Key

Name:_____

Date:_____

Acceleration

1. A car is initially traveling at a velocity of 52 km/hr [W]. During a time interval of 15 s, it increases its velocity to 76 km/hr [W]. What is the average acceleration of the car?

$\vec{a} = ?$
$t = 15s$
$\vec{v}_i = 52 km/hr\ [W]$
$\vec{v}_f = 76 km/hr\ [W]$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t} = \frac{76 - 52}{0.00417} = \boxed{5760\ km/hr^2\ [W]}$

$15s \times \frac{1min}{60s} \times \frac{1hr}{60min} = 0.00417\ hr$

Note: if you have different units your answer may look different

2. A rock falls off a cliff with an average acceleration of 9.8 m/s^2 downward. Assuming no air resistance, what is the rock's velocity after 2.4s?

↑+
$\vec{a} = -9.8 m/s^2$
$\vec{v}_i = 0 m/s$
$\vec{v}_f = ?$
$t = 2.4s$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$
$\vec{a}t = \vec{v}_f - \vec{v}_i$
$\vec{v}_f = \vec{v}_i + \vec{a}t = 0 + (-9.8)(2.4) = \boxed{-23.52 m/s}$

3. A person standing on a bridge throws a rock down toward the water below. The rock's initial velocity is 9.4 m/s downward. Assuming no air resistance, what is the rock's velocity when it hits the water 1.6 s later?

↑+
$\vec{a} = -9.8 m/s^2$
$\vec{v}_i = -9.4 m/s$
$t = 1.6s$
$\vec{v}_f = ?$

$\vec{v}_f = \vec{v}_i + \vec{a}t$
$= -9.4 + (-9.8)(1.6)$
$= \boxed{-25.08 m/s}$

4. A cheetah is waiting in the bushes for its prey. At just the right moment, it suddenly begins racing across the field. Within moments, it has reached its maximum velocity of 93 km/hr [N]. If its acceleration was 3.1 m/s^2 [N], how long did the cheetah take to reach its maximum velocity?

$\vec{a} = 3.1 m/s^2\ [N]$
$\vec{v}_f = 93 km/hr\ [N]$
$\vec{v}_i = 0$
$t = ?$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$
$\vec{a}t = \vec{v}_f - \vec{v}_i$
$t = \frac{\vec{v}_f - \vec{v}_i}{\vec{a}} = \frac{25.8 - 0}{3.1} = \boxed{8.3\ s}$

$93 \frac{km}{hr} \times \frac{1000m}{1km} \times \frac{1hr}{3600s} = 25.8 m/s$

5. A bicycle is moving east along a straight sidewalk. During a 1.7 s interval, the bicycle accelerates at 1.2 m/s^2 [E]. After that time interval, the bicycle's velocity is 4.3 m/s [E]. What was the bicycle's velocity at the beginning of that time interval?

$t = 1.7s$
$\vec{a} = 1.2 m/s^2\ [E]$
$\vec{v}_f = 4.3 m/s\ [E]$
$\vec{v}_i = ?$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t}$
$\vec{a}t = \vec{v}_f - \vec{v}_i$
$\vec{v}_i = \vec{v}_f - \vec{a}t = 4.3 - (1.2)(1.7) = \boxed{2.26 m/s\ [E]}$

6. A fish is swimming at a velocity of 16 km/hr [W]. It increases its velocity to 18 km/hr [W] with an acceleration of 2.4 m/s^2 [W]. What was the time interval during which the fish increased its velocity?

$\vec{v}_i = 16\ km/hr\ [W]$
$\vec{v}_f = 18\ km/hr\ [W]$
$\vec{a} = 2.4\ m/s^2\ [W]$
$t = ?$

$$t = \frac{\vec{v}_f - \vec{v}_i}{\vec{a}} = \frac{18-16}{31104} = \boxed{6.43\times10^{-5}\ hr \text{ or } 0.23\ s}$$

$$\frac{2.4\ m}{s^2} \times \frac{1\ km}{1000\ m} \times \left(\frac{3600\ s}{hr}\right)^2 = 31104\ km/hr^2$$

7. A person standing on a bridge throws a rock down toward the water. The rock's velocity when it hit the water was 46 m/s downward. If the rock took 2.4s to hit the water, what was the rock's initial velocity when it left the person's hand?

↑ +

$\vec{v}_f = -46\ m/s$
$t = 2.4\ s$
$\vec{a} = -9.8\ m/s^2$
$\vec{v}_i = ?$

$$\vec{v}_i = \vec{v}_f - \vec{a}t$$
$$= -46 - (-9.8)(2.4)$$
$$= \boxed{-22.48\ m/s}$$

8. A falcon starts from rest and reaches a flying velocity of 84 km/hr in the direction of its prey in 6.8 s. What is the falcon's acceleration?

$\vec{v}_i = 0$
$\vec{v}_f = 84\ km/hr$
$t = 6.8\ s$
$\vec{a} = ?$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t} = \frac{84-0}{0.0019} = \boxed{4.4\times10^4\ km/hr^2}$$

$$6.8\ s \times \frac{1\ hr}{3600\ s} = 0.0019\ hr$$

9. What is the speed of a rocket that travels 9000 meters in 12.12 seconds?

$\Delta d = 9000\ m$
$\Delta t = 12.12\ s$

$$s = \frac{\Delta d}{\Delta t} = \frac{9000}{12.12} = \boxed{743\ m/s}$$

10. What is the speed of a jet plane that travels 528 meters in 4 seconds?

$\Delta d = 528\ m$
$\Delta t = 4\ s$

$$s = \frac{\Delta d}{\Delta t} = \frac{528}{4} = \boxed{132\ m/s}$$

11. How long will your trip take (in hours) if you travel 350 km at an average speed of 80 km/hr?

$\Delta d = 350\text{km}$
$s = 80\ \text{km/hr}$

$s = \frac{\Delta d}{\Delta t}$

$\Delta t = \frac{\Delta d}{s} = \frac{350}{80} = \boxed{4.4\ \text{hr}}$

12. How far (in meters) will you travel in 3 minutes running at a rate of 6 m/s?

$s = 6\text{m/s}$
$t = 3\ \text{min} \times \frac{60\text{s}}{1\text{min}} = 180\text{s}$

$s = \frac{\Delta d}{\Delta t}$

$\Delta d = s\Delta t = 6(180) = \boxed{1080\ \text{m}}$

13. A trip to Cape Canaveral, Florida takes 10 hours. The distance is 816 km. Calculate the average speed.

$t = 10\text{hr}$
$d = 816\text{km}$

$s = \frac{\Delta d}{\Delta t} = \frac{816}{10} = \boxed{81.6\ \text{km/hr}}$

14. How many seconds will it take for a satellite to travel 450 km at a rate of 120 m/s?

$d = 450\text{km} \times \frac{1000\text{m}}{1\text{km}} = 4.5\times10^5\ \text{m}$
$s = 120\text{m/s}$

$s = \frac{\Delta d}{\Delta t}$ $\quad \Delta t = \frac{\Delta d}{s} = \frac{4.5\times10^5}{120} = \boxed{3750\ \text{m}}$

15. What is the speed of a walking person in m/s if the person travels 1000 m in 20 minutes?

$d = 1000\text{m}$
$t = 20\text{min} \times \frac{60\text{s}}{1\text{min}} = 1200\text{s}$

$s = \frac{\Delta d}{\Delta t} = \frac{1000}{1200} = \boxed{0.83\ \text{m/s}}$

16. A ball rolls down a ramp for 15 seconds. If the initial velocity of the ball was 0.8 m/sec and the final velocity was 7 m/sec, what was the acceleration of the ball?

↑ +

$t = 15\text{s}$
$\vec{v_i} = -0.8\text{m/s}$
$\vec{v_f} = -7\text{m/s}$
$\vec{a} = ?$

$\vec{a} = \frac{\vec{v_f} - \vec{v_i}}{t}$

$= \frac{-7+0.8}{15} = \boxed{-0.413\ \text{m/s}^2}$

17. A meteoroid changed velocity from 1.0 km/s to 1.8 km/s in 0.03 seconds. What is the acceleration of the meteoroid?

$\vec{v}_i = 1\ km/s$

$\vec{v}_f = 1.8\ km/s$

$t = 0.03\ s$

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

$= \frac{1.8 - 1}{0.03} = \boxed{26.7\ km/s^2}$

18. A car going 50mph accelerates to pass a truck. Five seconds later the car is going 80mph. Calculate the acceleration of the car.

$\vec{v}_i = 50\ mi/hr$

$\vec{v}_f = 80\ mi/hr$

$t = 5s \times \frac{1hr}{3600s} = 0.00139\ hr$

$\vec{a} = ?$

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

$= \frac{80 - 50}{0.00139} = \boxed{21600\ mi/hr^2}$

19. The space shuttle releases a space telescope into orbit around the earth. The telescope goes from being stationary to traveling at a speed of 1700 m/s in 25 seconds. What is the acceleration of the satellite?

$\vec{v}_i = 0$

$\vec{v}_f = 1700\ m/s$

$t = 25s$

$\vec{a} = ?$

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

$= \frac{1700}{25} = \boxed{68\ m/s^2}$

20. A ball is rolled at a velocity of 12 m/sec. After 36 seconds, it comes to a stop. What is the acceleration of the ball?

assume forward is ~~neg~~ positive

$\vec{v}_i = 12m/s$

$t = 36s$

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

$\vec{a} = ?$

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

$= \frac{0 - 12}{36} = \boxed{-0.33m/s^2}$

21. A dragster in a race accelerated from stop to 60 m/s by the time it reached the finish line. The dragster moved in a straight line and traveled from the starting line to the finish line in 8.0 sec. What was the acceleration of the dragster?

assume forward is positive

$\vec{v}_i = 0$

$\vec{v}_f = 60\ m/s$

$t = 8s$

$\vec{a} = ?$

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

$= \frac{60 - 0}{8} = \boxed{7.5\ m/s^2}$