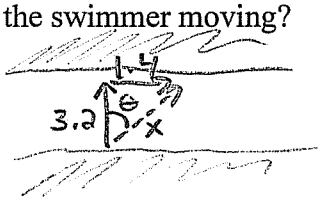
PHYSICS 11

NAME: _____

Review 2

1. A person that swims at 3.2 m/s swims straight across a river with a current of 1.4 m/s. What is the resulting velocity of the swimmer (across and downstream)? At what angle compared to straight across is the swimmer moving?



$3.2^2+1.4^2=x^2$

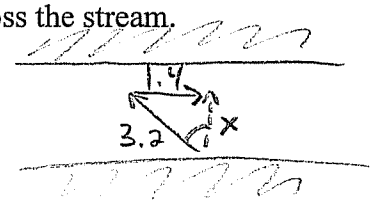
$x=3.5\text{m/s}$

$\tan\theta=\frac{O}{A}=\frac{1.4}{3.2}$

$\theta=\tan^{-1}\left(\frac{1.4}{3.2}\right)$

$=23.6°$

2. The swimmer above decides to swim into the current at such an angle that he will travel straight across. Find the angle (compared to straight across) at which he would have to swim. Calculate his velocity across the stream.



$\sin\theta=\frac{O}{H}=\frac{1.4}{3.2}$

$\theta=\sin^{-1}\left(\frac{1.4}{3.2}\right)$

$=26°$

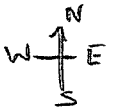
$1.4^2+x^2=3.2^2$

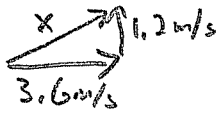
$x^2=3.2^2-1.4^2$

$x=2.9\text{m/s}$

3. A boat travels east at 13 km/hr when a tide is flowing north at 1.2 m/s. Find the actual velocity and heading of the boat.

$13\text{km/H}\div 3.6=3.6\text{m/s}$



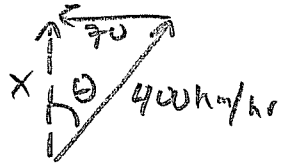


$3.6^2+1.2^2=x^2$

$x=3.8\text{m/s}\ @18°\ [N\text{ of }E]$

$\theta=\tan^{-1}\left(\frac{1.2}{3.6}\right)=18°$

4. A plane with an air speed of 400 km/hr wants to go north but a wind of 70 km/hr is blowing west. What must be the plane's heading (to go north)? (What will be its resulting ground speed?



resultant

$\theta=\sin^{-1}\left(\frac{70}{400}\right)$

$=10°$

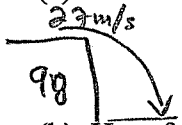
ground speed = x

$400^2-70^2=x^2$

$x=394\text{km/H}$

5. A rock is thrown horizontally from the top of a cliff 98 m high, with a horizontal speed of 27 m/s.

(a) For what interval of time is the rock in the air?



$d_y=v_{0y}t+\frac{1}{2}at^2$

$98=0+\frac{1}{2}(9.8)t^2$

$98=4.9t^2$

$t=4.48\text{s}$

(b) How far from the base of the cliff does the rock land?

$d_x=v_x\cdot t$, $d_x=(27\text{m/s})(4.48)=121\text{m}$

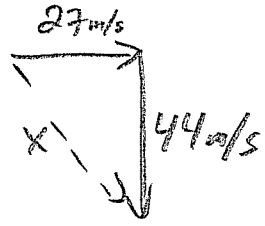
(c) With what velocity does the rock hit?

total

$v_{fy}=v_{0y}+at$

$=0+(9.8)(4.48)$

$=44\text{m/s}$

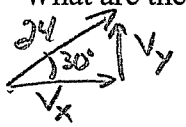


$27^2+44^2=x^2$

$x=51.6\text{m/s}$

6. A ball is thrown with a velocity of 24 m/s at an angle of 30° to the horizontal.

(a) What are the vertical and horizontal components of the initial velocity?



$V_x = 24\cos 30° = 20.8\ m/s$ $\quad V_y = 24\sin 30° = 12\ m/s$

(b) How long is the ball in the air?

$V_f = V_0 + at$

$-12\ m/s = 12\ m/s + (-9.8)t$

$-24 = -9.8 \cdot t$

$t = 2.45\ s$

(c) How far away will the ball land?

$d_x = V_x \cdot t = (20.8)(2.45\ s) = 51\ m$

(d) To what maximum height will the ball rise?

$V_f = 0$

$V_{f_y}^2 = V_{0_y}^2 + 2ad$

$0 = 12^2 + 2(-9.8)d$

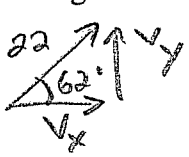
$-144 = -19.6d$

$d = 7.35\ m$

(e) With what velocity will the ball land?

Same as thrown. 24 m/s @ 30°

7. A youngster hits a baseball giving it a velocity of 22 m/s at an angle of 62° with the horizontal. How far will the ball travel before it is caught by a fielder (assuming the fielder catches the ball at the same height that it is hit)?



$V_x = 22\cos 62° = 10.3\ m/s$

$V_y = 22\sin 62° = 19.4\ m/s$

find time first

$V_f = V_0 + at$

$-19.4 = 19.4 + (-9.8)t$

$t = 3.96\ s$

$d_x = V_x \cdot t = (10.3)(3.96\ s)$

$d_x = 40.8\ m$

8. Determine the force of gravity between the Sun (Mass of Sun = 1.98×10^{30} kg) and the Earth (Mass of earth = 5.98×10^{24} kg). The distance between the sun and Earth's centers is 1.50×10^{11} m.

$$F_g = \frac{G m_1 m_2}{r^2} = \frac{(6.67\times10^{-11})(1.98\times10^{30})(5.98\times10^{24})}{(1.5\times10^{11})^2} = 3.51\times10^{22}\ N$$

9. What is the force of gravity between two 250 kg sumo wrestlers that are 2.0 m apart?

$$F_g = \frac{G(250\ kg)(250\ kg)}{2^2} = 1.04\times10^{-6}\ N$$

10. What is the distance between two 20.0 kg objects that have a mutual force of gravitational attraction of 3.0×10^{-7} N?

$F_g = \frac{G m_1 m_2}{r^2}$

$3\times10^{-7}\ N = \frac{G(20)(20)}{r^2}$

$r^2 = \frac{G(20)(20)}{3\times10^{-7}} = .0889$

$r = .298\ m$

11. What is the gravitational field strength of a planet with a mass of 7.9×10^{27} kg and radius of 3.2×10^{6} m?

$$g = \frac{GM}{r^2} = \frac{(6.67\times10^{-11})(7.9\times10^{27})}{(3.2\times10^{6}\,m)^2} = 5.15\times10^{4}\,N/kg$$

12. The constant G in the Law of Universal Gravitation has a value of 6.67×10^{-11} Nm^2/kg^2. Calculate the force of gravity between:

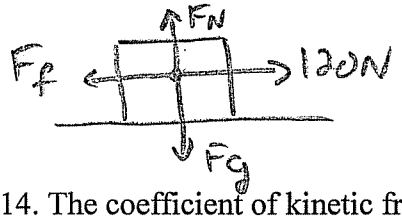
a) 100.0 kg person and the earth (Mass of earth = 5.98×10^{24} kg, Radius of earth = 6.38×10^{6} m)

$$F_g = \frac{G(5.98\times10^{24})(100)}{(6.38\times10^{6})^2} = 980N$$

b) 100.0 kg person and the moon (Mass of moon = 7.35×10^{22} kg, Radius of moon = 1.74×10^{6} m)

$$F_g = \frac{G(7.35\times10^{22})(100)}{(1.74\times10^{6})^2} = 162N$$

13. A force of 120 N is needed to push a box along a road at a steady speed. If the force of gravity on the box is 250 N, what is the coefficient of kinetic friction between the box and the road?



$F_{net} = F_{app} - F_f$

$0 = 120 - F_f$

$F_f = 120N$

$F_f = \mu F_N$

$\mu = \frac{F_f}{F_N} = \frac{120N}{250N} = .48$

14. The coefficient of kinetic friction between a steel block and an ice rink surface is 0.0100. If a force of 24.5 N keeps the steel block moving at steady speed, what is the force of gravity on the block?

$F_{net} = F_{app} - F_f$

$0 = 24.5N - F_f$

$F_f = 24.5N$

$F_f = \mu F_N$

$24.5 = (.01)F_N$

$\Sigma F_N = 2450 = mg$

$m = 250\,kg$

15. A boy exerts a 36.0 N horizontal force as he pulls a 52.0 N sled across a cement sidewalk at constant speed. What is the coefficient of kinetic friction between the sidewalk and the metal sled runners? Ignore air resistance.

$F_{net} = F_{app} - F_f$

$0 = 36N - F_f$

$F_f = 36N$

$F_f = \mu F_N$

$36N = \mu(52N)$

$\mu = .692$

16. A 10.0 N force stretches a length of fishing line by 10.0 cm. What is the line's spring constant?

$F_e = k \cdot x$

$10N = k(0.10m)$

$k = 100\,N/m$

17. A 20.0 N force is used to stretch various rubber bands. Calculate the amount of stretch that will occur, given each of the following spring constant.

(a) 200. N/m $F_e = kx$

$20\,N = (200\,N/m)(x)$ $x = 0.10\,m$

(b) 100. N/m $F_e = kx$

$20\,N = 100\,N/m\,(x)$ $x = 0.20\,m$

18. An archer pulls back with a force of 240. N, moving the arrow 60.0 cm. What is the spring constant of the bow?

$F_e = kx$

$240\,N = k(.60\,m)$

$k = 400\,N/m$

Answers:

1. **3.5 m/s & 23.6°**
2. **2.9 m/s @ 26°**
3. **3.8 m/s at 18.4° N of E**
4. **10° E of N, 394 km/h**
5. **4.47 s, 121 m, 51.5 m/s**
6. **12 m/s, 2.45 s, 51.0 m, 7.35 m, 24 m/s 30° from the horizontal**
7. **40.9 m**
8. **3.51×10^{22} N**
9. **1.04×10^{-6} N**
10. **0.30 m**
11. **5.15×10^{4} N/kg**
12. **980 N, 162 N**
13. **0.48**
14. **2450 N**
15. **0.692**
16. **100 N/m**
17. **0.100 m, 0.200 m**
18. **400. N/m**