Practice Exam #1

Name: ______________________________

Useful Equations

$$x(t) = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$$
$$y(t) = y_0 + v_{0y}t + \frac{1}{2}a_y t^2$$
$$v_x(t) = v_{0x} + a_x t$$
$$v_y(t) = v_{0y} + a_y t$$
$$v_{fx}^2 = v_{0x}^2 + 2a_x \Delta x$$
$$v_{fy}^2 = v_{0y}^2 + 2a_y \Delta y$$

$$a_c = \frac{v^2}{r}$$
$$\theta(t) = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$
$$\omega(t) = \omega_0 + \alpha t$$
$$\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$$
$$\sum_i \vec{\tau}_i = I\vec{\alpha} = \frac{d\vec{L}}{dt}$$

$$x(t) = A\cos(\omega t + \phi_0)$$
$$\omega = 2\pi f = 2\pi/T$$
$$v_{max} = A\omega$$
$$a_{max} = A\omega^2$$
$$v = \sqrt{F_T/\mu}$$
$$v = \lambda f$$
$$\omega_{spring} = \sqrt{k/m}$$
$$\omega_{pendulum} = \sqrt{g/L}$$
$$k = 2\pi/\lambda$$

$$\sum_i \vec{F}_i = m\vec{a} = \frac{d\vec{p}}{dt}$$
$$\vec{p} = m\vec{v}$$
$$F_{fr} = \mu_{s,k} F_N$$

$$K = \frac{1}{2}mv^2$$
$$K = \frac{1}{2}I\omega^2$$
$$U = mgy \text{ (gravity)}$$
$$U = \frac{1}{2}kx^2 \text{ (spring)}$$

$$a = R\alpha$$
$$v = R\omega$$
$$\vec{L} = I\vec{\omega}$$
$$\vec{L} = \vec{r}\times\vec{p}$$
$$I = \sum_i m_i R_i^2$$

$$\vec{P}_0 = \vec{P}_f$$
$$\vec{L}_0 = \vec{L}_f$$
$$\Sigma p_{0x} = \Sigma p_{fx}$$
$$\Sigma p_{0y} = \Sigma p_{fy}$$

Question 1: If you are told an object has a non-zero constant acceleration, what can you say about the velocity of the object?

(a) The object's velocity is increasing.

(b) The object's velocity is decreasing.

(c) The object's velocity isn't changing.

(d) The object's velocity is changing.

Question 2: If you throw a ball up into the air, which of the following correctly describes the motion of the ball when it hits the peak of its trajectory?

(a) The velocity will be zero, and the acceleration will be equal to gravity pointing down.

(b) The velocity will be non-zero, and the acceleration will be equal to gravity pointing down.

(c) The velocity and acceleration will both be non-zero and pointing down.

(d) The velocity and acceleration will both be zero.

(e) The velocity will be pointing down and the acceleration will be zero.

Question 3: If two vectors $\vec{a}$ and $\vec{b}$ obey the following relationships, describe them in words and with a picture.

$$\vec{a} + \vec{b} = \vec{c} \quad \text{and} \quad a + b = c. \tag{1}$$

Question 4: The length of the day on Earth is increasing at a (small) rate of 1.0 ms each century.

(a) How much longer is the day after 20 centuries?

(b) What is the percent change in the length of the day after 20 centuries?

Question 5: The cable supporting an elevator snaps when the empty elevator car is at rest at the top of a 120-m-tall building.

(a) With what speed does the elevator strike the ground?

(b) How long is it falling?

(c) What is its speed half way down?

(d) How long does it take to get half way down?

Question 6: For the following three vectors,

$$\begin{aligned}
\vec{a} &= 4\hat{\imath} + 5\hat{\jmath} - 6\hat{k} \\
\vec{b} &= -1\hat{\imath} + 2\hat{\jmath} + 3\hat{k} \\
\vec{c} &= 4\hat{\imath} + 3\hat{\jmath} + 2\hat{k},
\end{aligned}$$

(a) find $\vec{r} = \vec{a} - \vec{b} + \vec{c}$;

(b) find the angle between $\vec{r}$ and the x-axis;

(c) find the component of $\vec{a}$ along the direction of $\vec{b}$.

Question 7: At a certain instant, a fly ball has velocity $\vec{v} = 25\hat{\imath} - 4.9\hat{\jmath}$ m/s, where the x axis is horizontal and the y axis is vertical. Positive y is upward, and positive x is to the right.

(a) The ball is at the top of its trajectory.

(b) The ball has already reached the top of its trajectory.

(c) The velocity of the ball is negative.

(d) The ball is no longer accelerating.

Question 8: Consider the fly ball from problem 7 where the velocity is $\vec{v} = 25\hat{\imath} - 4.9\hat{\jmath}$ m/s. If we assume the height of the ball at that moment is 30 m, then

(a) how much time will elapse before it strikes the ground?

(b) what is the *total speed* of the ball **right before** it hits the ground?