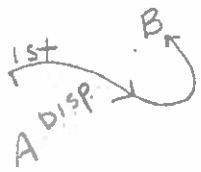
HPS Motion & Forces Calcs 2020 Name Key 2020 Per ____

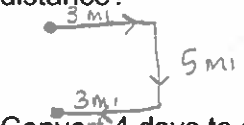
OBJECTIVE: Describe motion & forces both qualitatively and quantitatively (Obj 1, 3-5)

Speed = Distance/time (d/t)	Velocity = Displacement/time (x/t) direction
Acceleration = $(v_f - v_i)$/time	Force = mass x acceleration (direction)
Weight = mass x gravity	Momentum (p) = mass x velocity (direction)



1. What is the difference between distance and displacement? Draw a picture if necessary.
   dist - scalar, how far an obj has traveled (path taken)
   disp - vector, how far an obj has moved from its starting point

2. If I go 3 miles east, 5 miles south, and 3 miles west, what are my displacement and distance?



   x = 5 mi South
   d = 11 mi

3. Convert 4 days to seconds. (4 days is a measurement)

$$\frac{4\,d}{1\,d}\left|\frac{24\,hr}{1\,hr}\right|\frac{3600\,s}{} = 345{,}600 \rightarrow \boxed{300{,}000\,s}$$

4. If a train goes 52 mi/hr for 2.0 days, how far will it go?

$S = \frac{d}{t}$ $\quad 52\,mi/hr = \frac{d}{48\,h}$ $\quad (52)(48) = d$ $\quad 2496 \rightarrow \boxed{2500\,mi}$

5. If a sprinter goes from 0 m/s to 8 m/s in 0.1 seconds, what is her acceleration?

$a = \frac{v_f - v_i}{t}$ $\quad a = \frac{8\,m/s - 0\,m/s}{.1\,s} = \boxed{80\,m/s^2 \text{ in the pos. dir}}$

6. If you shout into the Grand Canyon, your voice travels at the speed of sound (340 m/s) to the bottom of the canyon and back, and you hear an echo. How deep is the Grand Canyon at a spot where you can hear your echo 5.2 seconds after you shout?

$s = 340\,m/s$ $\quad 340\,m/s = \frac{2d}{5.2\,s}$ $\quad d = 884 \rightarrow \boxed{880\,m}$

$t = 5.2\,s$

$d = ?\,2d$ $\quad (340)(5.2) = 2d$

7. Falling objects drop with an average acceleration of 9.8 m/s^2. If an object falls from a tall building, how long will it take before it reaches a speed of 49 m/s?

$a = 9.8\,m/s^2$ $\quad t = ?$ $\quad 9.8\,m/s^2 = \frac{49\,m/s - 0\,m/s}{t}$ $\quad \boxed{t = 5.0\,s}$

$v_i = 0\,m/s$

$v_f = 49\,m/s$

8. What is the weight (in pounds) of a 7.0 kg bowling ball on Earth's surface. (1kg = 2.2 lbs) What is the weight in N?

$$\frac{7.0\,kg}{1\,kg}\left|\frac{2.2\,lb}{}\right. = 15.4 \rightarrow \boxed{15\,lb}$$

$W = mg$

$W = (7.0\,kg)(9.8\,m/s^2) =$

$68.6 \rightarrow \boxed{69\,N}$

9. What is the mass of a 7.0 kg bowling ball on the surface of the moon?

Mass never changes! 7.0 kg anywhere!

10. What is the weight (in Newtons) of a 7.0 kg bowling ball on the surface of the moon? Gravity on the moon is 1.6 m/s^2.

$W = mg$ $\quad W = (7.0\text{ kg})(1.6\text{ m/s}^2)$

$\boxed{W = 11\text{ N}}$

11. What is the rate of acceleration of a 2,000-kilogram truck if a force of 4,200 N is used to make it start moving forward?

$F = ma$

$F = 4{,}200\text{ N}$

$m = 2{,}000\text{ kg}$

$a = ?$

$\frac{4{,}200\text{ N}}{2000\text{ kg}} = \frac{(2{,}000\text{ kg})(a)}{2000\text{ kg}}$

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

12. How much force is needed to accelerate a 68 kg skier at a rate of 1.2 m/s^2?

$F = ?$

$m = 68\text{ kg}$

$a = 1.2\text{ m/s}^2$

$F = (68\text{ kg})(1.2\text{ m/s}^2)$

$\boxed{F = 82\text{ N}}$

13. What is the mass of an object that needs a force of 4,500 N to accelerate it at a rate of 5 m/s^2?

$F = 4{,}500\text{ N}$

$m = ?$

$a = 5\text{ m/s}^2$

$\frac{4{,}500\text{ N}}{5} = \frac{(m)(5\text{ m/s}^2)}{5}$

$\boxed{m = 900\text{ kg}}$

14. My friend's mass is 65 kg. What is her weight in N?

$W = mg$ $\quad W = (65\text{ kg})(9.8\text{ m/s}^2)$

$W = 637 \rightarrow \boxed{640\text{ N}}$

15. Calculate the momentum of a 11.35 kg wagon rolling down a hill at 12 m/s.

$p = mv$

$m = 11.35\text{ kg}$

$v = 12\text{ m/s}$

$p = (11.35\text{ kg})(12\text{ m/s})$

$p = 136.2 \rightarrow \boxed{140\text{ kg}\cdot\text{m/s down hill}}$

16. Which has more momentum: a 6,000 kg elephant napping or a 0.15 kg baseball traveling at 40 m/s?

ELEPHANT

$p = (6000\text{ kg})(0\text{ m/s})$

$p = 0$!

vs.

BASEBALL

$p = (.15\text{ kg})(40\text{ m/s})$

$p = 6\text{ kg}\cdot\text{m/s}$

17. Which has more momentum: a 111 kg linebacker running at a speed of 5.6 m/s or a 82 kg quarterback moving at 2.5 m/s.

$p = (111\text{ kg})(5.6\text{ m/s})$

$p = 620\text{ kg}\cdot\text{m/s}$

LINEBACKER

$>$

$p = (82\text{ kg})(2.5\text{ m/s})$

$p = 205 \rightarrow 2.1 \times 10^2\text{ kg}\cdot\text{m/s}$

QB