Test 1 **Dr. Weppner**
PH 241 **Oct. 2007**

NAME _____ SCORE____

Remember to get full credit label answers with correct units, show all work, draw diagrams (pictures!), give axis directions.

A child throws a ball at an angle of 20 degrees.

Questions 1-3 are based on the motion of this ball.

1. **[5 pts]** What is the vertical velocity of the ball at its peak height?
(A) 0 m/s
(B) 9.8 m/s
(C) -9.8 m/s
(D) not enough information

Always zero

2. **[5 pts]** What is the horizontal velocity of the ball at its peak height?
(A) 0 m/s
(B) 9.8 m/s
(C) -9.8 m/s
(D) not enough information

we would need V_0

3. **[5 pts]** What is the acceleration of the ball at its peak height?
(A) 0 m/s^2
(B) 9.8 m/s^2
(C) -9.8 m/s^2
(D) not enough information

9.8 m/s^2 down towards earth

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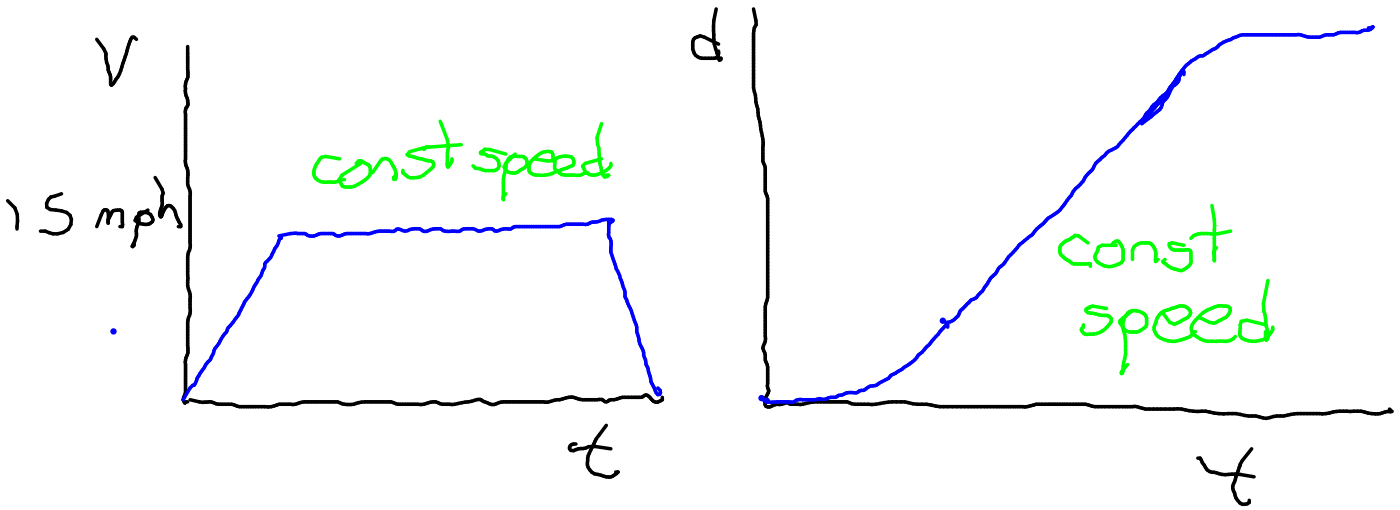
Questions 4-5 relate to the following situation:
A child gets on a bicycle, she tries to go as fast as she can. Within 20 seconds she is up to 15 MPH. She stays at this speed for one minute, then she begins to apply the break because she sees a stop sign ahead. She comes to a complete stop after 10 seconds.

4. **[12 pts]** Plot the story on a velocity vs. time graph **and** a distance vs. time graph:



5. **[8 pts]** What is the average acceleration during the 20 seconds of speeding up? What is the average acceleration for the whole trip?

$$\bar{a} = \frac{\Delta V}{\Delta t} = \frac{15\,\text{mph}}{20\,\text{s}} = \frac{15\,\text{mph}}{5.56\times10^{-3}\,\text{h}} = 2700\,\text{MPH}^2$$

Whole trip

$$\bar{a} = \frac{0}{\Delta t} = 0$$

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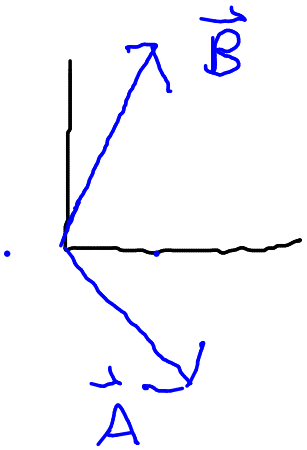
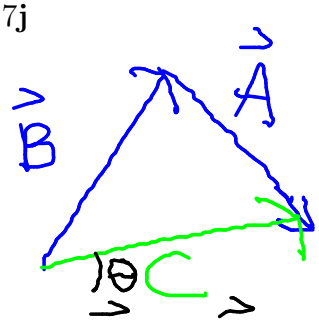
6. **[12 pts]** Add **A** + **B** displaying the answer in component form, graphical form, and mathematical form (numerical size and direction):

A = 3.0**i** − 3.2**j** **B** = 2.0**i** + 4.7**j**





$\vec{C} = \vec{A} + \vec{B}$

Component form

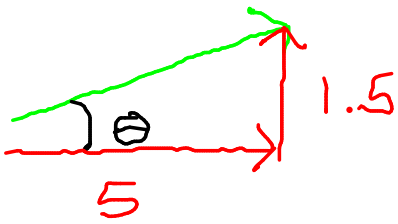
$(3+2)i + (-3.2+4.7)j$

$= 5i + 1.5j$

Math

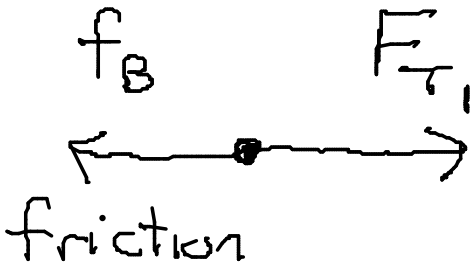
$|C| = \sqrt{5^2 + 1.5^2} = 5.2$

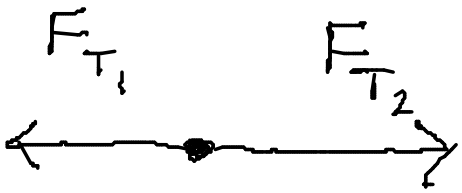
$\theta = \tan^{-1}\frac{1.5}{5} = 17^\circ$

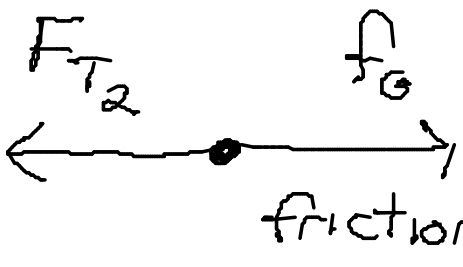


7. **[8 pts]** A boy and a girl are engaged in a tug-of-war. Draw a diagram showing the horizontal forces on

(A) the boy
(B) the girl
(C) the rope







Boy Rope Girl

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8. [22 pts] A projectile is launched from ground level to the top of a cliff which is 195 meters away and 155 meters high. If the projectile lands on top of the cliff 7.6 s after it is fired, find the initial velocity of the projectile (magnitude and direction). Show all work.

(1) $\Delta X = V_{ox} t$

(2) $\Delta y = V_{oy} t - \frac{1}{2} g t^2$

$V_y = V_{oy} - g t$

$-g \Delta y = \frac{V_y^2 - V_{oy}^2}{2}$

Note that this is a general solution most Let $\Delta X = 195m$ which is OK

must travel $\Delta y = 155m$

(2) $155m = V_{oy}(7.6s) - \frac{1}{2}(9.8 m/s^2)(7.6s)^2$

$V_{oy} = 57.6 m/s$

(1) $V_{ox} = \frac{\Delta X}{7.6s}$

$\theta = \tan^{-1}\left(\frac{57.6 m/s}{\frac{\Delta X}{7.6s}}\right)$

So $V_o = \sqrt{\left(\frac{\Delta X}{7.6s}\right)^2 + (57.6 m/s)^2}$

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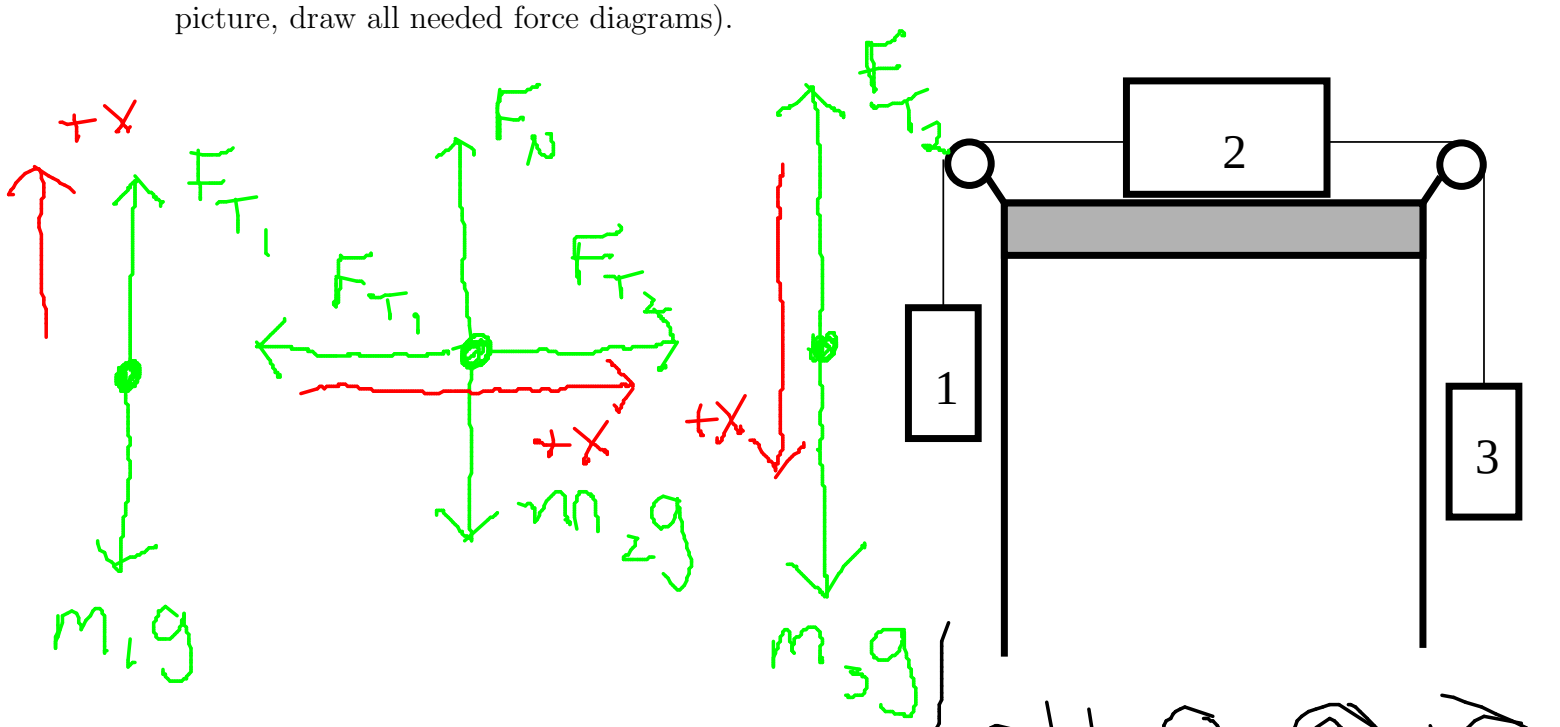
9. **[23 pts]** A box of mass $m_2 = 3.5kg$ rests on a frictionless horizontal shelf and is attached by strings to boxes of masses $m_1 = 1.5kg$ and $m_3 = 2.5kg$, which hang freely as shown in the figure. Both pulleys are frictionless and massless. The system is initially at rest. After it is released find the acceleration of the boxes (indicate direction on the picture, draw all needed force diagrams).



① $m_1 a = F_{T_1} - m_1 g$

② $m_2 a = F_{T_2} - F_{T_1}$

③ $m_3 a = m_3 g - F_{T_2}$

add ① + ② + ③

$a(m_1 + m_2 + m_3) = (m_3 - m_1) g$

$a = \left(\frac{m_3 - m_1}{m_1 + m_2 + m_3}\right) g$

$a = .13\ m/s^2$