**Test 1** **Dr. Weppner**
**PHN 241** **Oct. 2005**

NAME _____ ☐ Pledged SCORE____ / 100 pts

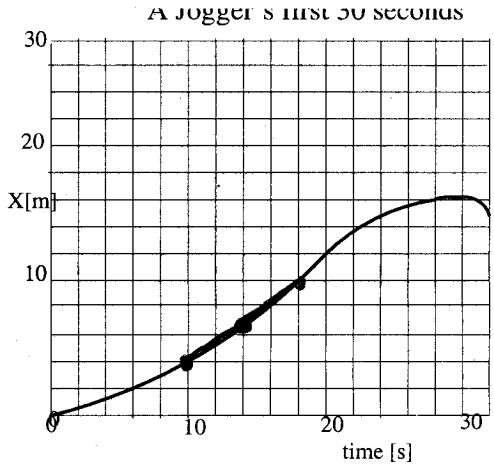
**Remember to get full credit label answers with correct units, show all work, draw diagrams, give axis directions, write all applicable formuli.**

1. [4 pts] How far does light travel in one year moving at $3 \times 10^8 m/s$?

(A) $3 \times 10^8 m$
(B) $9.5 \times 10^{15} m$
(C) $3 \times 10^8 km$
(D) $9.5 \times 10^8 km$
(E) none of these

$\Delta X = vt$ $t = 3.1 \times 10^7 s$ in one year

2. [6 pts] The figure below is a portion of a distance time-curve for a jogger. at t=14 s the instantaneous speed is about (show work)




(A) $0.50 m/s$
(B) $0.25 m/s$
(C) $1.0 m/s$
(D) $2.0 m/s$
(E) none of these

$m = \frac{10m - 4m}{18s - 10s}$

$= \frac{6m}{8s} \sim .75 m/s$

3. [4 pts] During a journey over which the speed varies, the average speed in comparison to the maximum attained speed **is always**

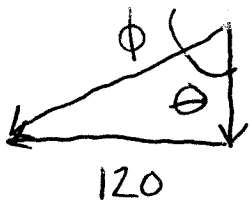
(A) one half of it
(B) greater than it
(C) less than it
(D) equal to it
(E) none of these

const speed

max = Ave

4. [6 pts] The inhabitants of the mythical planet Mongo measure distance in units of 'glogs'. A Mongoian displacement vector 90.0 glogs long points south from the truffle tree to the fountain. A second vector 120.0 glogs long points west from the fountain to the main reflector. The total displacement from tree to reflector is

(A) 150 glogs 49° S of W
(B) 150 glogs 37° S of W
(C) 150 glogs 37° S of E
(D) 80 glogs 41° S of E
(E) need more information




$R = \sqrt{90^2 + 120^2}$

$= 150$ Glogs

$\theta = \tan^{-1}\frac{120}{90} = 53^\circ$

$\phi = 37^\circ$

5. [6 pts] A bag of sand dropped from a hot-air balloon hits the ground at a certain speed, and the craft slowly rises and comes to a stop. A second identical bag is then dropped and it hits the ground twice as fast as the first bag. How much higher was the balloon when it dropped the second bag (show work)?

(A) 1/2 as high
(B) 2 times as high
(C) 4 times as high
(D) 8 times as high
(E) none of these

$V^2 = V_0^2 - 2g\Delta y$

$V_0 = 0$

$V^2 = -2g\Delta y$

so $V = \sqrt{|2g\Delta y|}$

6. [4 pts] A missile is fired horizontally from a battleship at an initial velocity of 200 m/s. While in the air what is the missiles acceleration?

(A) 0 $m/s^2$
(B) 9.8$m/s^2$ downward
(C) 200$m/s^2$ horizontal
(D) 200$m/s$ horizontal
(E) not enough information

7. [4 pts] if a nonzero constant net horizontal force is acting on a body sitting at rest on a frictionless table, the body will

(A) sometimes accelerate
(B) always move off at a constant speed
(C) always accelerate at a constant rate
(D) accelerate when the force exceeds its weight
(E) none of these

one force ⇒ acceleration

8. [4 pts] For an object moving along a curved path at a constant speed

(A) its acceleration is perpendicular to its instantaneous velocity
(B) its velocity is constant
(C) its acceleration vector is constant
(D) its acceleration is zero
(E) none of these

9. [12 pts] At 12:00 noon a speedboat is heading due west at 12.0 m/s, while a cruise ship is traveling south at 9.0 m/s. Given that the water is still, what is the speed of both vessels as seen from the others perspective?

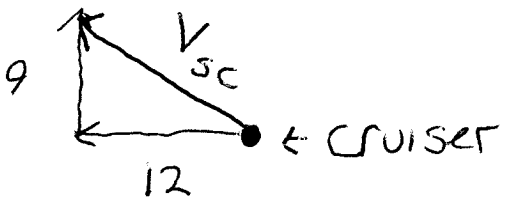
S - speed Boat W Ater
C cruise ship

12 m/s ←

9 m/s ↓

$V_{SC} = V_{SW} + V_{WC}$

$= 12\,m/s \text{ west} + 9\,m/s \text{ North}$




$V = \sqrt{(12)^2 m^2/s^2 + (9^2) m^2/s^2}$

$= 15\,m/s$

Poorly Worded

10. [14 pts] While making a movie, a cowboy on a horse rides up to a moving train traveling at 5.0 km/hr along a long straight length of track. After staying next to this last car for a while he suddenly charges ahead and gets to the engine of the train, 120 meters away in 1.1 minutes. Assuming it was constant, determine his magnitude of acceleration.

$V_0 = 5\,Km/hr = \left(\frac{5\,Km}{hr}\right)\left(\frac{1000\,m}{Km}\right)\left(\frac{1\,hr}{3600\,s}\right) = 1.4\,m/s$

for train

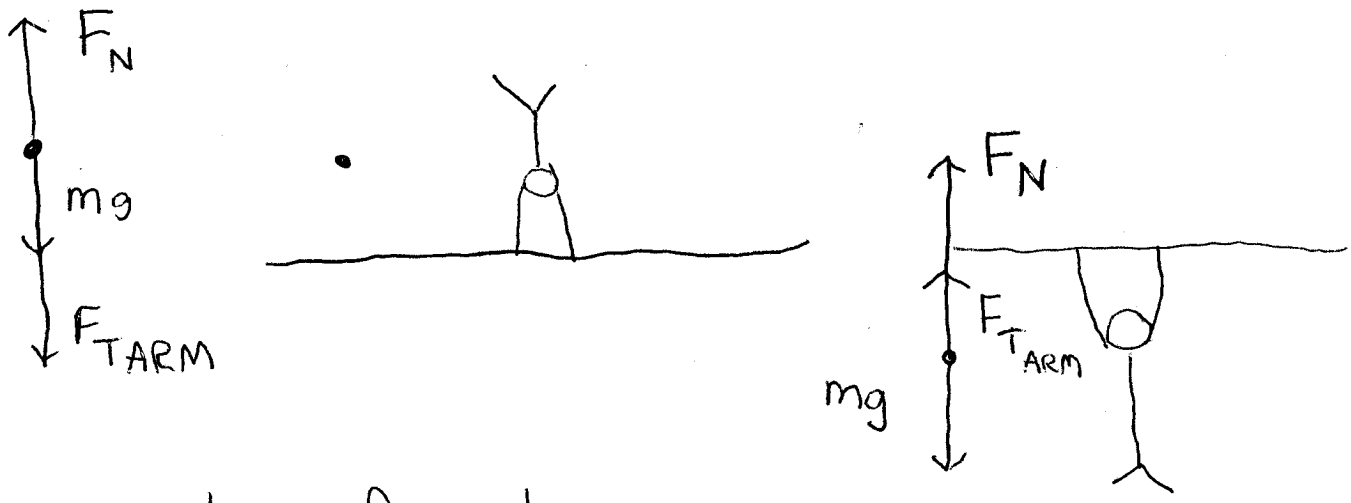
Lets work in train Ref frame (Not only way to do problem)

$V_{0CB} = 0$

$120\,m = \frac{1}{2} a (66\,s)^2$

$a = \frac{240\,m}{4356\,s^2} = .055\,m/s^2$

11. [16 pts] A gymnast who weighs 700 N is doing a giant circular swing on a high bar. On the top of the swing (when he is upside down) he experiences a tension force directed inward (on his arms) toward the bar of about 900 N. When he is on the bottom he experiences a tension force directed inward toward the bar of about 3500 N. Show, using diagrams and math how this could happen by calculating his speed at the top and the bottom. Assume the radius of movement is 1.8 meters.




Center of circle is Bar

$$\frac{mV_{TOP}^2}{r} = mg + F_{TARM} - F_N \qquad \frac{mV_{BOT}^2}{r} = F_{TARM} + F_N - mg$$

At critical value (when $F_N \sim 0$)

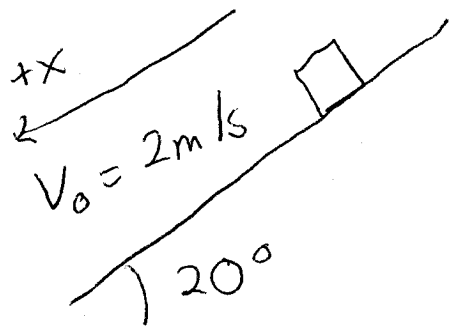
$$\frac{\left(\frac{700N}{9.81 m/s^2}\right) V_{TOP}^2}{1.8m} = 700N + 900N \qquad \frac{\left(\frac{700N}{9.81 m/s^2}\right) V_{BOT}^2}{1.8m} = 3500N - 700N$$

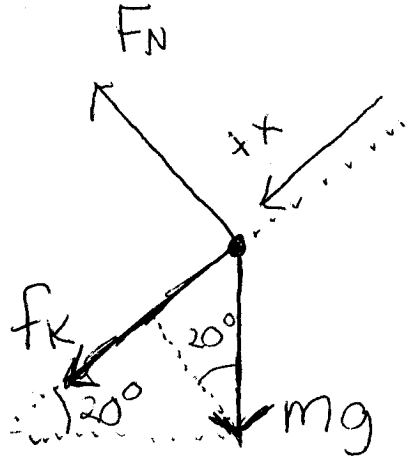
$V_{TOP} = 6.3 m/s$

$V_{BOT} = 8.4 m/s$

12. [20 pts] A child shoots a bottle cap up a 20° inclined board at 2.0 m/s. The cap slides in a straight line, de-accelerating, and eventually comes to a complete stop. If $\mu_k = .40$, what is the caps acceleration? What is the distance it traveled before it stopped?

$f_K = \mu_K F_N$




x: $ma = mg\sin\theta + f_K = mg\sin\theta - \mu_K F_N$

y: $0N = F_N - mg\cos\theta$

$F_N = mg\cos\theta$

so x: $ma = mg\sin\theta + \mu_K mg\cos\theta$

$a = g\sin 20^\circ + .4g\cos 20^\circ = 7.0\ m/s^2$

(downward)

$\Delta x = v_0 t + \frac{1}{2} a t^2$

$v^2 = 0 = v_0^2 + 2a\Delta x$

$0 = 4\ m^2/s^2 + 2(7.0\ m/s^2)\Delta x$

$\Delta x = .28\ m$