UNIVERSITY OF ALABAMA

Department of Physics and Astronomy

PH 125 / LeClair   January 28, 2009

Quiz 4: Solution

Instructions:

1. Answer both questions below. Both have equal weight.
2. Express your answer with the appropriate units and significant digits
3. Show your work for full credit.

1. An object experiences no acceleration. Which of the following *cannot* be true for the object?

If a single force acts, this force constitutes the net force and there is an acceleration according to Newton's second law. The second and third choices *could* be true - no forces would mean no acceleration, as would several forces canceling each other out. Newton's second law says that the *net* force gives acceleration, so zero net force mean zero acceleration. Finally, the last choice is somewhat obviously correct . . . no motion clearly means no acceleration.

2. A 3.00 kg object is moving in a plane, with its x and y coordinates in meters given by $x = 5t^2 - 1$ and $y = 3t^3 + 2$, where t is in seconds. What is the magnitude of the net force acting on this object at $t = 2.00\,\text{s}$?

- ∎ 112 N
- ☐ 30.0 N
- ☐ 108 N
- ☐ 37 N

First we need the components of acceleration:

$$a_x = \frac{d^2 x}{dt^2} = 10\,\text{m/s}^2$$

$$a_y = \frac{d^2 y}{dt^2} = 18t\,\text{m/s}^2$$

Evaluating at $t = 10\,\text{s}$,

$$a_x = 10\,\text{m/s}^2$$

$$a_y = 36\,\text{m/s}^2$$

The magnitude of the acceleration times the mass gives the magnitude of the force:

$$|\vec{\mathbf{F}}_{\text{net}}| = m|\vec{\mathbf{a}}| = (3.00\,\text{kg})\sqrt{10^2 + 36^2}\,\text{m/s}^2 \approx 112\,\text{kg} \cdot \text{m/s}^2 = 112\,\text{N}$$