WA3 Answer Key

Monday, August 19, 2019 12:49 PM

1. Question Details OSColPhysAP2016 2.5.P.022. [3604496]

A bullet in a gun is accelerated from the firing chamber to the end of the barrel at an average rate of 6.40×10^5 m/s^2 for 9.30×10^{-4} s. What is its muzzle velocity (in m/s) (that is, its final velocity)? (Enter the magnitude.)

[ ] 595 m/s

~~$\Delta x =$~~
$V_i = 0$
$V_f = ?$
$a = 6.4 \times 10^5$ m/s^2
$t = 9.3 \times 10^{-4}$ s

$V_f = V_i + at$
$V_f = 0 + (6.4 \times 10^5)(9.3 \times 10^{-4})$
$\boxed{V_f = 595.2 \text{ m/s}}$

2. Question Details

A powerful motorcycle can accelerate from rest to 26.8 m/s (60 mi/h) in only 1.90 s. $V_i = 0$

(a) What is its average acceleration in m/s^2? a?

[ ] 14.1 m/s^2

(b) How far does it travel in that time? Δx?

[ ] 25.5 m

$\Delta x = ?$
$V_i = 0$
$V_f = 26.8$
$a = ?$
$\Delta t = 1.9$ s

a) $V_f = V_i + at$
$26.8 = 0 + a(1.9)$
$\boxed{a = 14.1 \text{ m/s}^2}$

b) $\Delta x = \cancel{V_i t} + \frac{1}{2}at^2$
$\Delta x = \frac{1}{2}(14.1)(1.9)^2$
$\boxed{\Delta x = 25.46 \text{ m}}$

3. Question Details OSColPhysAP2016 2.5.P.031. [3652804]

A swan on a lake gets airborne by flapping its wings and running on top of the water.

(a) If the swan must reach a velocity of 5.80 m/s to take off and it accelerates from rest at an average rate of 0.325 m/s^2, how far (in m) will it travel before becoming airborne? Δx $V_i = 0$

[ ] 51.8 m

(b) How long (in s) does this take? Δt

[ ] 17.8 s

$\Delta x = ?$
$V_i = 0$
$V_f = 5.8$
$a = 0.325$
$\Delta t = ?$

$V_f^2 = \cancel{V_i^2} + 2a\Delta x$
$(5.8)^2 = 2(0.325)\Delta x$
$\boxed{\Delta x = 51.8 \text{ m}}$

$V_f = V_i + at$
$5.8 = 0 + (0.325)t$
$\boxed{t = 17.8 \text{ s}}$

4. Question Details OSColPhysAP2016 2.5.P.038. [3604706]

A bicycle racer sprints at the end of a race to clinch a victory. The racer has an initial velocity of 11.5 m/s and accelerates at the rate of 0.650 m/s^2 for 7.00 s.

(a) What is his final velocity (in m/s)?

[ ] 16.1 m/s

$V_f = V_i + at$
$= 11.5 + (0.650)(7)$
$\boxed{V_f = 16.05 \text{ m/s}}$

(b) The racer continues at this velocity to the finish line. If he was 300 m from the finish line when he started to accelerate, how much time (in s) did he save?

[ ] 6.4 s

300 m at constant speed of 11.5 = $\boxed{26.09 \text{ s}}$
300 m + acceleration + constant speed of 16.1 m/s = 12.68 + 7 = $\boxed{19.68 \text{ s}}$
26.09 − 19.68 = $\boxed{6.4 \text{ s}}$

(c) One other racer was 5.00 m ahead when the winner started to accelerate, but he was unable to accelerate and traveled at 11.6 m/s until the finish line. How far ahead of him (in meters and in seconds) did the winner finish?

distance [ ] 66.7 m

time [ ] 5.75 s

time [ ] 5.75 s

b.i. How much distance did the biker cover during the 7 sec accel?

$\Delta x = V_i t + \frac{1}{2} a t^2$

$= (11.5)(7) + \frac{1}{2}(0.65)(7)^2$

$\boxed{\Delta x = 96.425 \text{ m}}$

ii. What was the remaining distance that they traveled at constant velocity of 16.05 m/s?

$300 - 96.425 = \boxed{203.575 \text{ m}}$

$V = \frac{d}{t} \qquad t = \frac{d}{V} = \frac{203.575}{16.05} = \boxed{12.68 \text{ s}}$ (constant velocity)

7 sec (accel) + 12.68 s (constant velocity) = $\boxed{19.68 \text{ s}}$

c. $\Delta x = 295$ m

$V = 11.6$ m/s $\rightarrow \Delta t = 25.4$ s

$25.4 - 19.68 = \boxed{5.75 \text{ s}}$

@ 19.68 s, where was the 2nd biker?

$\Delta x = v \cdot t$

$= (11.6)(19.68)$

$= 228.3$ m

$295 - 228.3 = \boxed{66.7 \text{ m}}$

5. Question Details OSColPhysAP2016 2.5.P.040. [3652997]

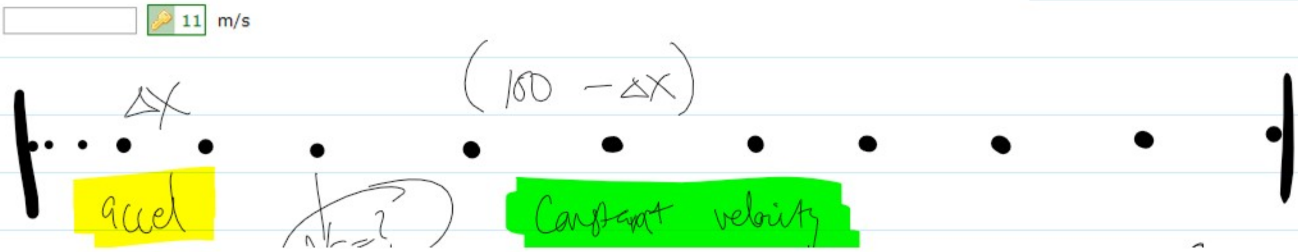
(a) A world record was set for the men's 100 m dash in the 2008 Olympic Games in Beijing by Usain Bolt of Jamaica. Bolt "coasted" across the finish line with a time of 9.69 s. If we assume that Bolt accelerated for 2.36 s to reach his maximum speed, and maintained that speed for the rest of the race, calculate his maximum speed (in m/s) and his acceleration (in m/s^2).

maximum speed [ ] 11.8 m/s

acceleration [ ] 4.98 m/s^2

(b) During the same Olympics, Bolt also set the world record in the 200 m dash with a time of 19.30 s. Using the same assumptions as for the 100 m dash, what was his maximum speed for this race (in m/s)?

[ ] 11 m/s



accel $V_f = ?$ Constant velocity

0 time = 2.36 s $t_{constant} = 7.33$ s 9.69 s

accel

$\Delta x = ?$ $\Delta x = (100 - \Delta x_{accel})$

$V_i = 0$ $V_i = V_f$

$V_f = ?$ $\xrightarrow{\text{same}}$ $V_f = V_f$

$a = ?$ $a = \emptyset$

$\Delta t = 2.36$ $\Delta t = 7.33$

$$V_f = V_i + at$$
$$V_f = 2.36\,a \longrightarrow (100 - \Delta x_{accel}) = V_f \cdot 7.33$$
$$100 - \Delta x_{accel} = (2.36\,a)(7.33)$$
$$\Delta x_{accel} = 100 - 17.3\,a$$

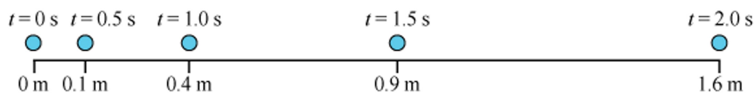
$$V_f^2 = \cancel{V_i^2} + 2a\,\Delta x$$
$$(2.36\,a)^2 = 0 + 2a\,(100 - 17.3\,a)$$
$$5.57\,a^2 = 200\,a - 34.6\,a^2$$
$$40.17\,a^{\cancel{2}} = 200\,\cancel{a}$$
$$\boxed{a = 4.98\ m/s^2}$$

$$\boxed{V_f = (2.36)(4.98) = 11.75\ m/s}$$

Windows

6. Question Details — OSColPhysAP2016 2.5.WA.016.Tutorial. [357022

A remote controlled toy car starts from rest and begins to accelerate in a straight line. The figure below represents "snapshots" of the car's position at equal 0.5 s time intervals. (Assume the positive direction is to the right. Indicate the direction with the sign of your answer.)



(a) What is the car's average velocity in the interval between t = 0.5 s to t = 1.0 s?

0.6 m/s

$V_{avg} = \frac{\Delta x}{\Delta t} = \frac{0.3\ m}{0.5\ s} = \boxed{0.6\ m/s}$

(b) Using data from t = 0.5 s to t = 1.5 s, what is the car's acceleration at t = 1.0 s?

0.8 m/s^2

$V_{0.5} = \frac{0.1}{0.5} = 0.2\ m/s \quad V_{1.5} = \frac{0.9}{1.5} = 0.6\ m/s \quad a_{avg} = \frac{\Delta V}{\Delta t} = \frac{0.9 - 0.1}{1.5 - 0.5} = \frac{0.8}{1.0}$

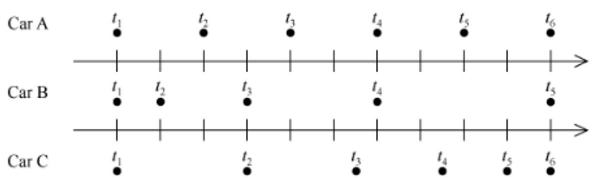
$\boxed{a_{avg} = 0.8\ m/s^2}$

(c) Is the car's speed increasing or decreasing with time?

- increasing
- decreasing
- constant
- not enough information

7. Question Details — OSColPhysAP2016 2.5.WA.017. [3570072]

Suppose you are looking down from a helicopter at three cars traveling in the same direction along a freeway. The positions of the three cars every 2 seconds are represented by dots on the diagram. The positive direction is to the right.



(a) Which car is traveling at a constant speed?

- Car A
- Car B
- Car C
- All cars are traveling at a constant speed.
- None of the cars are traveling at a constant speed.

equal spaced dots

(b) During which time interval do Car A and Car B have the same average speed?

- t_1 to t_2
- t_2 to t_3
- t_3 to t_4
- t_4 to t_5

2 spaces

(c) Which car has the greatest average velocity during the time interval t_1 to t_2?

- Car A
- Car B
- Car C

3 spaces

(d) Which car has the greatest average velocity during the time interval t_4 to t_5?

- Car A

(d) Which car has the greatest average velocity during the time interval t_4 to t_5?

- Car A
- Car B
- Car C

4 spaces

(e) At which time does Car B catch up with Car A?

- t_2
- t_3
- t_4
- t_5

same location

(f) During what time interval does Car C pass Car A?

- t_1 to t_2
- t_2 to t_3
- t_3 to t_4
- t_4 to t_5

(g) At what time does Car A catch Car C?

- t_2
- t_3
- t_4
- t_5
- t_6

(h) During what time interval does Car B pass Car C?

- t_1 to t_2
- t_2 to t_3
- t_3 to t_4
- t_4 to t_5

(i) Which car has an acceleration in the positive direction?

- Car A — no acceleration
- Car B
- Car C – deceleration

(j) Which car has an acceleration in the negative direction?

- Car A
- Car B
- Car C

8. Question Details OSColPhysAP2016 2.5.WA.025. [3570260]

A particular airplane will reach liftoff at a speed of 120 km/h. Convert!

(a) What minimum constant acceleration does the airplane require for it to liftoff after a takeoff run of 280 m? (Enter the magnitude only.)

1.98 m/s^2

(b) How long does it take the airplane to reach liftoff speed?

16.8 s

a) $\frac{120 \text{ km}}{\text{h}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ h}}{60 \text{ mins}} \times \frac{1 \text{ min}}{60 \text{ s}} = 33.\overline{3} \text{ m/s}$

$\Delta x = 280 \text{ m}$

$V_i = 0$

$V_f = 33.3$

$a = ?$

$t =$

$V_f^2 = \cancel{V_i^2} + 2a\Delta x$

$33.3^2 = 0 + 2a(280)$

$\boxed{a = 1.98 \text{ m/s}^2}$

b) $\Delta x = \cancel{V_i t} + \frac{1}{2}at^2$

$280 = 0 + \frac{1}{2}(1.98)t^2$

$\boxed{t = 16.6 \text{ s}}$