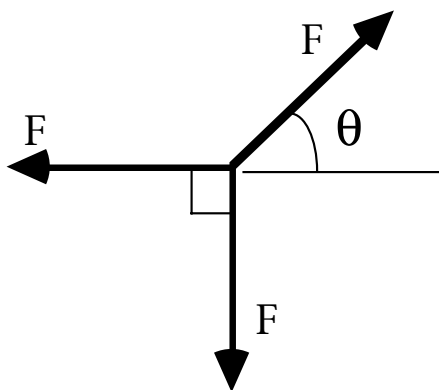


Problem 5



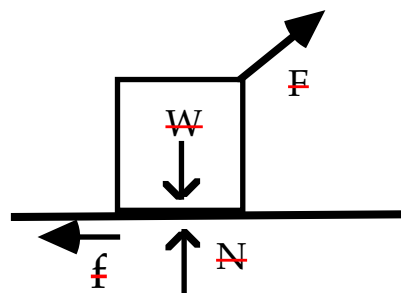
An object is acted on by three forces. All three forces have exactly the same magnitude. Two of the forces are perpendicular and the third acts at an angle as shown above. No other forces act on this object. Which of the following is true? For full credit, explain your answer.

- 1) It is possible for this particle to remain at rest.
- 2) It is not possible for this particle to remain at rest.
- 3) You cannot answer this question without knowing the value of the angle θ .
- 4) You cannot answer this question without knowing both the value of the angle θ and the magnitude of the forces F .

Problem 6

~~A person pulls on a block by applying a force F and the block remains at rest. The arrows in the diagram correctly show the directions, but not necessarily the magnitudes, of the various forces on the block. Which of the following relations among the force magnitudes F , W , N , f must be true? f is friction and W is the weight (the force of gravity).~~

- ☐ ~~$F = f$ and $N = W$~~
- ☐ ~~$F = f$ and $N > W$~~
- ☐ ~~$F > f$ and $N < W$~~
- ☐ ~~$F > f$ and $N = W$~~
- ☐ ~~None of the above choices is correct.~~



Problem 7

~~The position of a particle is given by the following equations:~~

$$x = at + bt^3 \quad \text{where } a = 2.0 \frac{m}{s} \quad \text{and } b = 0.5 \frac{m}{s^3}$$

$$y = A \sin(Bt) \quad \text{where } A = 2.0m \quad \text{and } B = \frac{\pi}{2} \frac{rad}{s}$$

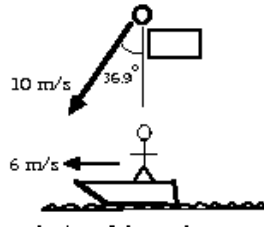
- a) ~~Write equations for the components of the velocity, v_x and v_y , as functions of time.~~
- b) ~~Write equations for the components of the acceleration, a_x and a_y , as functions of time.~~
- c) ~~Make an XY plot showing (as dots numbered 0 and 1) the position of the particle at $t=0$ and 1 seconds. On this same plot, draw two arrows at each dot showing the approximate direction of the velocity and acceleration at that time. If either velocity or acceleration has zero magnitude, indicate that clearly. Label your two arrows so we know which is which. Don't worry about the length of these arrows, just their approximate directions~~

Problem 8

~~While driving along the highway at 40 m/s, you spot a police car 50 m ahead, traveling at a constant speed of 30 m/s which is the speed limit. You apply the brakes and begin decelerating at 1.0 m/s^2 . Assume that the police officer will give you a speeding ticket only if you pass her car. Will you get a ticket? Justify your answer numerically. [Hint: You can solve this problem by trying to solve a quadratic equation; look closely at the numbers! Instead, you might want to think about when the cars have equal velocities.]~~

Problem 3

a)



$$v_x = 10 \sin(36.9^\circ) = 6 \text{ m/s}$$

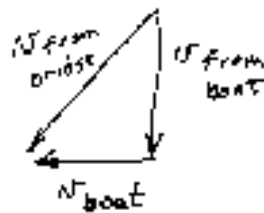
$$v_y = -10 \cos(36.9^\circ) = -8 \text{ m/s}$$

b)

$$v_x = 6 - 6 = 0 \text{ m/s}$$

$$v_y = -8 - 0 = -8 \text{ m/s}$$

c)



Problem 4

a)

$$v_x = B - 2Ct \quad a_x = -2C$$

$$v_y = E + FG \sin(Gt) \quad a_y = FG^2 \cos(Gt)$$

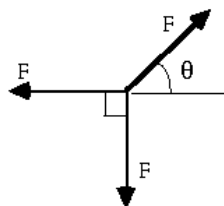
$$v_z = FG \cos(Gt) \quad a_z = -FG^2 \sin(Gt)$$

b)

$$|a| = \sqrt{4C^2 + F^2 G^4}$$

Magnitude constant, direction changes.

Problem 5



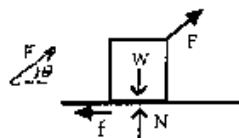
$$\sum F_x = F \cos(\theta) - f \quad \text{Can't be zero unless } \theta = 0.$$

$$\sum F_y = F \sin(\theta) - F \quad \text{Can't be zero unless } \theta = 90^\circ.$$

\Rightarrow Can't both be zero. Answer is (2).

Problem 6

a)



☐ ~~$F = f$ and $N = W$~~

☐ ~~$F = f$ and $N > W$~~

\Rightarrow ☐ ~~$F > f$ and $N < W$~~

☐ ~~$F > f$ and $N = W$~~

☐ ~~None of the above choices is correct.~~

~~$$f = F \cos(\theta) < F$$~~

~~$$N + F \sin(\theta) = W \quad N < W$$~~

Problem 7

a)

~~$$v_x = a + 3bt^2 = 2 + \frac{3}{2}t^2$$~~

~~$$v_y = AB \cos(Bt) = \pi \cos\left(\frac{\pi}{2}t\right)$$~~

b)

~~$$a_x = 6bt = 3t$$~~

~~$$a_y = -AB^2 \sin(Bt) = -\frac{\pi^2}{2} \sin\left(\frac{\pi}{2}t\right)$$~~

c)

	x	y	v_x	v_y	a_x	a_y
0	0	0	2	π	0	0
1	$2\frac{1}{2}$	2	$3\frac{1}{2}$	0	3	$-\frac{\pi^2}{2} \approx -5$