Python Question **Question #9**

Which code block is the correct way to perform a calculation over a set of data (rather than a single number)?

```
from numpy import array

xi = array([5,5.2,4.8,4.5,5.9,5.5,3.9,4.7,4.75,5.12])
vi = array([32,31.5,33.2,34.5,32.2,30.8,31.7,32.4,34.4,31.6])
t = 15
xf = xi + vi * t
```

C

```
from numpy import array

xi = array(5,5.2,4.8,4.5,5.9,5.5,3.9,4.7,4.75,5.12)
vi = array(32,31.5,33.2,34.5,32.2,30.8,31.7,32.4,34.4,31.6)
t = 15
xf = xi + vi * t
```

B

```
from numpy import array

xi = [5,5.2,4.8,4.5,5.9,5.5,3.9,4.7,4.75,5.12]
vi = [32,31.5,33.2,34.5,32.2,30.8,31.7,32.4,34.4,31.6]
t = 15
xf = xi + vi * t
```

A

Python Question **Question #10**

How do you raise a number to a power in python?

```
a = 5
b = a^2
```

D

```
a = 5
b = a**2
```

E

Python Question **Question #11**

Which code block is a good example of using variables to perform a calculation?

```
xi = 5
vi = 22.8
deltaT = 15
a = 6.7
xf = xi + vi * deltaT + 1/2 * a * deltaT**2
print(xf)
```

D

```
print(5 + 22.8 * 15 + 1/2 * 6.7 * 15**2)
```

E

A Helpful Chart

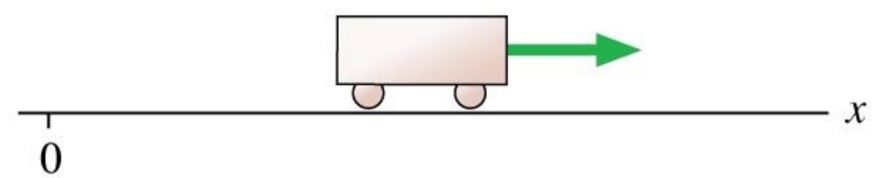
Differentiate

$$s \;\rightleftarrows\; v \;\rightleftarrows\; a$$

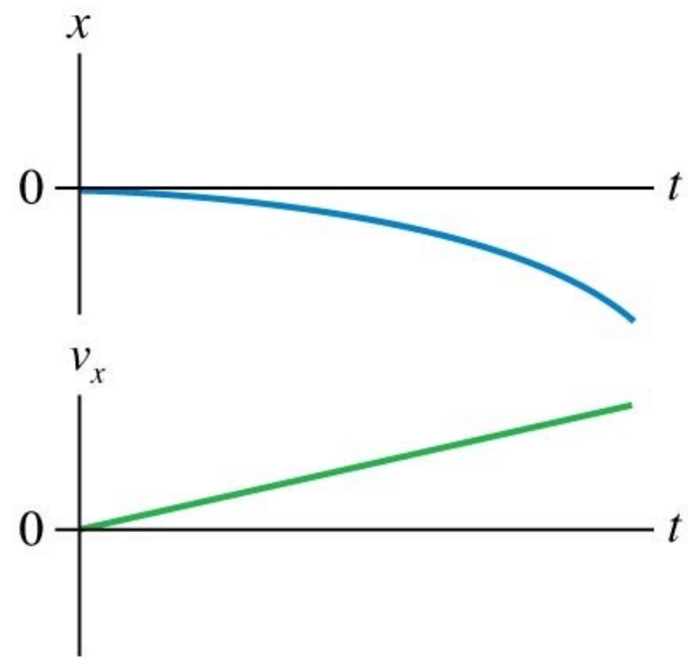
Integrate

Question #12

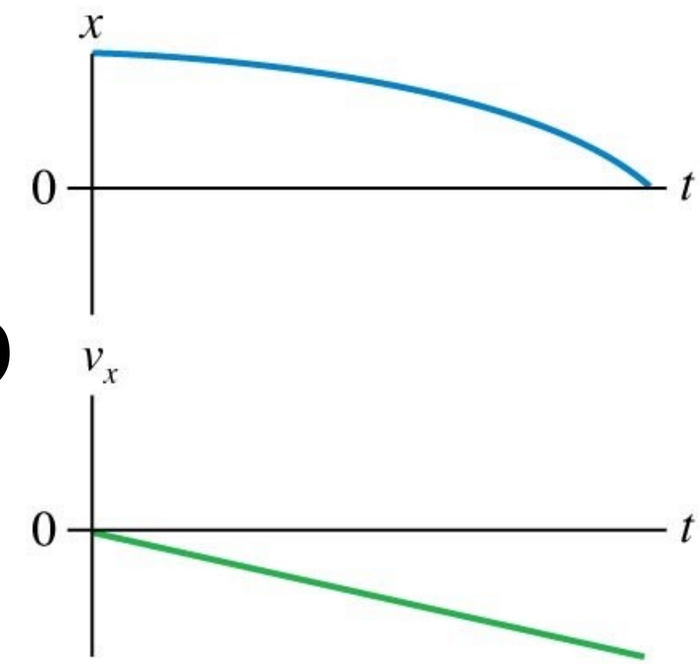
A cart slows down while moving away from the origin. What do the position and velocity graphs look like?



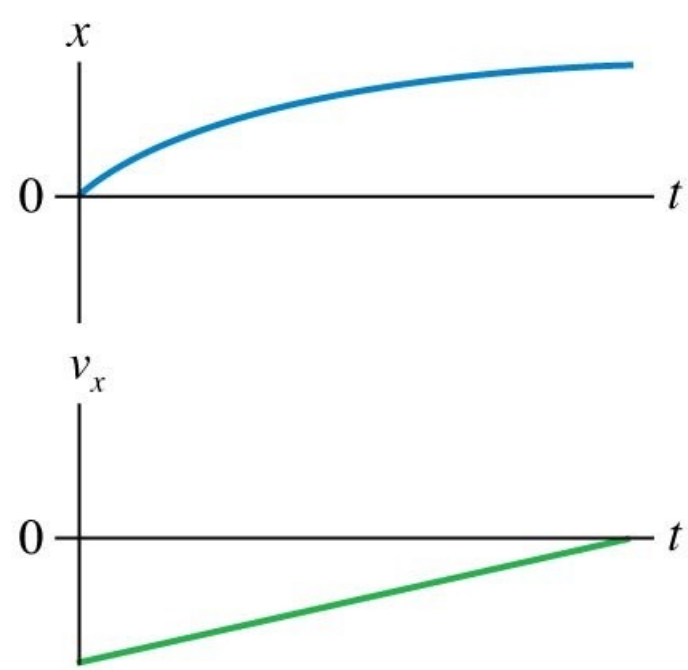
C



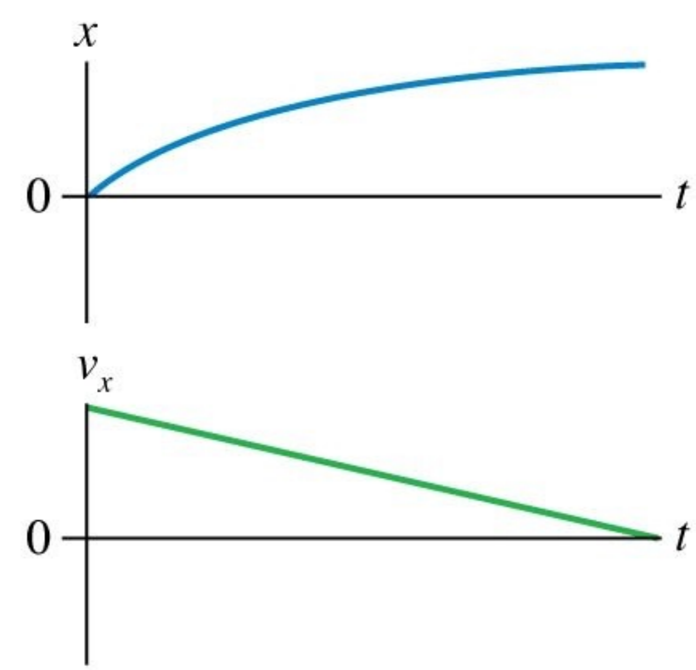
D



B

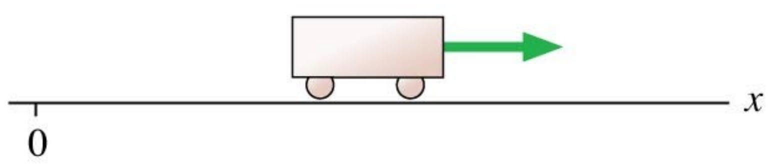


E

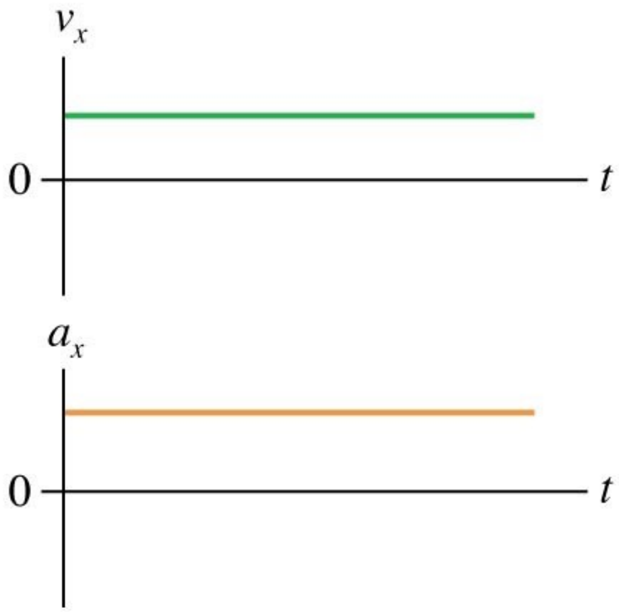


Question #13

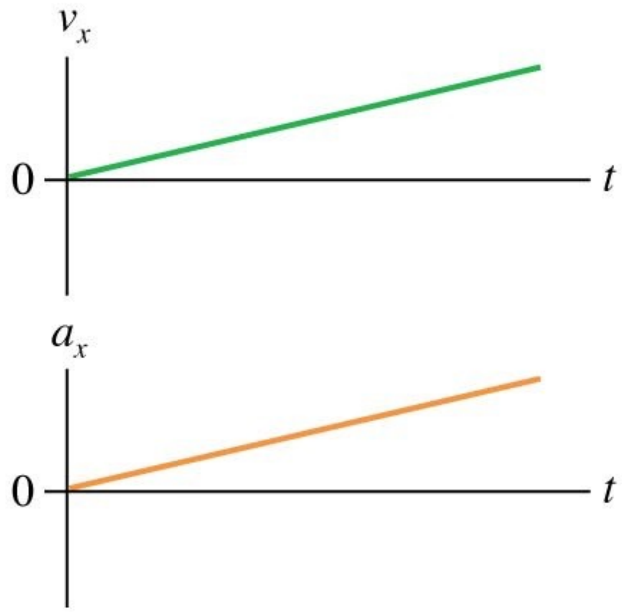
A cart speeds up while moving away from the origin. What do the velocity and acceleration graphs look like?



E



C



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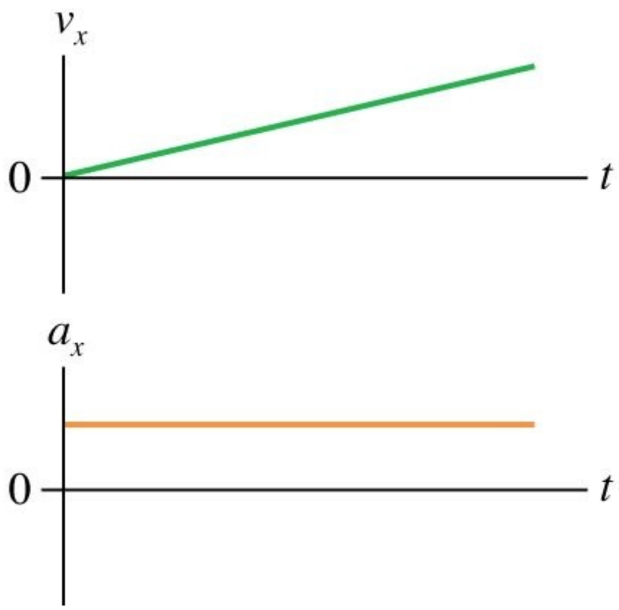
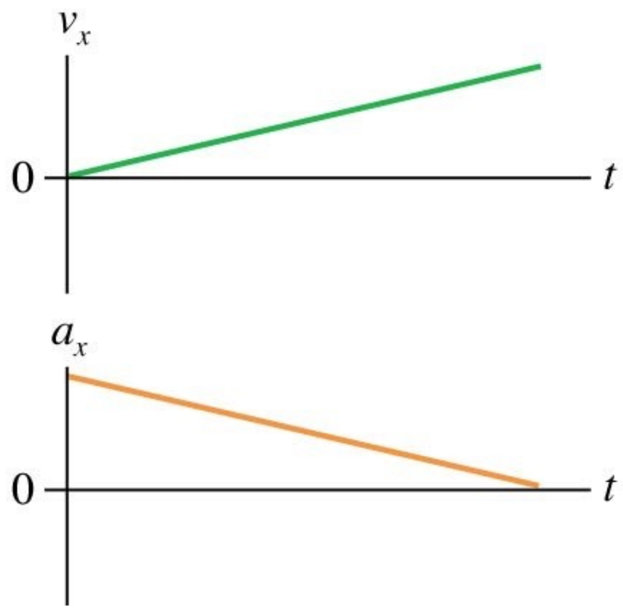
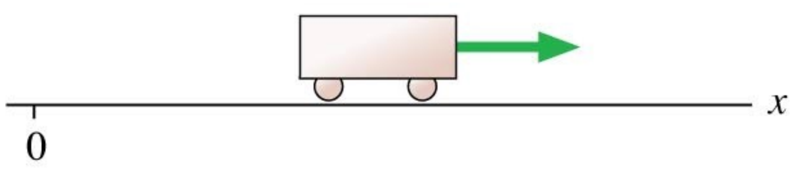


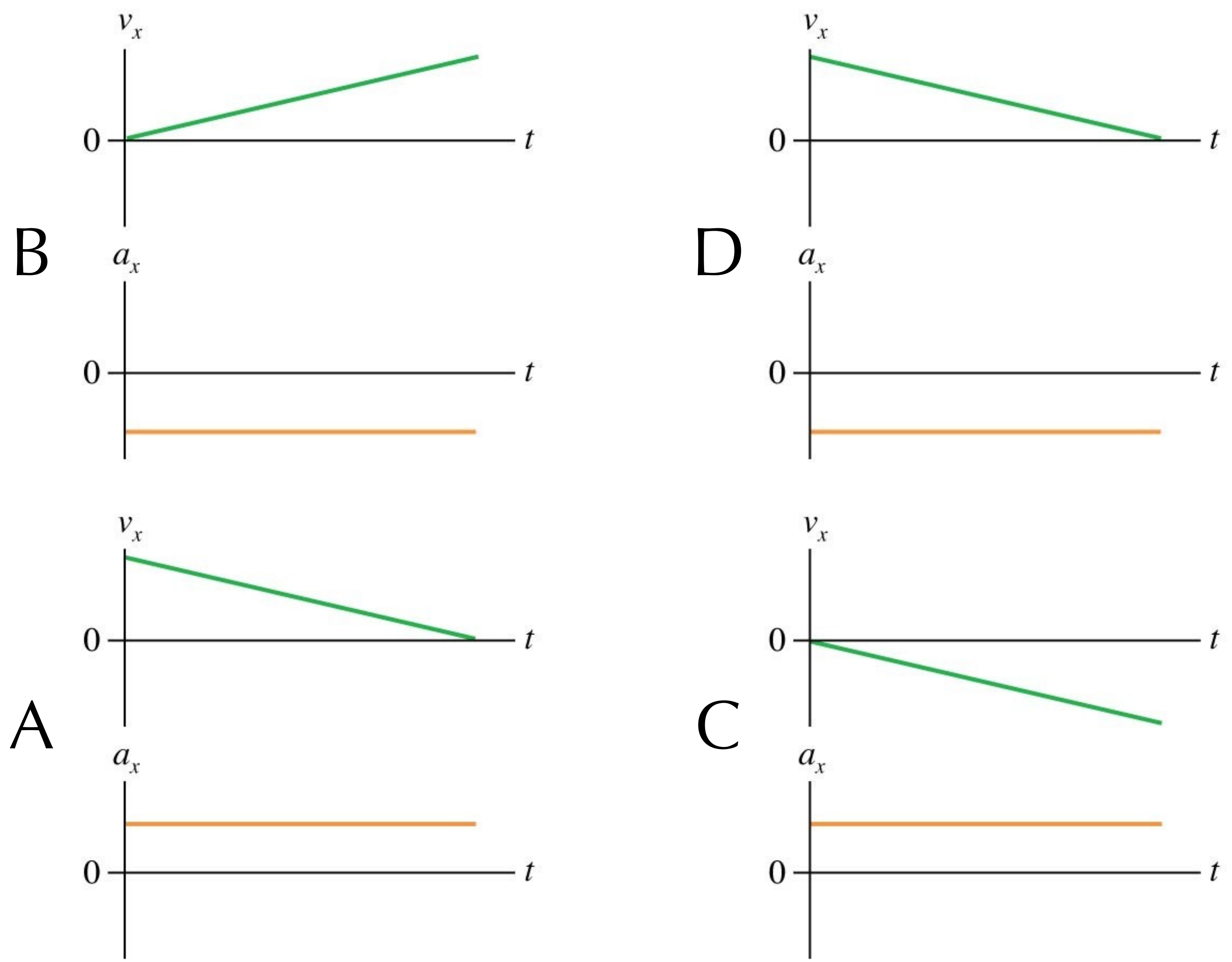
D



Question #14

A cart slows down while moving away from the origin. What do the velocity and acceleration graphs look like?



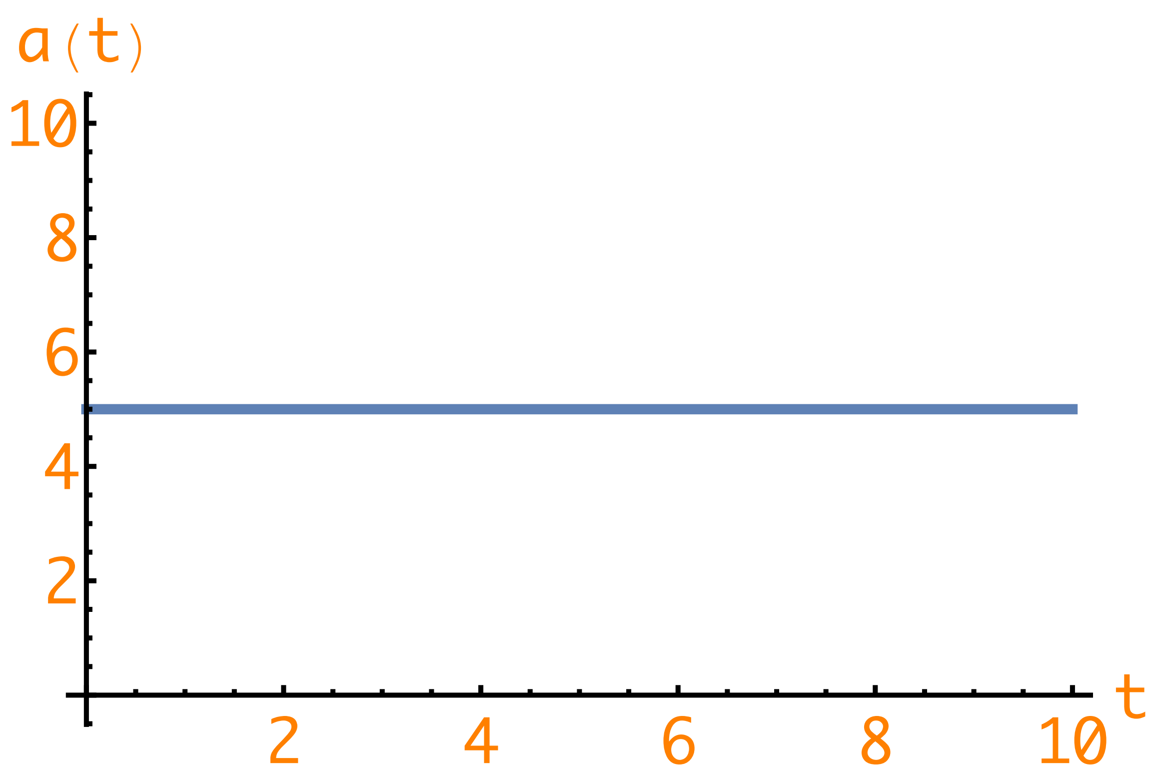


Kinematic Equations

Differentiate

$$s \overset{\longrightarrow}{\underset{\longleftarrow}{}} v \overset{\longrightarrow}{\underset{\longleftarrow}{}} a$$

Integrate



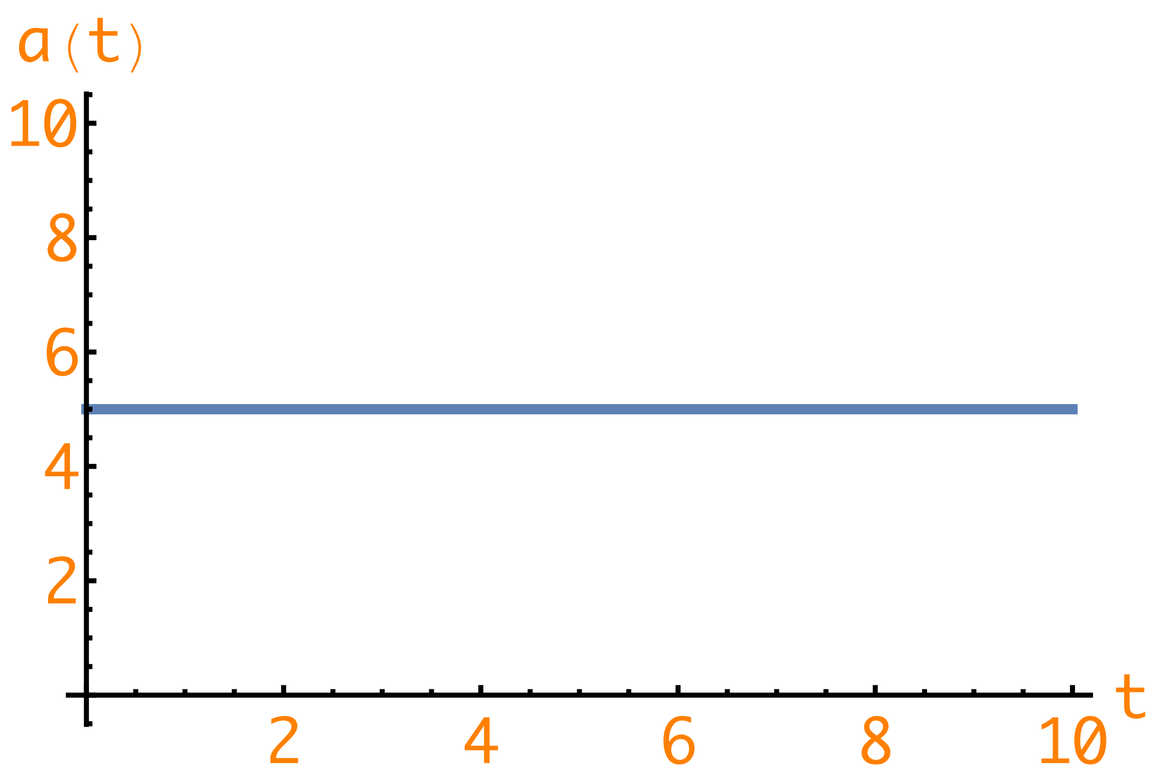
The initial velocity is 20 m/s and the initial position is 10 m.

Kinematic Equations

Differentiate

$$\underset{\longleftarrow}{\overset{\longrightarrow}{s}}\quad \underset{\longleftarrow}{\overset{\longrightarrow}{v}}\quad a$$

Integrate



A. Write down the function shown at the left for the acceleration.

B. Integrate the function once to get the velocity function.

C. Integrate the velocity function to get the position function.

D. What do these functions look like?

The initial velocity is 20 m/s and the initial position is 10 m.

Kinematic Equations

Differentiate

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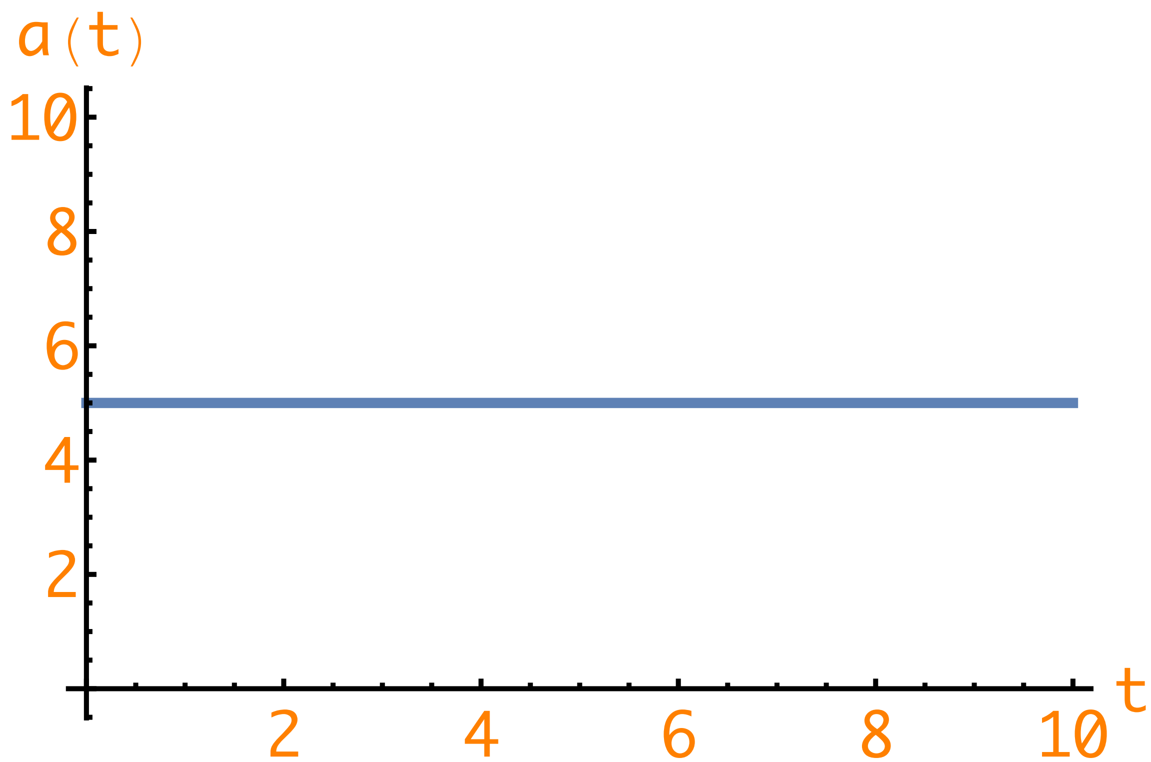
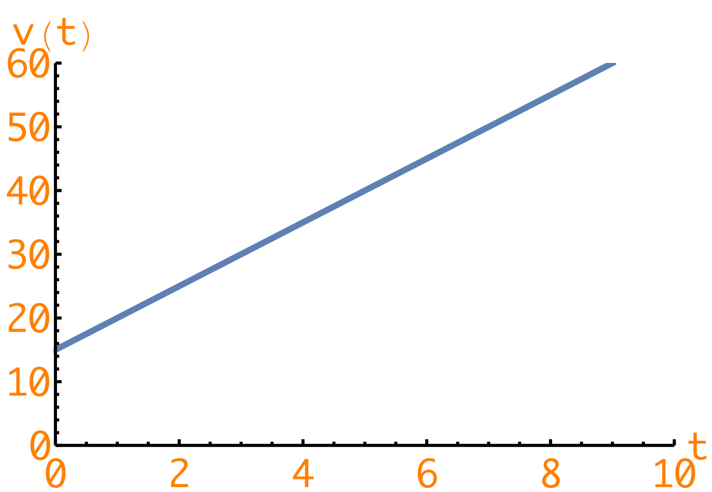
Integrate





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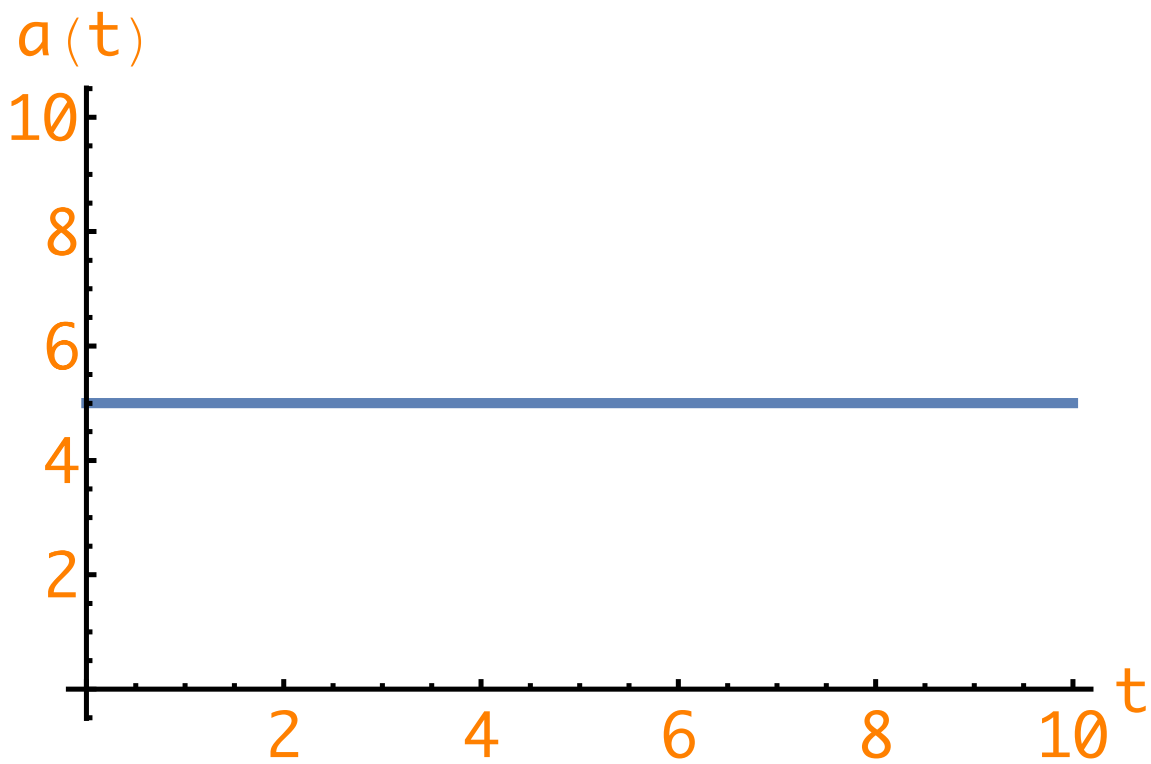

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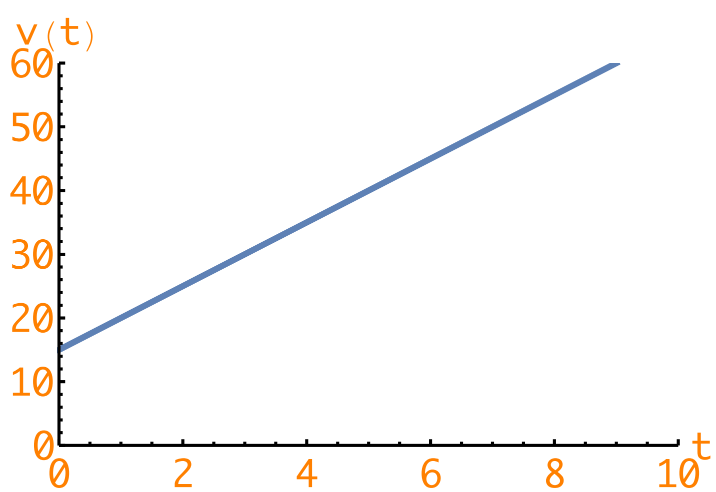
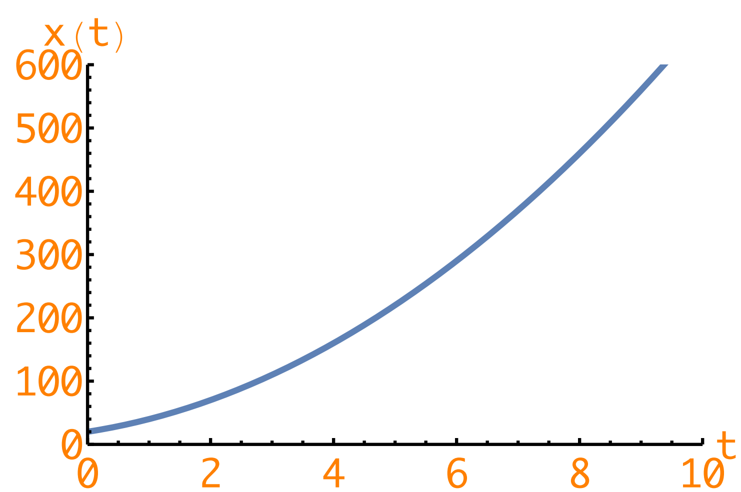




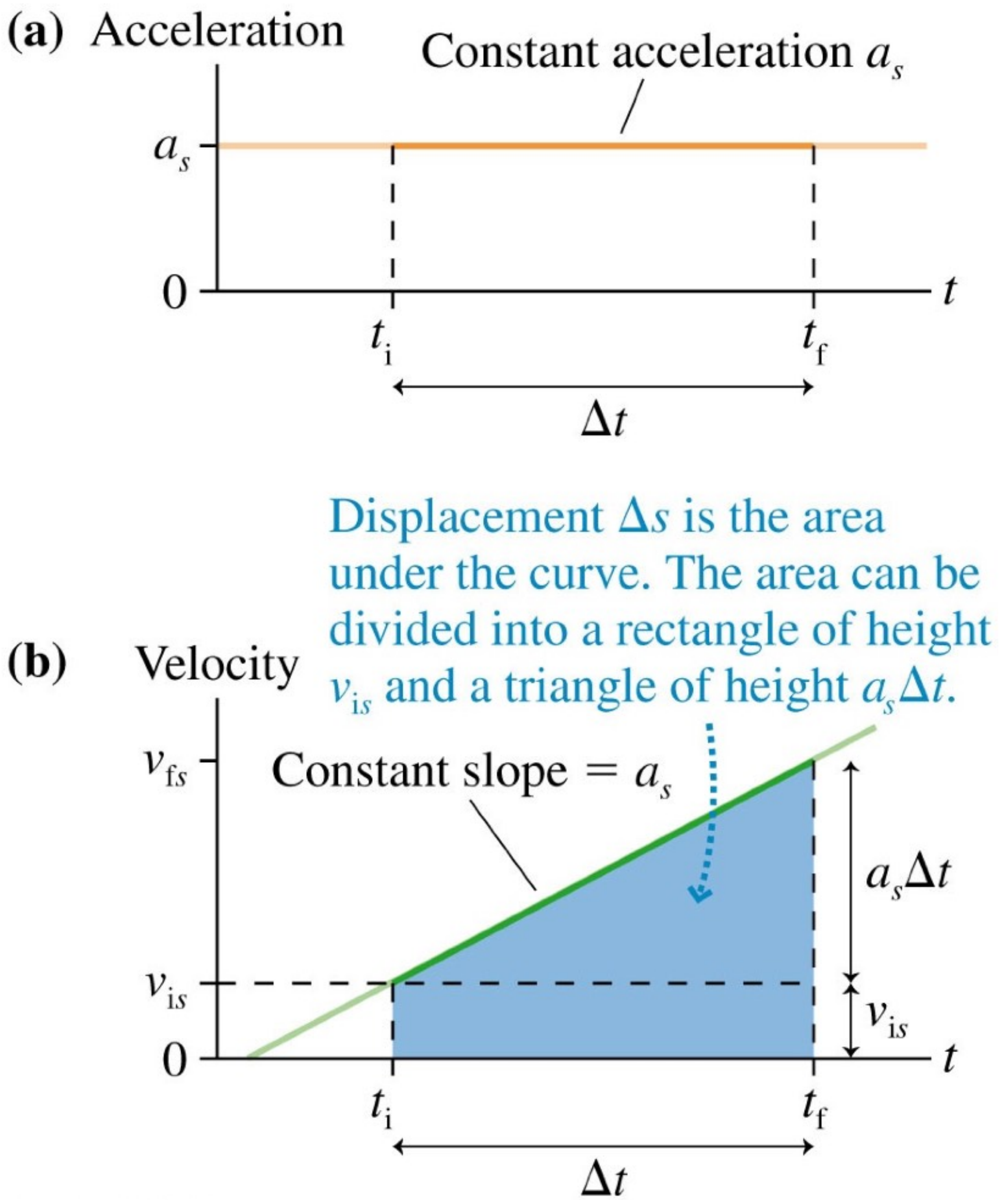
The initial velocity is 20 m/s and the initial position is 10 m.

Kinematic Equations for **constant** acceleration

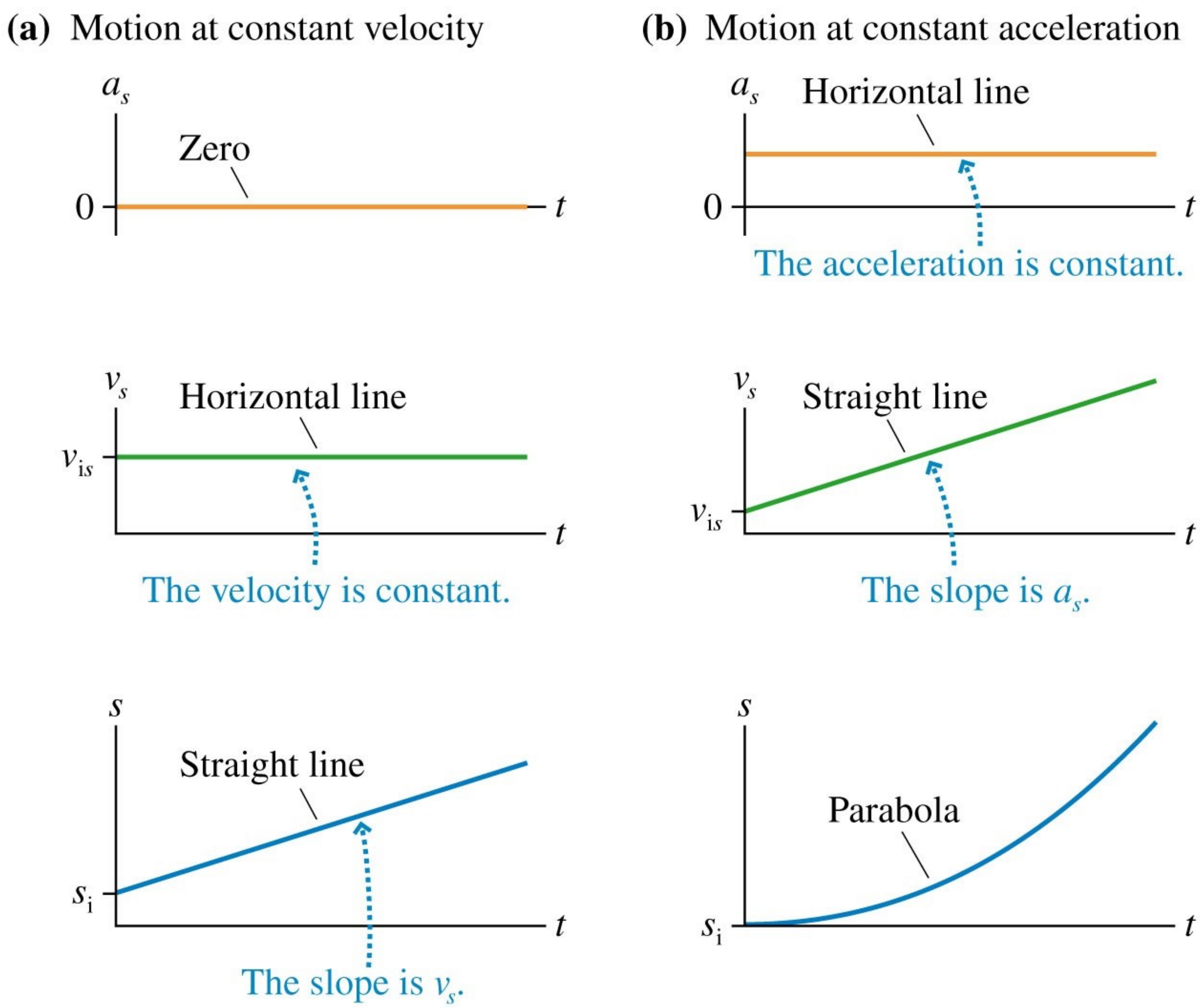
$$v_f = v_i + a\Delta t$$

$$x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$$

$$v_f^2 = v_i^2 + 2a\Delta x$$



The Kinematic Equation of Constant Acceleration

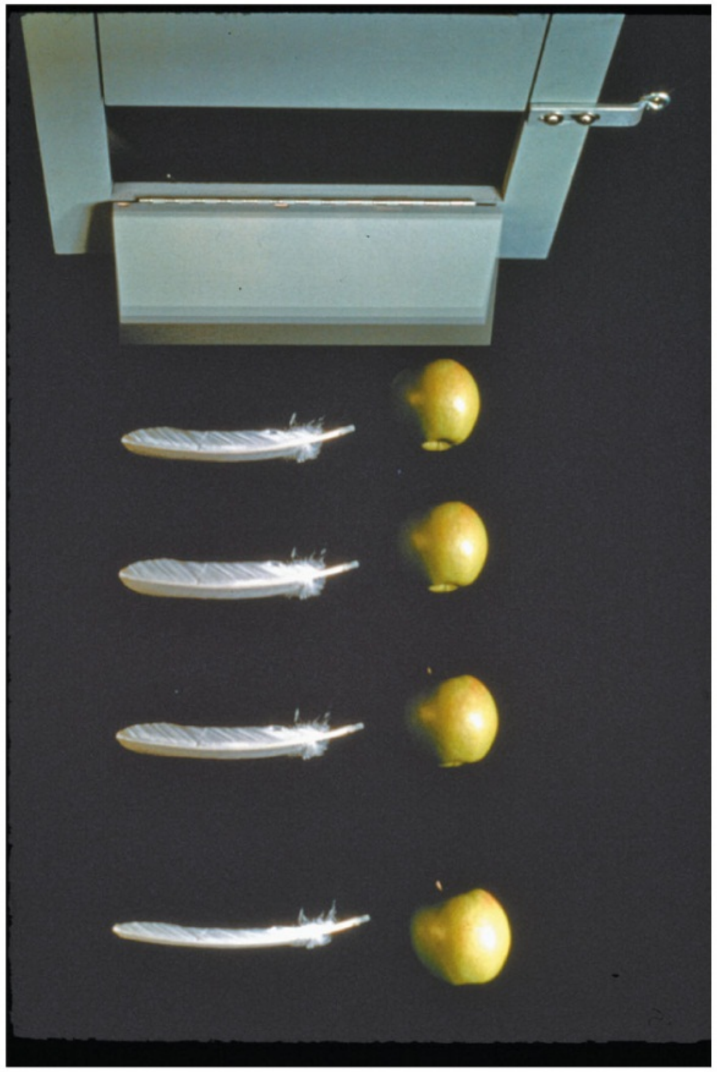


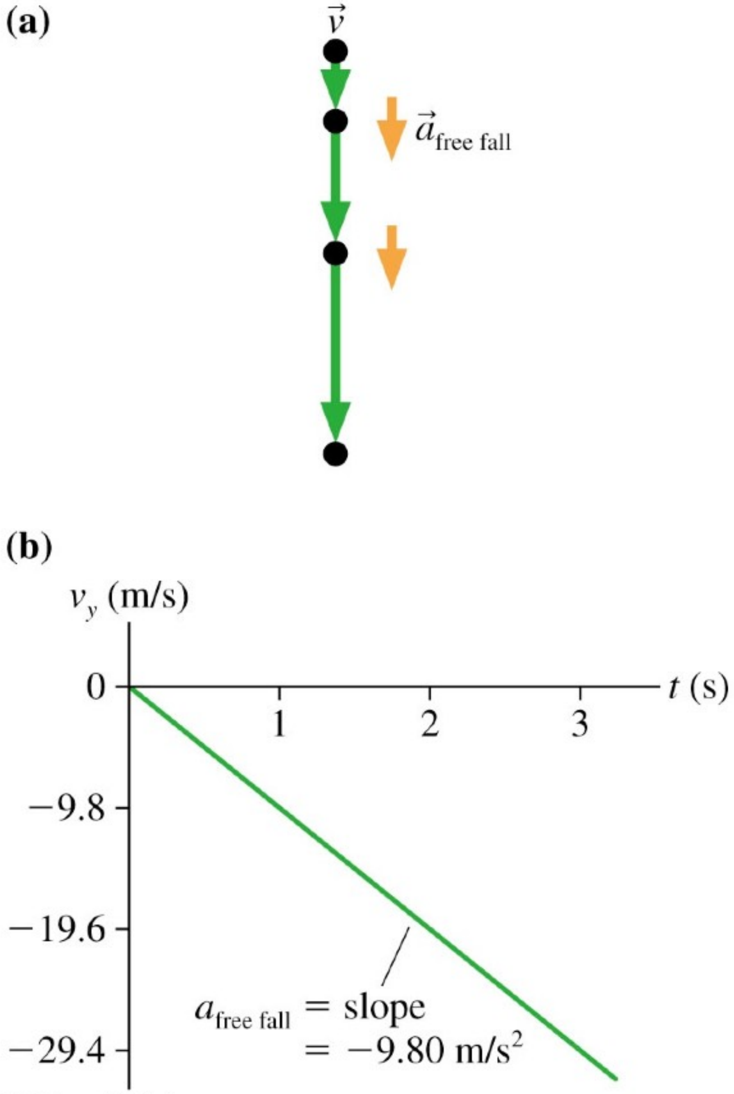
Let’s do a problem!

You are driving to the grocery store at 20 m/s. You are 110 m from an intersection when the traffic light turns red. Your reaction time is 0.5 s and your car brakes at constant acceleration.

- How far are you from the intersection when you begin to brake?
- What acceleration will bring you to rest right at the intersection?
- How long does it take you to stop after the light turns red?

Free fall (acceleration due to gravity)





$$\vec{a}_{\text{free fall}} = (9.80\ \text{m/s}^2,\ \text{vertically downward})$$

Galileo was right

Question #15

A ball is tossed straight up in the air. At its very highest point, the ball's acceleration vector $\vec{a}$

a. Points up.

b. Is zero.

c. Points to the left.

d. Points down.

Question #15

A ball is tossed straight up in the air. At its very highest point, the ball's acceleration vector $\vec{a}$

a. Points up.

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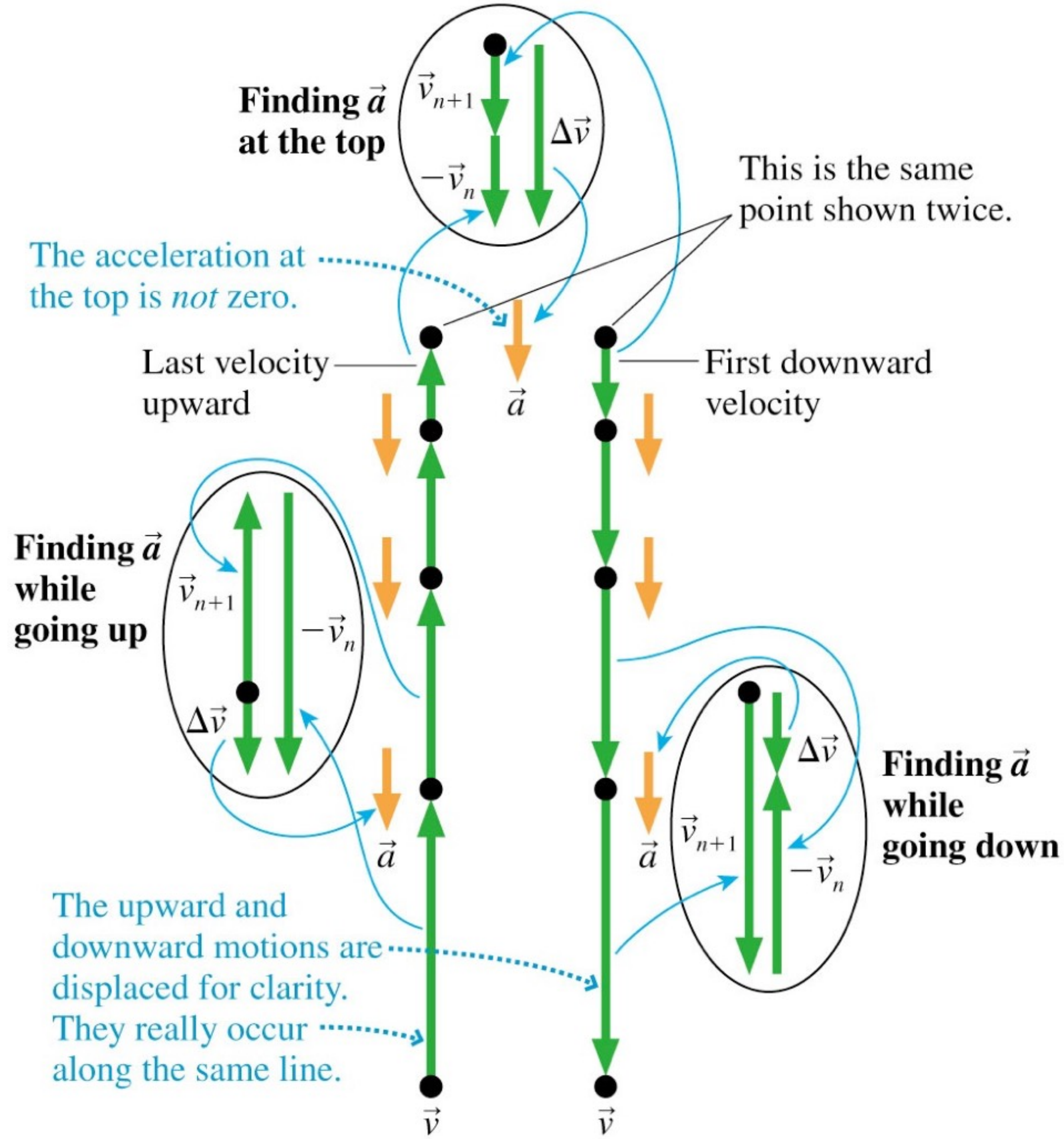
c. Points to the left

d. Points down.

In fact, the acceleration vector points down as the ball rises, at the highest point, and as it falls.



Question #16

A rock is tossed straight up from the ground level with an initial speed of 20 m/s. When it returns it falls into a 10-m deep hole. How fast is it going when it hits the bottom of the hole?

This is a one-equation problem. Which equation is the best choice to answer the question?

a) Equation I
b) Equation II
c) Equation III
d) Both I and III would work.

I $$v_f = v_i + a\Delta t$$

II $$x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$$

III $$v_f^2 = v_i^2 + 2a\Delta x$$

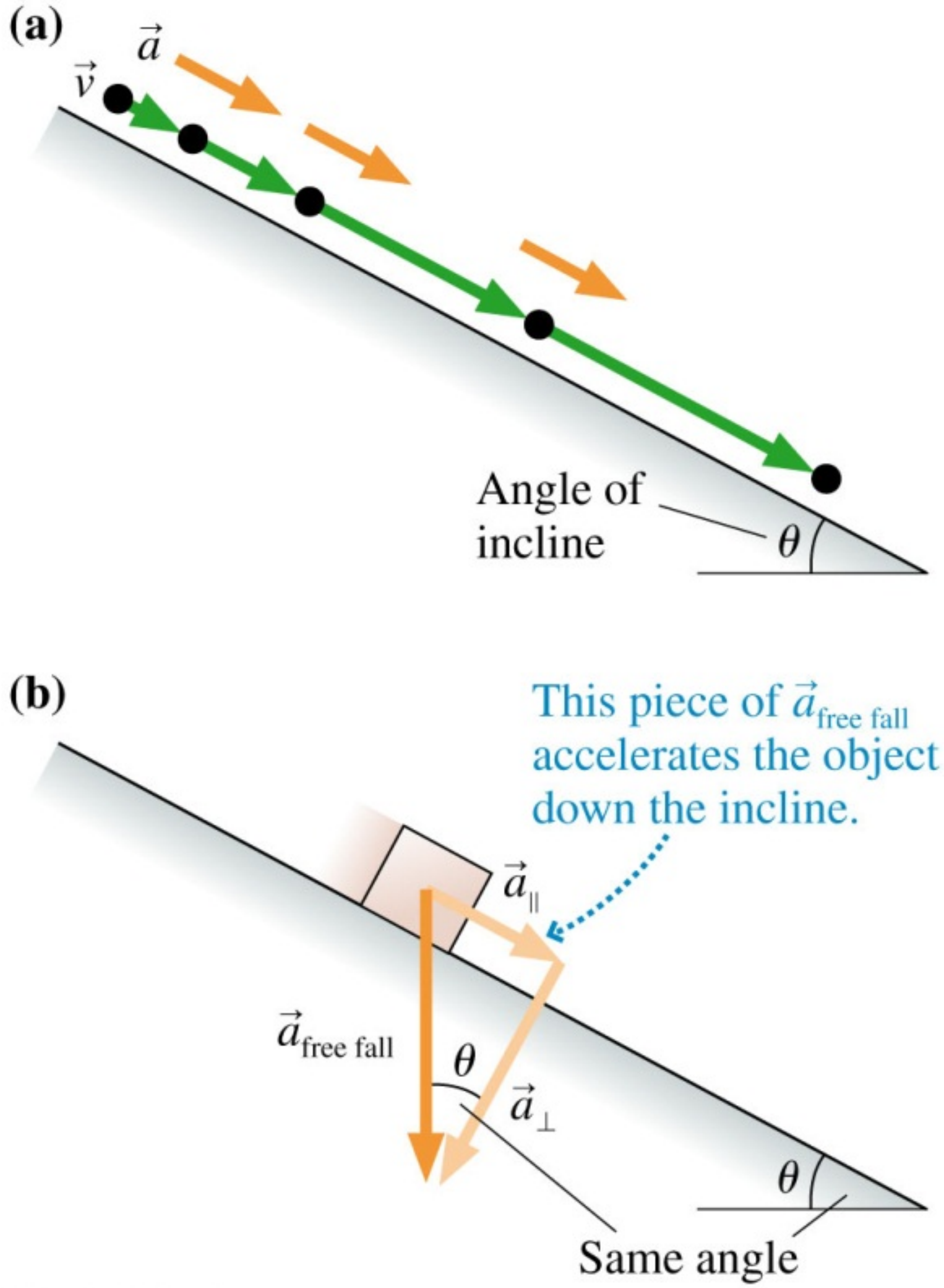
Vertical Kinematics

A 200 kg weather rocket is loaded with 100 kg of fuel and fired straight up. It accelerates upward at 30 m/s^2 for 30 s, then runs out of fuel.

a)What is the rocket's max altitude
b) How long is the rocket in the air before hitting the ground.

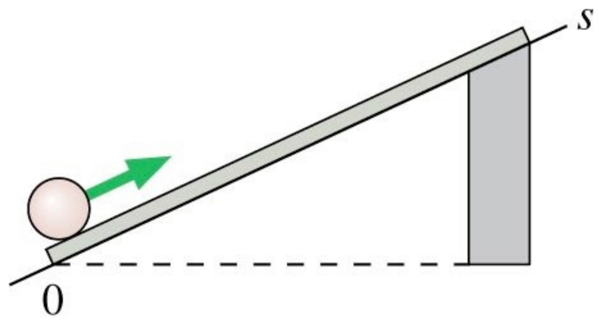
Motion on an incline

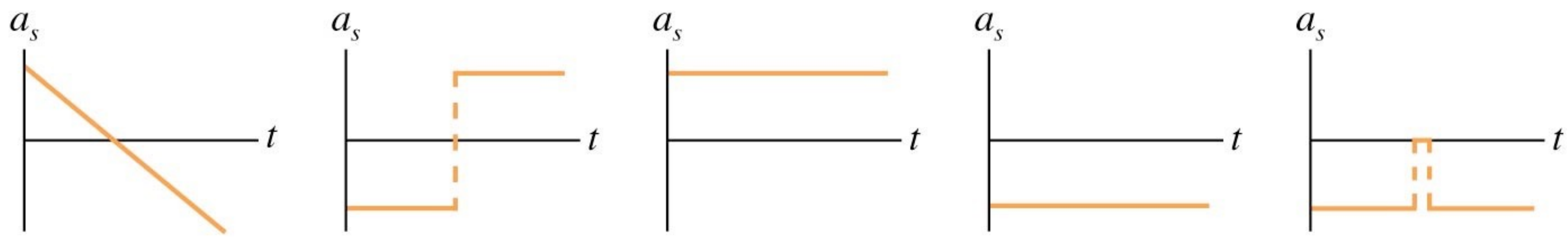
$$a_s = \pm g \sin\theta$$



Question #17

A ball rolls up the ramp, and then rolls back down. Which is the correct acceleration graph?





B D C A E

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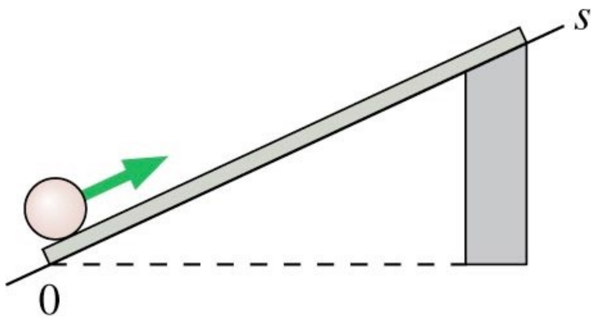
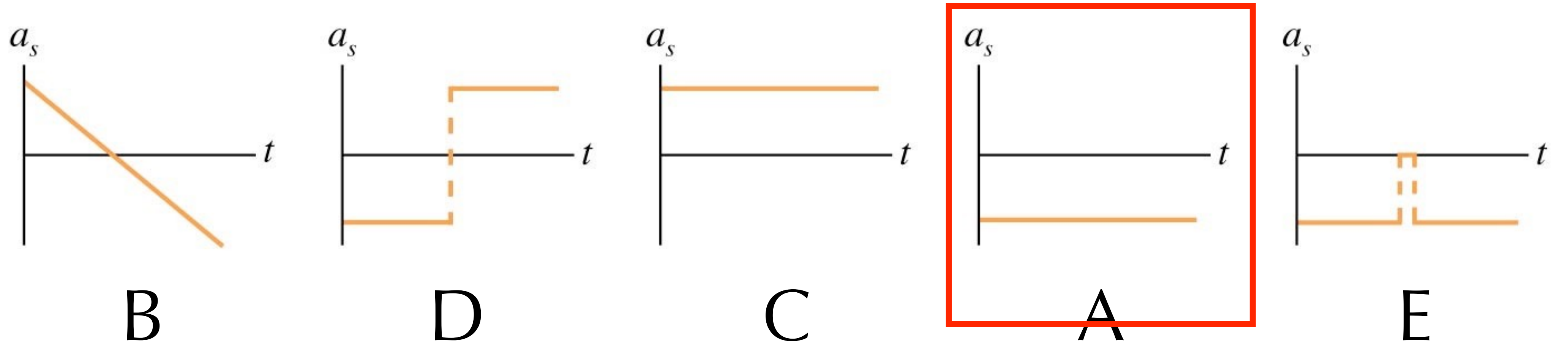




Question #18

A car traveling 30 m/s runs out of gas on a 10 degree incline. How far up the hill will it coast before starting to roll back down?

This is a one-equation problem. Which equation is the best choice to answer the question?

a) Equation I
b) Equation II
c) Equation III
d) Both I and III would work.

I $$v_f = v_i + a\Delta t$$

II $$x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$$

III $$v_f^2 = v_i^2 + 2a\Delta x$$

You try

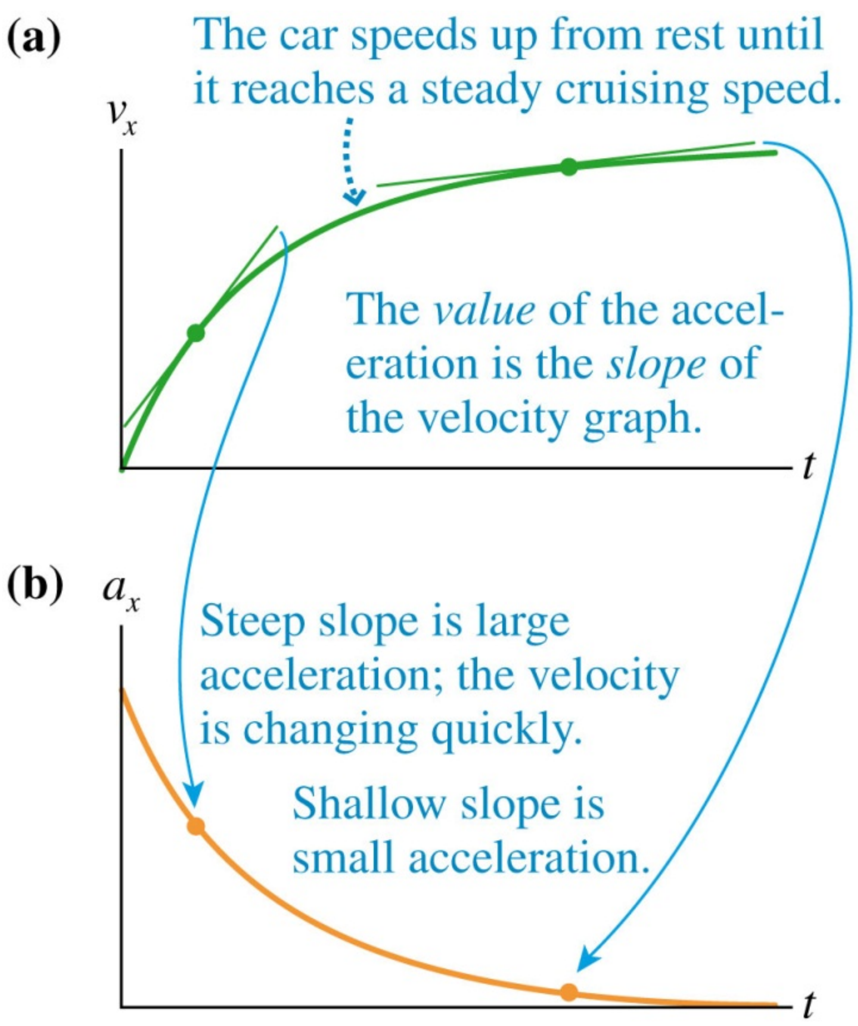
A car is driving along at 25 m/s when it begins to go down a hill with a slope of 20 degrees. You immediately let off the gas and allow the slope of the hill to take you down without braking. If your speed is 60 m/s at the bottom of the hill, how far did you travel?

Instantaneous acceleration

$$v_f = v_i + a\Delta t$$

$$x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2$$

$$v_f^2 = v_i^2 + 2a\Delta x$$



$$v_f = v_i + \int a\ dt$$

Instantaneous acceleration

$$\cancel{v_f = v_i + a\Delta t}$$

$$\cancel{x_f = x_i + v_i\Delta t + \frac{1}{2}a(\Delta t)^2}$$

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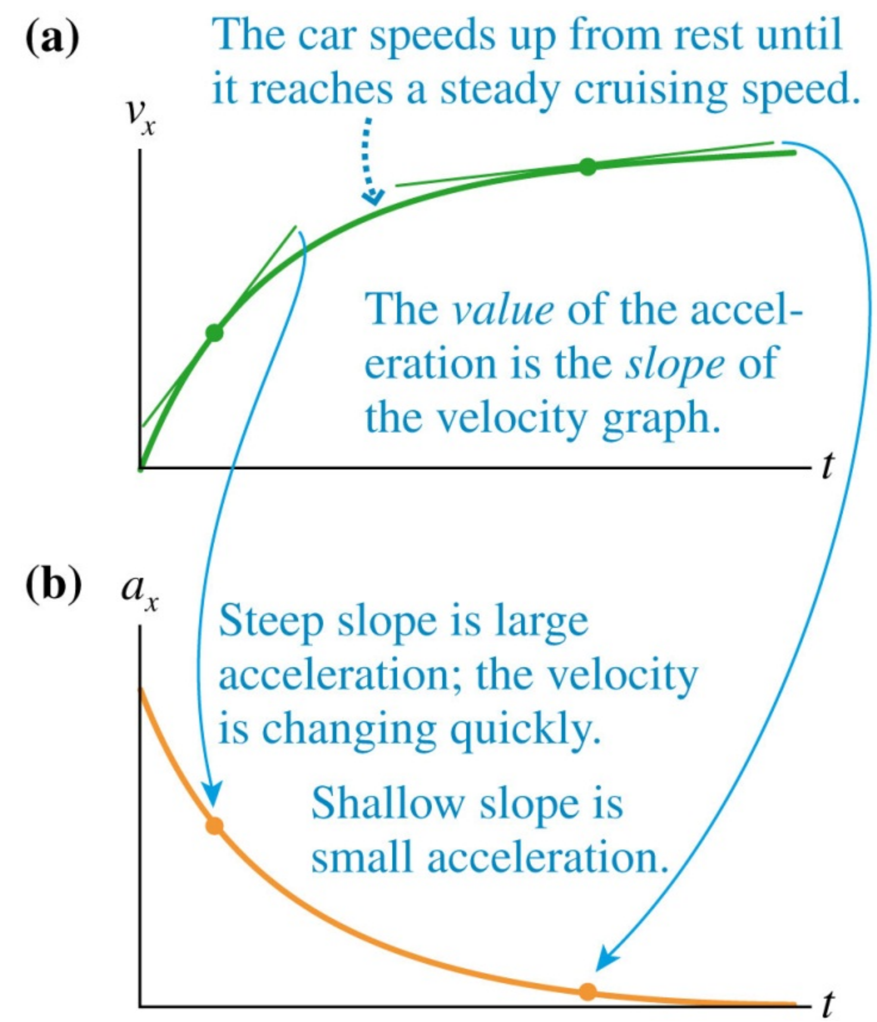
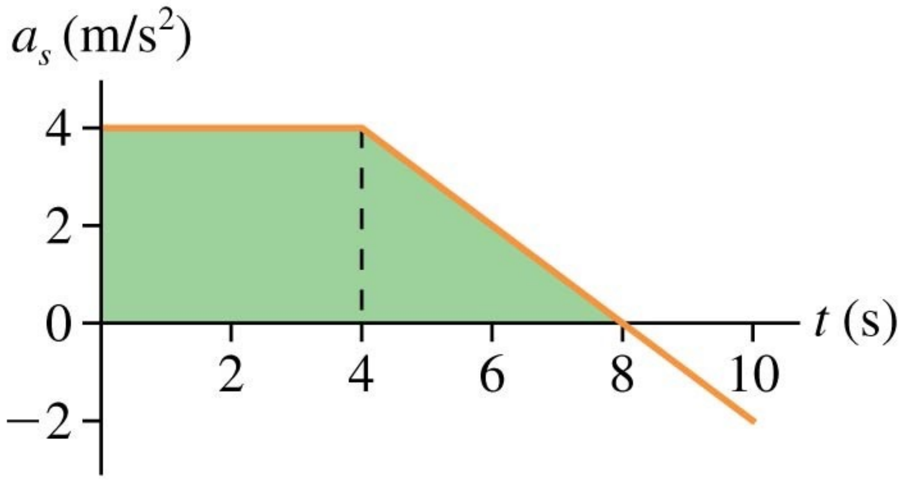


$$v_f = v_i + \int a \, dt$$

Question #25

The figure below shows the acceleration graph for a particle with an initial velocity of 10 m/s. What is the particle's velocity at t = 8 s?

a. 24 m/s
b. 32 m/s
c. 16 m/s
d. 26 m/s
e. 34 m/s



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