key

Physics 112

Extra - Uniformly Accelerated Motion Problems

1. A car travelling at 28.0 m/s [E] slows down for a stoplight. If it takes the car 8.0 s to come to a complete stop, what is the displacement of the car while it is coming to a stop?

2. If a motorcycle with an initial velocity of 12 m/s [N] accelerates at 4.0 m/s^2 [N] how long will it take for the motorcycle to have a final velocity of 30 m/s [N]?

3. A runner off the starting block accelerates at 2.0 m/s^2 [S] for 3.0 s. What is his displacement?

4. A golf ball rolls up a steep hill. It is initially travelling at 25 m/s and slows down with an acceleration with a magnitude of 5.0 m/s^2. Find its displacement after 15 s.

5. What is the acceleration of a truck that takes 8.5 s to decrease its speed from 35 m/s to 5.0 m/s?

6. It takes a car 6.5 s to accelerate from rest to a final velocity of 24 m/s. What is the acceleration of the car?

7. An airplane accelerates down a runway at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before takeoff.

8. Upton Chuck is riding the Giant Drop at Great America. If Upton free falls for 2.60 s, what will be his final velocity and how far will he fall?

9. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car and the distance traveled.

10. A feather is dropped on the moon from a height of 1.40 meters. The acceleration of gravity on the moon is 1.67 m/s^2. Determine the time for the feather to fall to the surface of the moon.

11. A car traveling at 22.4 m/s skids to a stop in 2.55 s. Determine the skidding distance of the car.

12. A kangaroo is capable of jumping to a height of 2.62 m. Determine the takeoff speed of the kangaroo.

13. If Michael Jordan has a vertical leap of 1.29 m, then what is his takeoff speed and his hang time (total time to move upwards to the peak and then return to the ground)?

14. The observation deck of tall skyscraper is 370 m above the street. Determine the time required for a penny to free fall from the deck to the street below.

15. A bullet is moving at a speed of 367 m/s when it embeds into a lump of moist clay. The bullet penetrates for a distance of 0.0621 m. Determine the acceleration of the bullet while moving into the clay.

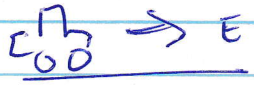
16. It was once recorded that a Jaguar left skid marks that were 290 m in length. Assuming that the Jaguar skidded to a stop with a constant acceleration of 3.90 m/s^2, determine the speed of the Jaguar before it began to skid.

17. A helicopter, traveling at 180 km/h accelerates at 1.6 m/s^2 for 15 s. What is its speed at the end of the 15 s, and how far did it travel during that time?

18. A speedboat covers a distance of 685 m in 22 seconds. If the boat started out going 24 m/s, what was its acceleration and how fast was it going at the end of 22 seconds?

19. A plane flying at 80 m/s is uniformly accelerated at the rate of 2.0 m/s2. What is the distance it will travel during a 10 s interval after acceleration begins?

1.

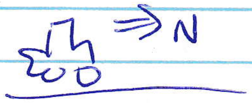


$\vec{v}_i = +28.0 m/s$
$\vec{v}_f = 0 m/s$
$t = 8.0 s$
$\vec{d} = ?$

$$\vec{d} = \frac{1}{2}(\vec{v}_i + \cancel{\vec{v}_f})t$$
$$\vec{d} = \frac{1}{2}(+28.0)(8.0)$$
$$\vec{d} = +1.1 \times 10^2 m$$

The displacement was 1.1×10^2 m E.

2. $\vec{v}_i = +12 m/s$
$\vec{a} = +4.0 m/s^2$
$t = ?$
$\vec{v}_f = +30 m/s$



$$\vec{v}_f = \vec{v}_i + \vec{a}t$$
$$t = \frac{\vec{v}_f - \vec{v}_i}{\vec{a}}$$
$$t = \frac{+30 - (+12)}{+4.0}$$
$$t = 4.5 s$$

3. $\vec{v}_i = 0 m/s$
$\vec{a} = -2.0 m/s^2$
$t = 3.0 s$
$\vec{d} = ?$

(−) South.

$$\vec{d} = \cancel{\vec{v}_i t} + \frac{1}{2}\vec{a}t^2$$
$$\vec{d} = \frac{1}{2}(-2.0)(3.0)^2$$
$$\vec{d} = -9.0 m$$

His displacement is 9.0 m [S].

4.

$\vec{v}_i = +25 m/s$
$\vec{a} = -5.0 m/s^2$
$t = 15 s$
$\vec{d} = ?$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$
$$\vec{d} = (25)(15) + \frac{1}{2}(-5.0)(15)^2$$
$$\vec{d} = -1.9 \times 10^2 m$$

[$t = \frac{0 - 25}{-5.0}$
$t = 5.0 s$ until it stops]

Its displacement was 1.9×10^2 m down the hill.

5. $\vec{a} = ?$

$t = 8.5 s$

$\vec{v}_i = +35 m/s$

$\vec{v}_f = +5.0 m/s$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

$$\vec{a} = \frac{5.0 - 35}{8.5}$$

$$\vec{a} = -3.5 m/s^2$$

The acc. was 3.5 m/s², left.

truck ⇒ right

6. $t = 6.5 s$

$\vec{v}_i = 0 m/s$

$\vec{v}_f = 24 m/s$

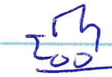
$\vec{a} = ?$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

$$\vec{a} = \frac{24 - 0}{6.5}$$

$$\vec{a} = 3.7 m/s^2$$

The acc. of the car was 3.7 m/s², right.



⇒ right

7. $\vec{v}_i = 0 m/s$

$\vec{a} = 3.20 m/s^2$

$t = 32.8$ ~~m/s~~ s

$\vec{d} = ?$

$$\vec{d} = \cancel{\vec{v}_i t} + \frac{1}{2}\vec{a}t^2$$

$$\vec{d} = \frac{1}{2}(3.20)(32.8)^2$$

$$\vec{d} = +1.72 \times 10^3 m$$

plane ⇒

The distance traveled was 1.72x10³ m.

8. $t = 2.60 s$

$\vec{a} = -9.80 m/s^2$

$\vec{v}_i = 0 m/s$

a) $$\vec{v}_f = \cancel{\vec{v}_i} + \vec{a}t$$

$$\vec{v}_f = (-9.80)(2.60)$$

$$\vec{v}_f = -25.5 m/s$$

His final vel. was 25.5 m/s, down.

b) $$\vec{d} = \cancel{\vec{v}_i t} + \frac{1}{2}\vec{a}t^2$$

$$\vec{d} = \frac{1}{2}(-9.80)(2.60)^2$$

$$\vec{d} = -33.1 m$$

He fell 33.1 m.

9. $\vec{v}_i = 18.5 m/s$
$\vec{v}_f = 46.1 m/s$
$t = 2.47 s$

a) $\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$

$\vec{a} = \frac{46.1-18.5}{2.47}$

$\vec{a} = 11.2 m/s^2$

The acc. of the car is $11.2 m/s^2$, right.

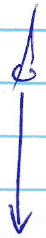
b) $\vec{d} = \frac{1}{2}(\vec{v}_i + \vec{v}_f)t$

$\vec{d} = \frac{1}{2}(18.5 + 46.1)(2.47)$

$\vec{d} = +79.8 m$

The dist. travelled was 79.8m.

10.



$\vec{d} = -1.40 m$
$\vec{a} = -1.67 m/s^2$
$t = ?$
$\vec{v}_i = 0$

$\vec{d} = \cancel{\vec{v}_i t} + \frac{1}{2}\vec{a}t^2$

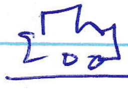
$t = \sqrt{\frac{2\vec{d}}{\vec{a}}}$

$t = \sqrt{\frac{2(-1.40)}{-1.67}}$

$t = 1.29 s$

It took 1.29s.

11.



$\vec{v}_i = +22.4 m/s$
$v_f = 0$
$t = 2.55 s$
$\vec{d} = ?$

$\vec{d} = \frac{1}{2}(\vec{v}_i + \cancel{\vec{v}_f})t$

$\vec{d} = \frac{1}{2}(22.4)(2.55)$

$\vec{d} = +28.6 m$

The skidding distance was 28.6m.

12.

K ⇑

$\vec{v}_f = 0$ m/s

$\vec{d} = +2.62$ m

$\vec{a} = -9.80$ m/s^2

$\vec{v}_i = ?$

$$\cancel{\vec{v}_f}^2 = \vec{v}_i^{\,2} + 2\vec{a}\vec{d}$$

$$\vec{v}_i = \sqrt{-2\vec{a}\vec{d}}$$

$$\vec{v}_i = \sqrt{-2(-9.80)(2.62)}$$

$$\vec{v}_i = +7.17 \text{ m/s}$$

His take off <u>speed</u> was 7.17 m/s.

13.

MJ ↑

$\vec{d} = +1.29$ m

$\vec{v}_i = ?$

$t = ?$

$\vec{a} = -9.80$ m/s^2

$\vec{v}_f = 0$

$$\cancel{\vec{v}_f}^2 = \vec{v}_i^{\,2} + 2\vec{a}\vec{d}$$

$$\vec{v}_i = \sqrt{-2\vec{a}\vec{d}}$$

$$\vec{v}_i = \sqrt{-2(-9.80)(1.29)}$$

$$\vec{v}_i = +5.03 \text{ m/s}$$

His takeoff speed was 5.03 m/s.

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

$$t = \frac{\cancel{\vec{v}_f} - \vec{v}_i}{\vec{a}}$$

$$t = \frac{-(5.03)}{-9.80}$$

$$t = 0.513 \text{ s}$$

hang time = 2(0.513)
= 1.03 s.

His hang time was 1.03 s.

14. $\vec{d} = -370$ m

$\vec{a} = -9.80$ m/s^2

$t = ?$

$\vec{v}_i = 0$ m/s

o ↓

$$\vec{d} = \cancel{\vec{v}_i t} + \frac{1}{2}\vec{a}t^2$$

$$t = \sqrt{\frac{2\vec{d}}{\vec{a}}}$$

$$t = \sqrt{\frac{2(-370)}{-9.80}}$$

$$t = 8.69 \text{ s}$$

It would take 8.69 s

D ⇒ right

15. $\vec{v}_i = +367 m/s$

$\vec{v}_f = 0 m/s$

$\vec{d} = +0.0621 m$

$\vec{a} = ?$

$$\cancel{\vec{v}_f^2} = \vec{v}_i^2 + 2\vec{a}\vec{d}$$

$$-2\vec{a}\vec{d} = \vec{v}_i^2$$

$$\vec{a} = \frac{-\vec{v}_i^2}{2\vec{d}}$$

$$\vec{a} = \frac{-(367)^2}{2(0.0621)}$$

$$\vec{a} = -1.08 \times 10^6 m/s^2$$

The acc. of the bullet was $1.08 \times 10^6 m/s^2$, left.

16. $\vec{d} = 290 m$

$\vec{v}_f = 0 m/s$

$\vec{a} = -3.90 m/s^2$

$\vec{v}_i = ?$

$$\cancel{\vec{v}_f^2} = \vec{v}_i^2 + 2\vec{a}\vec{d}$$

$$\vec{v}_i^2 = -2\vec{a}\vec{d}$$

$$\vec{v}_i = \sqrt{-2(-3.90)(290)}$$

$$\vec{v}_i = +47.6 m/s$$

J ⇒ right

The jaguar's speed was 47.6 m/s.

17.

H ⇒

$\vec{v}_i = +180 km/h = 50.0 m/s$

$\vec{a} = +1.6 m/s^2$

$t = 15 s$

$\vec{v}_f = ?$

$\vec{d} = ?$

~~a~~ $$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$$

$$\vec{v}_f = \vec{v}_i + \vec{a}t$$

$$\vec{v}_f = 50.0 + (1.6)(15)$$

$$\vec{v}_f = 74 m/s$$

Its speed was 74 m/s.

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

$$\vec{d} = 50.0(15) + \frac{1}{2}(1.6)(15)^2$$

$$\vec{d} = +9.3 \times 10^2 m$$

It travelled $9.3 \times 10^2 m$.

18. $\vec{d} = +685 \text{ m}$

$t = 22 \text{ s}$

$\vec{v}_i = 24 \text{ m/s}$

$\vec{a} = ?$

$\vec{v}_f = ?$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

$$\frac{2(\vec{d} - \vec{v}_i t)}{t^2} = \vec{a}$$

$$\vec{a} = \frac{2(685 - (24)(22))}{(22)^2}$$

$$\vec{a} = +0.65 \text{ m/s}^2$$

Boat ⇒ right

Its acc. was 0.65 m/s², right

$$\vec{d} = \frac{1}{2}(\vec{v}_i + \vec{v}_f)t$$

$$\frac{2\vec{d}}{t} - \vec{v}_i = \vec{v}_f$$

$$\vec{v}_f = \frac{2\vec{d}}{t} - \vec{v}_i$$

$$\vec{v}_f = \frac{2(685)}{22} - 24$$

$$\vec{v}_f = 38 \text{ m/s}$$

It was going 38 m/s at the end of 22 s.

19. $\vec{v}_i = 80 \text{ m/s}$

$\vec{a} = 2.0 \text{ m/s}^2$

$\vec{d} = ?$

$t = 10 \text{ s}$

$$\vec{d} = \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

$$\vec{d} = (80)(10) + \frac{1}{2}(+2.0)(10)^2$$

$$\vec{d} = 9.0 \times 10^2 \text{ m}$$

It traveled 9.0×10^2 m.