Physics
Quiz # 8

Date Given: June 2, 2022
Date Due: June 9, 2022

Q1. (1 point) The number of coordinates required to specify the positions of all parts of a system having two degrees of freedom is:

(a) Four.

(b) One.

(c) Two.

(d) Three.

Answer:
(c) The number of coordinates required to specify the positions of all parts of a system is equal to the number of degrees of freedom that the system has.

Q2. (1 point) According to Newton's second law:

(a) The net force on a particle is equal to the product of the mass of the particle with the acceleration of a particle.

(b) The net force on a particle is equal to the product of the velocity of the particle with the acceleration of a particle.

(c) The velocity of a particle is equal to the net force on the particle multiplied by the mass of the particle.

(d) The velocity of a particle is equal to the net force on the particle divided by the mass of the particle.

Answer:
(a) Newton's second law states that the net force on a particle is equal to the product of the mass of the particle with the acceleration of the particle.

Q3. (2 points) The 10kg block is subjected to the forces shown in Figure 1. In each case, determine its velocity when $t = 2$s if $v = 0$ when $t = 0$.

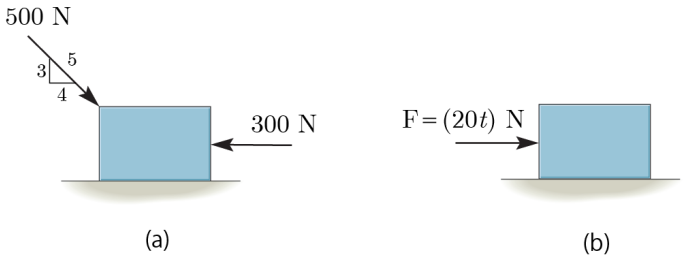

Figure 1: Illustration to Question 3.

Answer:

(a) First, $\sum F_x = ma_x \Longrightarrow \frac{4}{5}500\text{N} - 300\text{N} = 10a \Longrightarrow a = 10\text{m/s}^2$. Next $v = v_0 + at \Longrightarrow v = 10 \times 2 = 20\text{m/s}$.

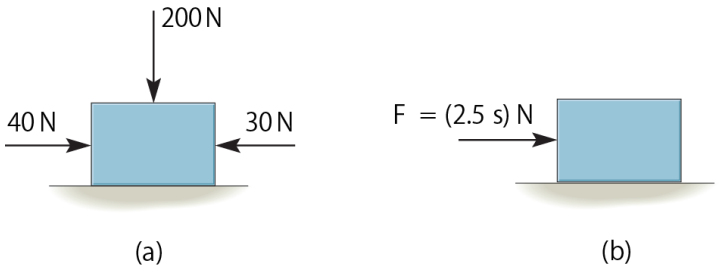

Figure 2: Illustration to Question 4.

(b) First, $\sum F_x = ma_x \Longrightarrow 20t = 10a \Longrightarrow a = 2t$. Next, $\mathrm{d}v = a\mathrm{d}t \Longrightarrow \int_0^v \mathrm{d}v = \int_0^2 2t\mathrm{d}t \Longrightarrow v = 4\mathrm{m/s}$.

Q4. (2 points) The 10kg block is subjected to the forces shown in Figure 2. In each case, determine its velocity at $s = 8\mathrm{m}$ if $v = 3\mathrm{m/s}$ at $s = 0$. Motion occurs to the right.

Answer:

(a) First, $\sum F_x = ma_x \Longrightarrow 40\mathrm{N} - 30\mathrm{N} = 10a \Longrightarrow a = 1\mathrm{m/s^2}$. Next $v\mathrm{d}v = a\mathrm{d}s \Longrightarrow v^2 = v_0^2 + 2a(s - s_0) \Longrightarrow v^2 = 3^2 + 2 \times 1 \times (8 - 0) \Longrightarrow v = 5\mathrm{m/s}$.

(b) First, $\sum F_x = ma_x \Longrightarrow 2.5s = 10a \Longrightarrow a = 0.25s$. Next, $v\mathrm{d}v = a\mathrm{d}s \Longrightarrow \int_3^v v\mathrm{d}v = \int_0^8 0.25s\mathrm{d}s \Longrightarrow v^2 = v_0^2 + 0.25(s^2 - s_0^2) \Longrightarrow v^2 = 3^2 + 0.25(8^2 - 0^2) \Longrightarrow v = 5\mathrm{m/s}$.

Q5. (2 points) Write the equations of motion in the x and y directions for the 10kg block shown in Figure 3.

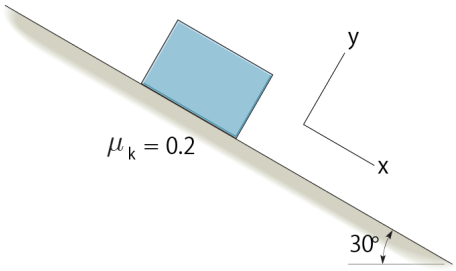

Figure 3: Illustration to Question 5.

Answer:

- $\sum F_x = ma_x \Longrightarrow mg\sin 30^\circ - \mu_k N = ma \Longrightarrow 98.1\frac{1}{2} - 0.2N = 10a$
- $\sum F_y = ma_y \Longrightarrow N - mg\cos 30^\circ = 0 \Longrightarrow N - 98.1\frac{\sqrt{3}}{2} = 0$