1. The speed of light is 3.00×10^8 m/s . What is the distance that light travels in 1 year?

A) 5.64×10^{13} m
B) 4.37×10^{14} m
C) 6.83×10^{15} m
D) 5.95×10^{16} m
E) 3.75×10^{12} m
F) 2.95×10^{13} m
G) 4.87×10^{14} m
H) 9.46×10^{15} m

$$1\,\text{yr} = (365\,\text{days})(24\,\text{hr/day})(60\,\text{min/hr})(60\,\text{s/min}) = 3.154\times10^7\,\text{s}$$
$$d = vt = (3.00\times10^8\,\text{m/s})(3.154\times10^7\,\text{s}) = 9.46\times10^{15}\,\text{m}$$

2. The speed of light is 3.00×10^8 m/s , and the average distance between the Earth and the sun is 1.50×10^8 km . How long does it take for light to travel this distance?

A) 20.2 minutes
B) 2.67 years
C) 9.23 seconds
D) 5.01 minutes
E) 3.03 hours
F) 8.33 minutes
G) 45.3 seconds
H) no time at all

$$t = d/v = (1.50\times10^{11}\,\text{m})/(3.00\times10^8\,\text{ m/s}) = 500\,\text{s} = (500\,\text{s})(1\,\text{min}/60\,\text{s}) = 8.33\text{ min}$$

3. Which one of the following is equal to 8.00 m^3?

A) 8.0×10^{-9} cm^3
B) 8.0×10^{-9} cm^3
C) 8.0×10^{-3} cm^3
D) 8.0×10^{0} cm^3
E) 8.0×10^{3} cm^3
F) 8.0×10^{6} cm^3
G) 8.0×10^{9} cm^3
H) the correct answer is not given

$$8.00\,\text{m}^3(100\text{ cm/m})^3 = 8.00\times10^6\,\text{cm}^3$$

4. The length of three sticks are 0.47 m. 0.62 m and 0.78 m, and are arranged to form a right triangle. What are the three angles of the triangle?

A) 90°, 45°, and 45°
B) 90°, 63°, and 37°
C) 90°, 59°, and 31°
D) 90°, 48°, and 42°
E) 90°, 53°, and 37°
F) 90°, 50°, and 40°
G) 90°, 65°, and 15°
H) 90°, 43°, and 37°

$$\theta_R = 90°$$
$$\theta_1 = \sin^{-1}(0.47/0.78) = 37°$$
$$\theta_2 = 90° - \theta_1 = 53°$$

5. A force vector $\vec{\mathbf{F}}_1 = a\hat{\mathbf{i}}$ and a second force vector $\vec{\mathbf{F}}_2 = b\hat{\mathbf{i}} + c\hat{\mathbf{j}}$ both act on an object. A third force vector $\vec{\mathbf{F}}_3$ must act on the object if the sum of the three forces is zero. What is $\vec{\mathbf{F}}_3$?

A) $-(a+b+c)(\hat{\mathbf{i}}+\hat{\mathbf{j}})$
B) $-\sqrt{a^2+b^2}\hat{\mathbf{i}} - c\hat{\mathbf{j}}$
C) $(a-b)\hat{\mathbf{i}} + c\hat{\mathbf{j}}$
D) $-(a+b)\hat{\mathbf{i}} - c\hat{\mathbf{j}}$
E) $(a+b+c)(\hat{\mathbf{i}}+\hat{\mathbf{j}})$
F) $-\sqrt{(a^2+b^2-c^2)}(\hat{\mathbf{i}}+\hat{\mathbf{j}})$
G) $(a+b)\hat{\mathbf{i}} + b\hat{\mathbf{j}}$
H) $-\sqrt{(a^2+b^2+c^2)}(\hat{\mathbf{i}}+\hat{\mathbf{j}})$

6. In which of the following situations does the car have a westward acceleration?

A) When a child throws a rock westward from the car traveling eastward.
B) The car travels eastward and speeds up.
C) The car travels westward and slows down.
D) The car travels eastward and slows down.
E) The car starts from rest and moves toward the east.
F) The car starts moving westward but later is moving eastward.
G) The car travels westward at constant speed.
H) The car has a westward acceleration in all of the cases above

Let East be positive and West be negative.
Car going East slows down ($v_{0x} > v_x$)
If $v_{0x} > v_x \Rightarrow a_x = (v_x - v_{0x})/t$ is negative!
a_x is westward.

7. A car is moving at a constant velocity when it is involved in a collision. The car comes to rest after 0.450 s with an average acceleration of 60.0 m/s^2 in the direction opposite that of the car's velocity. What was the speed, in km/h, of the car before the collision?

A) 29.2 km/hr
B) 44.8 km/hr
C) 97.2 km/hr
D) 105 km/hr
E) 144 km/hr
F) 205 km/hr
G) 75.0 km/hr
H) 133 km/hr

$v_x = v_{0x} + at$

$v_{0x} = v_x - at = 0 - (-60.0\,\text{m/s}^2)(0.450\,\text{s})$

$= 27.0\,\text{m/s (1 km/1000m)(3600 s/hr)} = 97.2\text{ km/hr}$

8. A car starts from rest and accelerates at a constant rate in a straight line. In the first second the car moves a distance of 2.0 meters. How fast will the car be moving at the end of the second second?

A) 4.0 m/s
B) 16 m/s
C) 2.0 m/s
D) 32 m/s
E) 8.0 m/s
F) 0.25 m/s
G) 1.0 m/s
H) 0.5 m/s

$\Delta x = v_{0x}t + \frac{1}{2}at^2; \quad a = 2\Delta x/t^2 = 2(2\text{m}/1\text{s}^2) = 4\,\text{m/s}^2$

$v_x = v_{0x} + at = (4\,\text{m/s}^2)(2\text{ s}) = 8\text{ m/s}$

9. The minimum takeoff speed for a certain airplane is 75.0 m/s. If the plane starts from rest at one end of the runway what minimum acceleration is required if the plane must leave a runway of length 1050 m?

A) 1.50 m/s^2
B) 3.09 m/s^2
C) 4.53 m/s^2
D) 6.02 m/s^2
E) 2.68 m/s^2
F) 3.57 m/s^2
G) 5.39 m/s^2
H) 6.73 m/s^2

$v_x^2 = v_{0x}^2 + 2a\Delta x$

$a = v_x^2/2\Delta x = (75\text{m/s})^2/2100\,\text{m} = 5 = 2.68\,\text{m/s}^2$

10. A brick is dropped from rest from a height of 4.9 m. Assuming no air resistance, how long does it take for the brick to reach 1.0 m from the ground? (Hint: what is Δx ?)

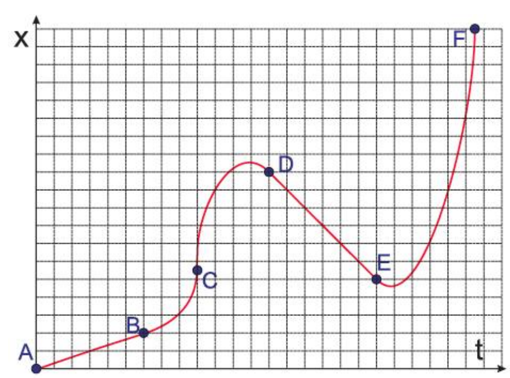
A) 0.623 s
B) 1.00 s
C) 1.24 s
D) 1.47 s
E) 2.00 s
F) 0.892 s
G) 0.555 s
H) 4.90 s

$\Delta y = (1.00 - 4.90)\,\text{m} = -3.90\,\text{m}$

$\Delta y = v_{0y}t + \frac{1}{2}a_y t^2$

$t = \sqrt{2\Delta y/a_y} = \sqrt{2(-3.90\text{m})/-9.80\,\text{m/s}^2} = 0.892\text{ s}$

11. Consider the plot of position vs. time shown on the right. The point "A" is at (t = 0, x = 0).



What are the regions where the velocity is negative and constant throughout?

A) AB
B) BC
C) AB & BC
D) CD
E) CD & DE
F) DE
G) DE and EF
H) EF

12. In the same plot, what are the regions where the acceleration is negative throughout?

A) AB
B) BC
C) AB & BC
D) CD
E) CD & DE
F) DE
G) DE and EF
H) EF

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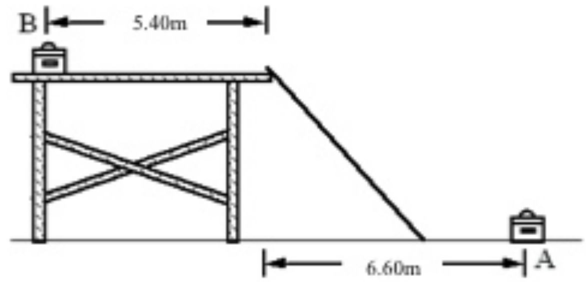
13. A toolbox sits at point A. It is then moved to the left, up the ramp and over to point B on a scaffold 5.00 high. What is the magnitude of its displacement in the movement from point A to point B?



A) 15.3 m
B) 18.10 m
C) 13.0 m
D) 17.0 m
E) 19.7 m
F) 11.6 m
G) 12.0 m
H) none of the choices is correct

$\Delta x = (6.60 + 5.40)\,\text{m} = 12.0\,\text{m}; \ \Delta y = 5.00\,\text{m};$

$d = \sqrt{12^2 + 5^2}\ \text{m} = 13\,\text{m}$

14. An eagle is flying due east at 8.90 m/s carrying a gopher in its talons. The gopher manages to break free at a height of 14.0 m. What is the magnitude of the gopher's velocity as it reaches the ground? Note: effects of air resistance are not included in this calculation.

A) 22.3 m/s
B) 17.7 m/s
C) 11.4 m/s
D) 9.81 m/s
E) 8.90 m/s
F) 16.4 m/s
G) 12.8 m/s
H) 18.8 m/s

$v_x = v_{0x} = 8.90\ \text{m/s}; \quad \Delta y = -14.0\ \text{m}; \quad v_y^2 = v_{0y}^2 - 2g\Delta y$

$v_y^2 = 275\ \text{m}^2/\text{s}^2$

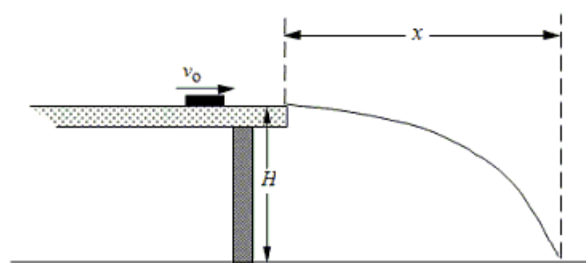
$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(8.9)^2 + 275}\,\text{m/s} = 18.8\ \text{m/s}$

15. A football is kicked at an angle of 37.3° with respect to the horizontal. Which one of the following statements best describes the kinematics of the football during this event if air resistance is neglected?

A) The acceleration is 9.81 m/s^2 before the football leaves the players foot.
B) The acceleration is zero m/s^2 during the entire free flight
C) The acceleration is 9.81 m/s^2 during the entire free flight
D) The acceleration is zero m/s^2 when the football reaches the highest point in its trajectory.
E) The velocity of the football remains constant during the entire flight
F) The velocity is higher at the beginning of the flight than it is at the end of the flight.
G) The acceleration starts at 9.8 m/s^2 and drops to a lower value just above the ground.
H) The acceleration is greater than 9.81 m/s^2 if the football is spinning rapidly.

16. A puck slides across a smooth, level tabletop at height H at a constant speed v_0. It slides off the edge of the table and hits the floor a distance x away as shown in the figure.

What equation relates x to the given: H and v_0?



A) $x = v_0^2\sqrt{\dfrac{H}{2g}}$

B) $x = \dfrac{v_0^2}{2gH}$

C) $x = \dfrac{v_0^2}{gH}$

D) $x = \dfrac{2H}{gv_0^2}$

E) $x = g\sqrt{\dfrac{v_0^2}{2H}}$

F) $x = v_0\sqrt{\dfrac{2H}{g}}$

G) $x = \dfrac{gH}{v_0^2}$

H) $x = v_0\sqrt{\dfrac{gH}{v_0^2}}$

$v_x = v_0; \quad \Delta y = v_{0y}t - \tfrac{1}{2}gt^2 = -H$

$2H/g = t^2 \quad t = \sqrt{2H/g}$

$x = v_x t = v_0\sqrt{2H/g}$