X1.4a **1130**

PHYS-1130(4) (Kaldon-40519) Name ______S O L U T I O N__________

WMU - Fall 2006

Exam 1A - 100,000 points Book Title ________________________________

Rev. 09/26/06 Tu.3

State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Short Answers Should Be Short! – Feel Free to Ask Any Questions

EXAM 1 [FORM - A]

PHYS-1130 (KALDON-4)

FALL 2006

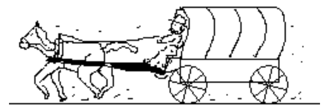
WMU

Gasoline Prices Plummet from
over $3/gallon to around $2/gallon.
What? Are you saying that there are *Elections* soon?

And It's Only Just September!

The Road Out West (50,000 points)

1.) The Oregon Trail took many settlers into the western United States from the 1840s to the 1870s. There really wasn't just one trail, but the typical routes ran about 2000 miles or 3220 kilometers (3,220,000 m). The average travelers took about six months (185 days) to make the trip.
(a) Find the average speed to make the trip, in meters/second (m/s).



$$t = 185 days(24 hours/day)(3600 \sec/hour) = 15{,}984{,}000 \sec$$
$$v = \frac{d}{t} = \frac{3{,}220{,}000 m}{15{,}984{,}000 \sec} = 0.2015 m/\sec$$

(b) Of course a traveler wouldn't be on the move 24/7, i.e. all the time. Still, the Oregon Trail wasn't a nice smooth Interstate highway. In truth, during the day they moved at a walking pace. (Can you imagine, *walking* across 2/3 of the continent?) If a walking pace might be 1.50 m/s, find the time t it takes to make the trip. Give the answer first in seconds, then in days.

$$t = \frac{d}{v} = \frac{3{,}220{,}000 m}{1.50 m/s} = 2{,}147{,}000 \sec = 24.85 days$$

(c) One of the horses gets frightened and races away, pulling a wagon. In a distance of 13.0 meters, the wagon goes from rest to 8.75 m/s. What is the acceleration of the horse and wagon?

$$v^2 = v_0^2 + 2a(x - x_0) = 2ax$$
$$a = \frac{v^2}{2x} = \frac{(8.75 m/s)^2}{2(13.0 m)} = 2.945 m/s^2$$

(d) A box sitting on the back of the wagon is 1.55 meters above the ground. When the horse takes off, the box falls off the wagon. How much time does it take for the box to fall to the ground?

$$y = y_0 + v_{0y} t - \tfrac{1}{2} g t^2$$
$$0 = y_0 - \tfrac{1}{2} g t^2$$
$$\tfrac{1}{2} g t^2 = y_0 \ ; \ t^2 = \frac{2 y_0}{g}$$
$$t = \sqrt{\frac{2 y_0}{g}} = \sqrt{\frac{2(1.55 m)}{9.81 m/s^2}} = 0.5621 \sec$$

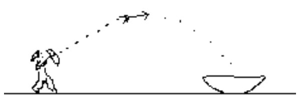
(e) For this falling box, what is its speed, v_y, when it hits the ground? *This problem can be solved without the answer to (d).*

$$\begin{aligned} v_y &= v_{0y} - gt = -gt \\ &= -(9.81 m/s^2)(0.5621 \sec) \\ &= -5.514 m/s \end{aligned}$$

OR

$$\begin{aligned} v^2 &= v_0^2 - 2g(y - y_0) = 2gy_0 \\ v &= \sqrt{2gy_0} = \sqrt{2(9.81 m/s^2)(1.55m)} = -5.515 m/s \end{aligned}$$

This Week On *The Amazing Race 10…* (50,000 points)



2.) Ah, reality television… Not really all that real, but the stunts they make people do – it's great stuff for a PHYS-1130 exam… On Sunday's episode of *The Amazing Race*, the contestants were in Mongolia and at one point had to launch flaming arrows 175 feet (53.4 meters) to a big pan filled with the pyrotechnic chemicals they use in fireworks. (a) If the arrow is in the air for 5.00 seconds, find v_{0x}.

$$\begin{aligned} &(a_x = 0) \\ &v_{0x} = \frac{d}{t} = \frac{53.4m}{5.00 \sec} = 10.68 m/s \end{aligned}$$

(b) To simplify the problem, let's assume the launch height and landing height are the same. How high, h, does the arrow go?

$$\begin{aligned} &\text{Time to rise} = \text{Time to fall} = \tfrac{1}{2}(5.00 \sec) \\ &y = y_0 + v_{0y}t - \tfrac{1}{2}gt^2 \\ &0 = h - \tfrac{1}{2}gt^2 \\ &h = \tfrac{1}{2}gt^2 = \tfrac{1}{2}(9.81 m/s^2)(2.500 \sec)^2 \\ &\quad = 30.66m \end{aligned}$$

(c) Find the y-component of the velocity, v_{oy}.

$$\begin{aligned} v_y &= v_{0y} - gt \\ 0 &= v_{0y} - gt \\ v_{0y} &= gt \\ &= (9.81 m/s^2)(2.500 \sec) \\ &= 24.53 m/s \end{aligned}$$

OR

$$\begin{aligned} v_y &= v_{0y} - gt \\ -v_{0y} &= v_{0y} - gt \\ 2v_{0y} &= gt \\ &= \tfrac{1}{2}(9.81 m/s^2)(5.00 \sec) \\ &= 24.53 m/s \end{aligned}$$

OR

$$\begin{aligned} v_y^2 &= v_{0y}^2 - 2g(y - y_0) \\ 0 &= v_{0y}^2 - 2gh \\ v_{0y} &= \sqrt{2gh} \\ &= \sqrt{2(9.81 m/s^2)(30.66m)} \\ &= +24.53 m/s \end{aligned}$$

(d) Find the initial velocity vector $\vec{v}_0$. *Give the answer in Standard Form.*

$$\begin{aligned} v_0 &= \sqrt{v_{0x}^2 + v_{0y}^2} \\ &= \sqrt{(10.68 m/s)^2 + (24.53 m/s)^2} \\ &= 26.75 m/s \\ \theta &= \tan^{-1}\left(\frac{v_{0y}}{v_{0x}}\right) = \tan^{-1}\left(\frac{24.53 m/s}{10.68 m/s}\right) = 66.5° \\ \vec{v}_0 &= 26.75 m/s @ 66.5° \end{aligned}$$

(e) When the arrow is launched, it goes from rest to the initial speed v_o in a distance of 1.00 meter. Find the acceleration a the arrow undergoes, first in m/s² and then as a multiple of g. *If you did not find v_0, use 12.0 m/s.*

$$\begin{aligned} &v^2 = v_0^2 + 2a(x - x_0) = 2ax \\ &a = \frac{v^2}{2x} = \frac{(26.75 m/s)^2}{2(1.00m)} = 357.8 m/s^2 \\ &\frac{357.8 m/s^2}{9.81 m/s^2} = 36.47\ gee's \end{aligned}$$