19/21**

*Solutions*

Exam2S21



1. An 8.50 kg block is attached to a spring and lowered until it stops moving. The spring has a spring constant of 500 N/m.

a. Draw a free body diagram on the block above and to the right. (5)

b. Write out Newton's 2<sup>nd</sup> Law for the block in the y-direction (take "up" as the + y-direction) and find the extension of the spring. (10)

$$\begin{aligned} kx - mg &= 0 \\ x &= \frac{mg}{k} = \frac{8.50 \text{ g}}{500} \\ &= 0.167 \text{ m} \end{aligned}$$

c. The spring/block combination is placed in an elevator which begins to accelerate downwards with magnitude 2.50 m/s<sup>2</sup>. Write out Newton's 2<sup>nd</sup> Law for the block and find the extension of the spring. (15)

$$\begin{aligned} kx - mg &= ma \\ x &= \frac{m}{k} (g + a) \\ &= \frac{8.50}{500} (9.8 - 2.50) \\ &= 0.124 \text{ m} \end{aligned}$$

d. The elevator then reaches a constant speed downwards of 6.50 m/s. Write out Newton's 2<sup>nd</sup> Law for the block and find the extension of the spring. (5)

$$\begin{aligned} kx - mg &= 0 \\ x &= 0.167 \text{ m} \end{aligned}$$

2. A 75.0-kg airplane pilot pulls out of a dive by following, at a constant speed of 62.5 m/s, the arc of a circle whose radius is 315 m.

a. Find the magnitude and direction ("up" or "down") of the acceleration of the pilot at the bottom of the circle. (10)

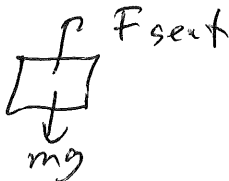
direction is "up"

$$a = \frac{v^2}{r} = \frac{(62.5)^2}{315} = 12.4 \text{ m/s}^2$$

b. Find the magnitude of the net force of the pilot at the bottom of the circle. (5)

$$F = ma = (75.0)(12.4) \\ = 930 \text{ N}$$

c. Find the magnitude of the force exerted on the pilot by the airplane seat. (10)

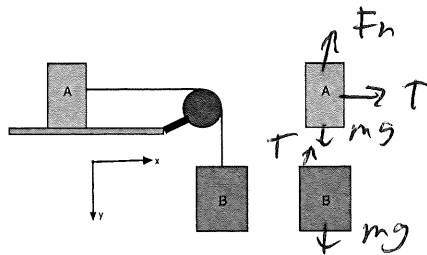


$$F_s - mg = ma = 930$$

$$F_s = mg + 930$$

$$= \text{~~930~~} 75.0g + 930$$

$$= 1.67 \times 10^3 \text{ N}$$



3. Blocks A and B (masses  $m_A$  and  $m_B$ ) are connected by a light string and attached over a massless pulley and are initially at rest. Assume a rough surface under block A with coefficient of kinetic friction  $\mu_k$ .

~~a. Draw free body diagrams on the blocks shown above and on the right. (5)~~

Take  $m_A = 7.50$  kg,  $m_B = 9.50$  kg, and  $\mu_k = 0.450$ .

a. b. Take the initial heights of the blocks above ground level as 5.00 m and 3.50 m with  $h=0$  at ground level. Find the initial energy of the system before the blocks are released. (10)

$$U_i = g \sum [7.50 \cdot 5.00 + 9.50 \cdot 3.50]$$

$$= 694 \text{ J}$$

b. c. Using Conservation of Energy, find the speed of the blocks after they have been released and they have moved 3.00 m. (Assume block A stays on the horizontal surface). ~~(25)~~ (30)

$$694 = U_f + \frac{1}{2} (m_A + m_B) v^2 + \mu_k F_{NA} \Delta s$$

$$U_f = g \sum [7.50 \cdot 1.50 + 9.50 \cdot 1.5]$$

$$= 414 \text{ J}$$

$$\mu_k F_{NA} \Delta s = (0.450) (7.50) g (3.00)$$

$$= 99.3 \text{ J}$$

$$694 = 414 + 99.3 + \frac{1}{2} (17.0) v^2$$

$$8.50 v^2 = 181 \text{ J}$$

$$v = 4.60 \text{ m/s}$$