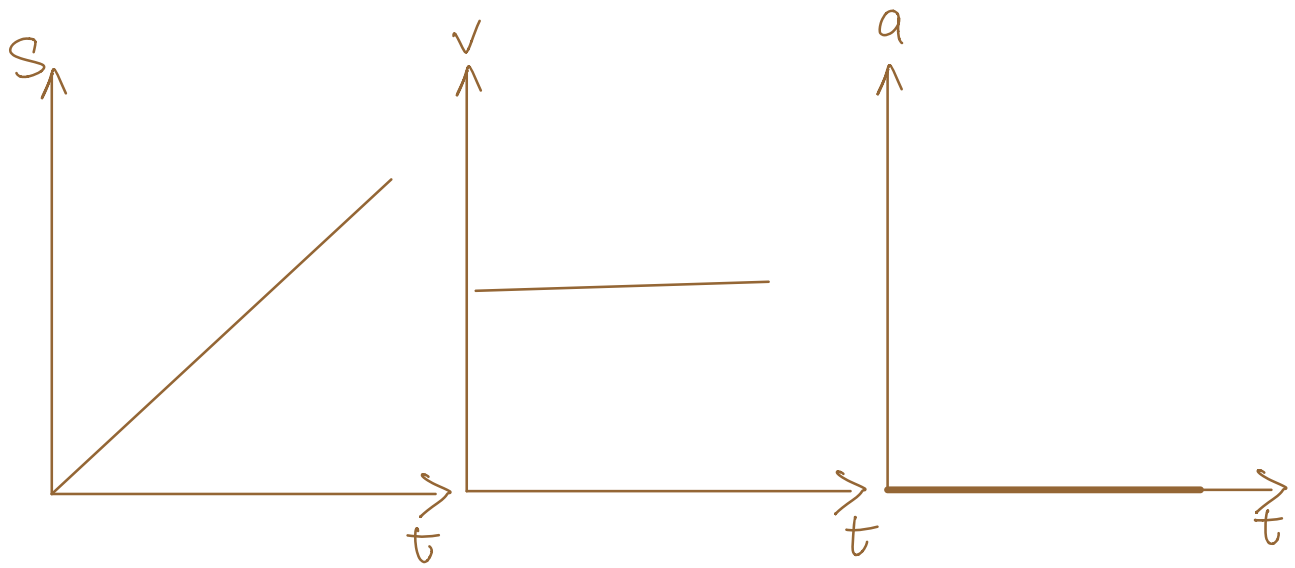
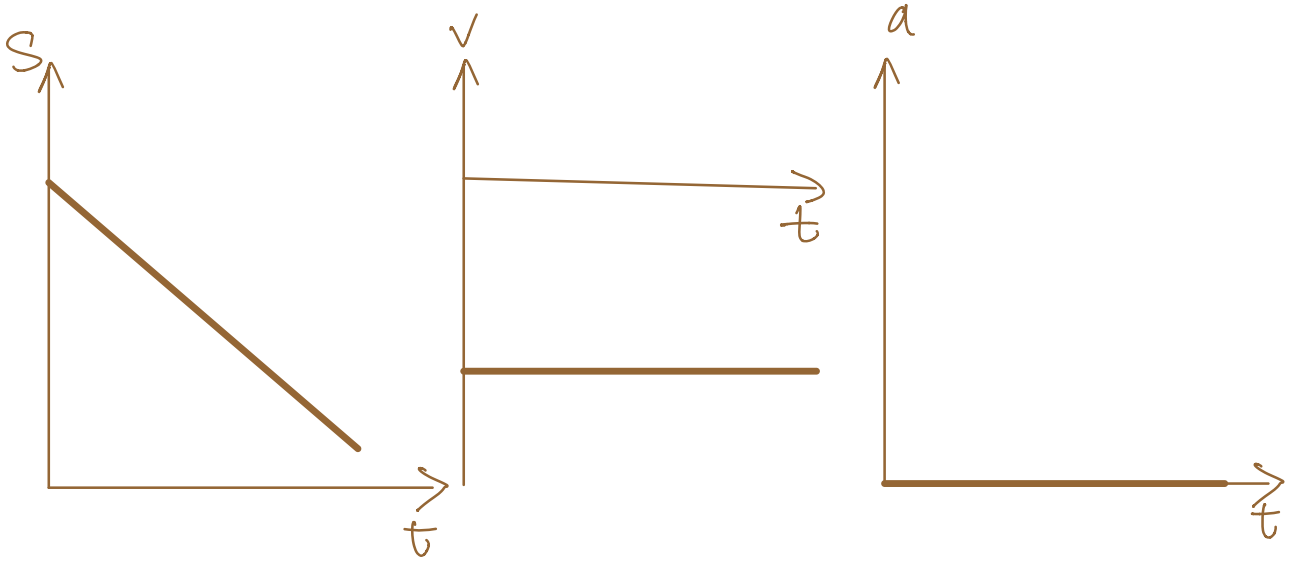
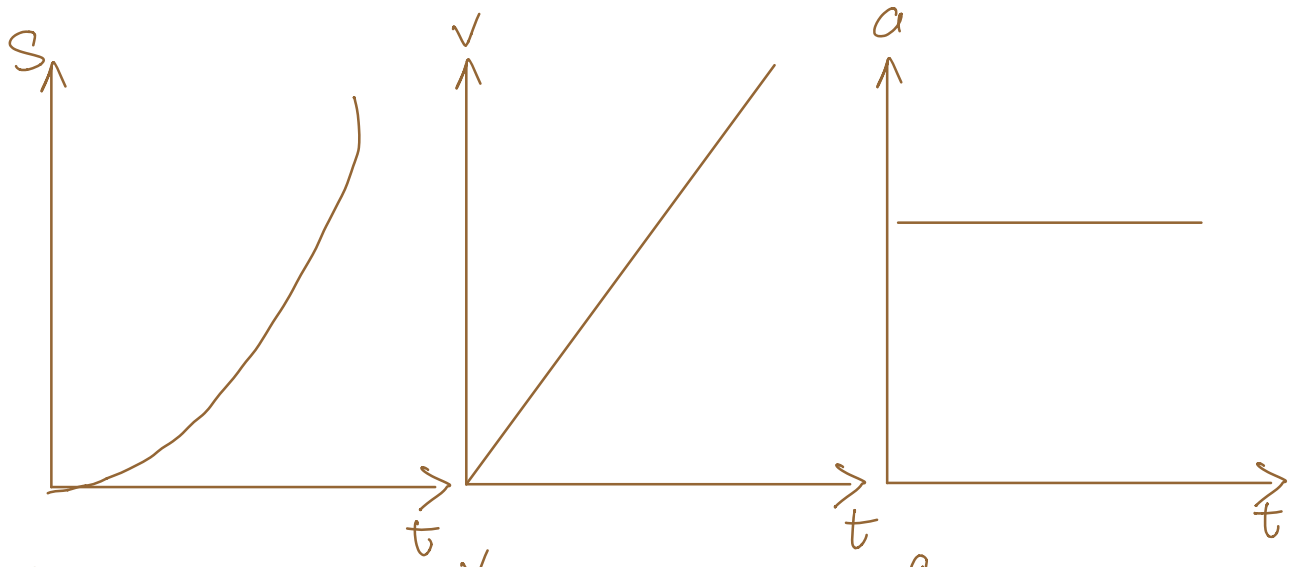
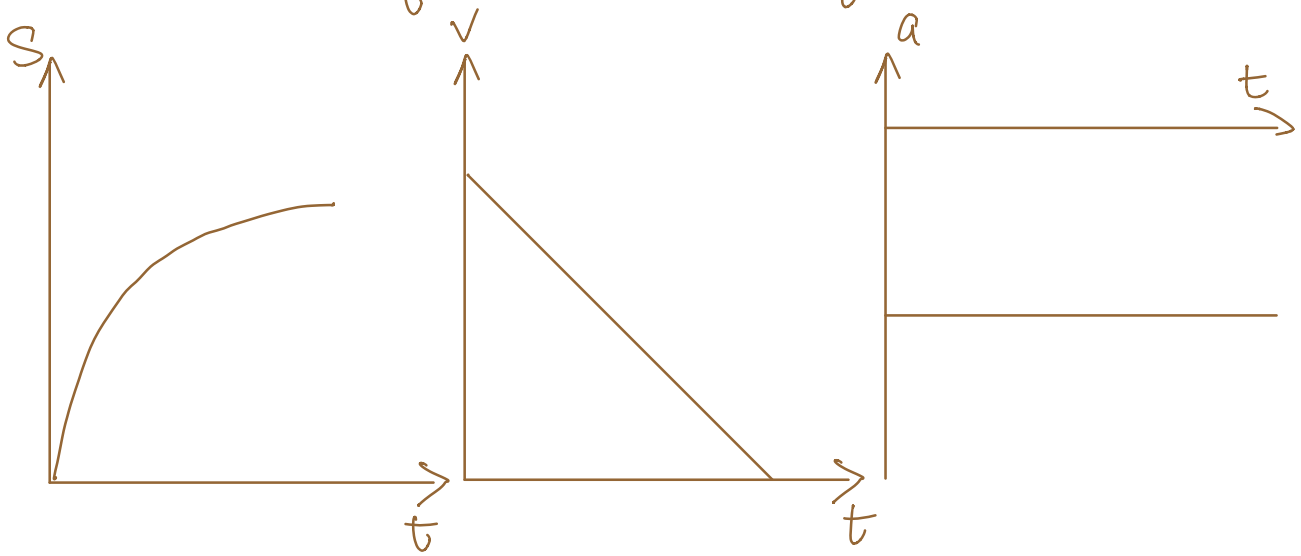
s v a conversions:

(s) (v) (a)






s
t
v
t
a
t


s
t
v
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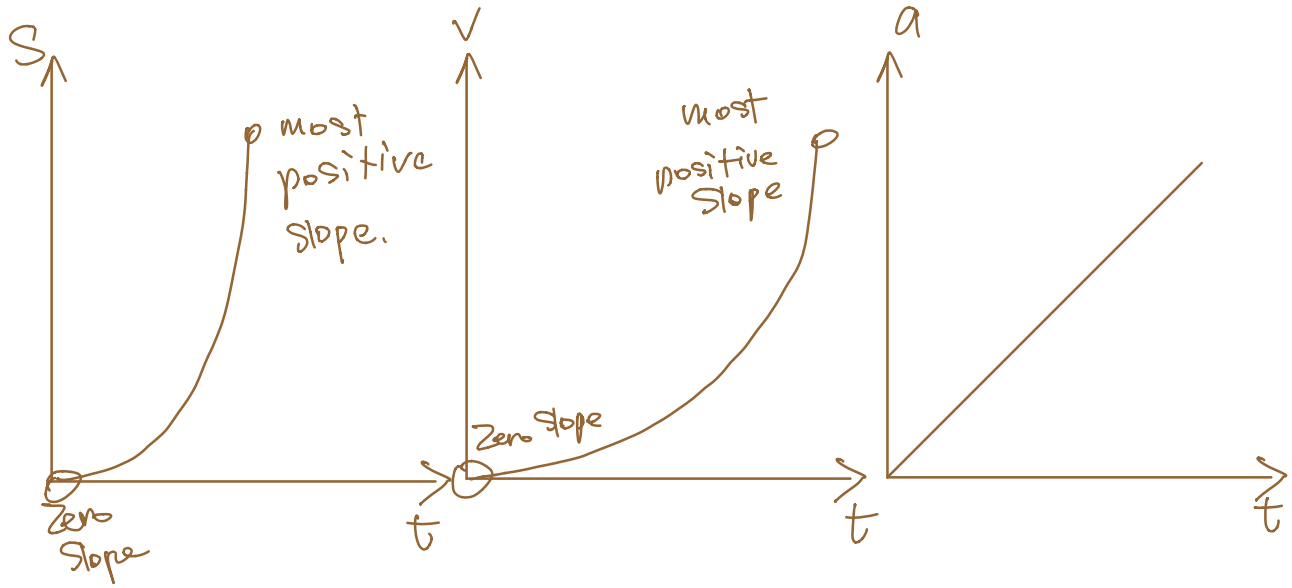
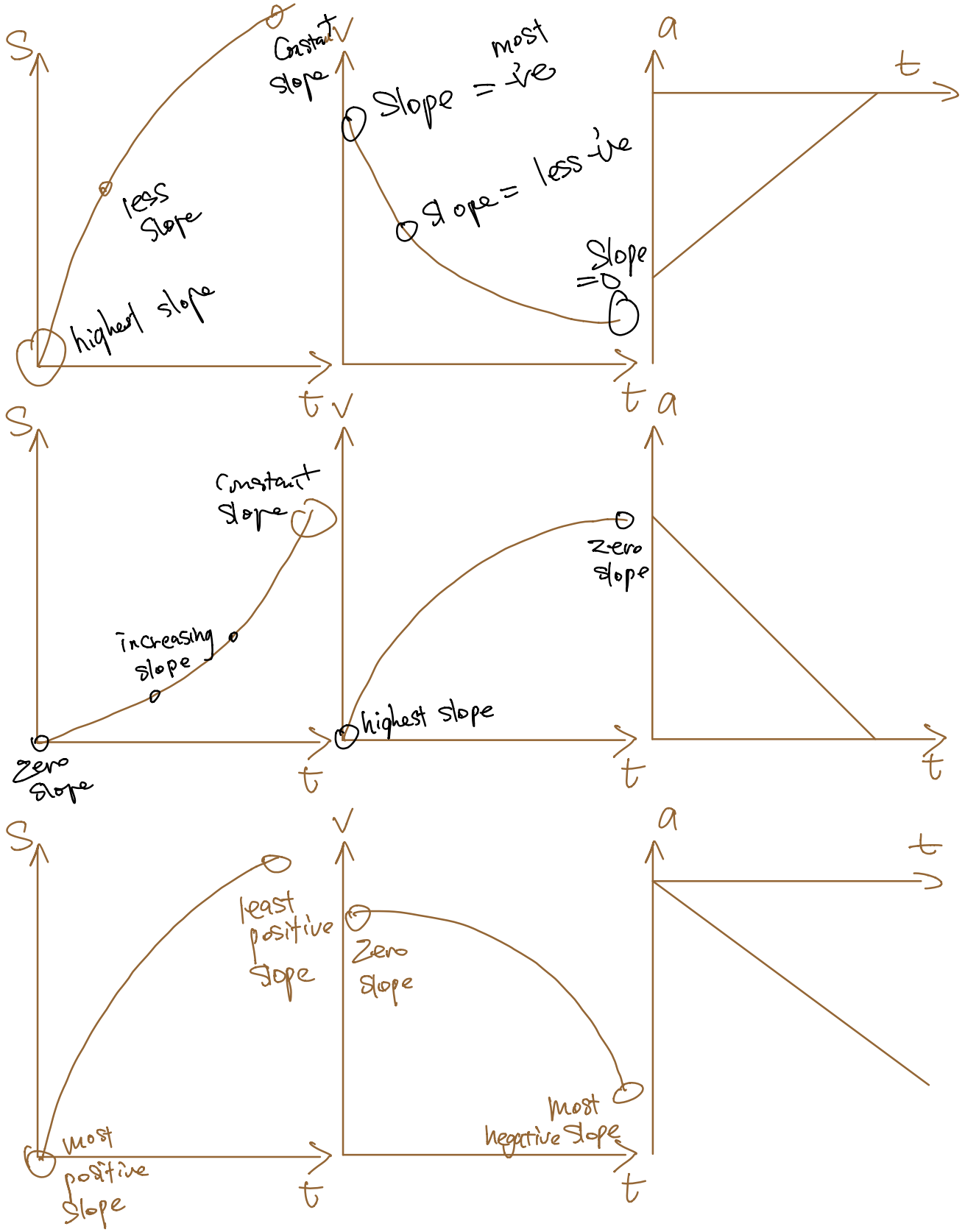
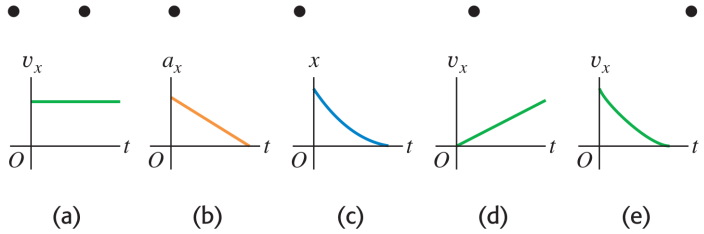

s
most positive slope.
Zero Slope
t
v
most positive slope
Zero Slope
t
a
t


S
t
Constant slope
most
Slope = -ve
Slope = less -ve
Slope = 0
less Slope
highest slope
v
t
a
t
S
t
Constant slope
increasing slope
zero slope
v
highest slope
t
a
zero slope
t
S
t
least positive slope
Zero slope
most positive slope
v
t
most negative slope
a
t

Q2.2 The top diagram in Fig. Q2.2 represents a series of high-speed photographs of an insect flying in a straight line from left to right (in the positive x-direction). Which of the graphs in Fig. Q2.2 most plausibly depicts this insect's motion?

Figure **Q2.2**



2.2. **IDENTIFY:** $v_{av\text{-}x} = \dfrac{\Delta x}{\Delta t}$

SET UP: 13.5 days $= 1.166\times10^6$ s. At the release point, $x = +5.150\times10^6$ m.

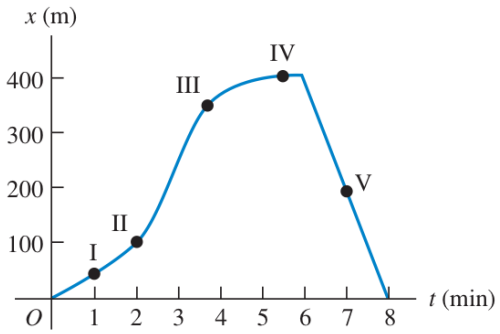
EXECUTE: **(a)** $v_{av\text{-}x} = \dfrac{x_2 - x_1}{\Delta t} = \dfrac{5.150\times10^6 \text{ m}}{1.166\times10^6 \text{ s}} = -4.42$ m/s

(b) For the round trip, $x_2 = x_1$ and $\Delta x = 0$. The average velocity is zero.

EVALUATE: The average velocity for the trip from the nest to the release point is positive.

2.10 • A physics professor leaves her house and walks along the sidewalk toward campus. After 5 min it starts to rain and she returns home. Her distance from her house as a function of time is shown in Fig. E2.10. At which of the labeled points is her velocity (a) zero? (b) constant and positive? (c) constant and negative? (d) increasing in magnitude? (e) decreasing in magnitude?

Figure **E2.10**



2.10. **IDENTIFY** and **SET UP:** The instantaneous velocity is the slope of the tangent to the x versus t graph.

EXECUTE: **(a)** The velocity is zero where the graph is horizontal; point IV.

(b) The velocity is constant and positive where the graph is a straight line with positive slope; point I.

(c) The velocity is constant and negative where the graph is a straight line with negative slope; point V.

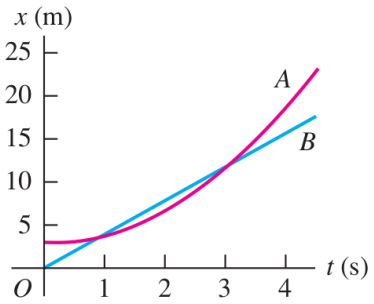
(d) The slope is positive and increasing at point II.

(e) The slope is positive and decreasing at point III.

EVALUATE: The sign of the velocity indicates its direction.

2.32 • Two cars, *A* and *B*, move along the *x*-axis. Figure E2.32 is a graph of the positions of *A* and *B* versus time. (a) In motion diagrams (like Figs. 2.13b and 2.14b), show the position, velocity, and acceleration of each of the two cars at $t = 0$, $t = 1$ s, and $t = 3$ s. (b) At what time(s), if any, do *A* and *B* have the same position? (c) Graph velocity versus time for both *A* and *B*. (d) At what time(s), if any, do *A* and *B* have the same velocity? (e) At what time(s), if any, does car *A* pass car *B*? (f) At what time(s), if any, does car *B* pass car *A*?

Figure **E2.32**



2.32. **IDENTIFY:** $v_x(t)$ is the slope of the x versus t graph. Car *B* moves with constant speed and zero acceleration. Car *A* moves with positive acceleration; assume the acceleration is constant.

SET UP: For car *B*, v_x is positive and $a_x = 0$. For car *A*, a_x is positive and v_x increases with t.

EXECUTE: **(a)** The motion diagrams for the cars are given in Figure 2.32a.

(b) The two cars have the same position at times when their x-t graphs cross. The figure in the problem shows this occurs at approximately $t = 1$ s and $t = 3$ s.

(c) The graphs of v_x versus t for each car are sketched in Figure 2.32b.

(d) The cars have the same velocity when their x-t graphs have the same slope. This occurs at approximately $t = 2$ s.

(e) Car *A* passes car *B* when x_A moves above x_B in the x-t graph. This happens at $t = 3$ s.

(f) Car *B* passes car *A* when x_B moves above x_A in the x-t graph. This happens at $t = 1$ s.

EVALUATE: When $a_x = 0$, the graph of v_x versus t is a horizontal line. When a_x is positive, the graph of v_x versus t is a straight line with positive slope.

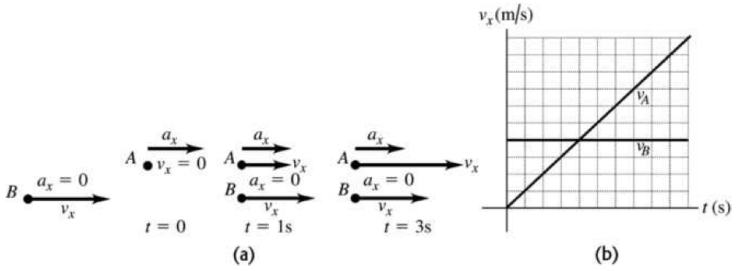
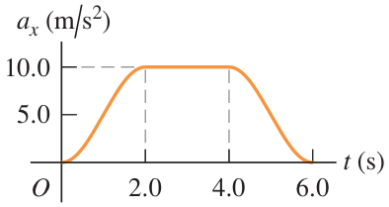


Figure 2.32a-b

4.13 • A 4.50-kg toy cart undergoes an acceleration in a straight line (the x-axis). The graph in Fig. E4.13 shows this acceleration as a function of time. (a) Find the maximum net force on this cart. When does this maximum force occur? (b) During what times is the net force on the cart a constant? (c) When is the net force equal to zero?



4.13. **IDENTIFY:** The force and acceleration are related by Newton's second law.
SET UP: $\Sigma F_x = ma_x$, where ΣF_x is the net force. $m = 4.50$ kg.
EXECUTE: **(a)** The maximum net force occurs when the acceleration has its maximum value.
$\Sigma F_x = ma_x = (4.50 \text{ kg})(10.0 \text{ m/s}^2) = 45.0$ N. This maximum force occurs between 2.0 s and 4.0 s.
(b) The net force is constant when the acceleration is constant. This is between 2.0 s and 4.0 s.
(c) The net force is zero when the acceleration is zero. This is the case at $t = 0$ and $t = 6.0$ s.
EVALUATE: A graph of ΣF_x versus t would have the same shape as the graph of a_x versus t.