ABRHS PHYSICS (CP) NAME: KEY

Force Problems I

1. What net force is needed to accelerate a 100 kg bag 2 m/s² to the left?

$\Sigma F = ma$ $\Sigma F = (100)(2) = 200\text{N}$ Left

2. What is the acceleration of a 2 kg object if the net force on it is 5 N to the right?

$5 = (2)a$ $a = 2.5\ m/s^2$ right

3. What is the acceleration of a 2 kg object if the net force on it is 5 N straight down?

$5 = (2)a$ $a = 2.5\ m/s^2$ down

4. A car of mass 1000 kg is accelerating with a constant rate of 1.5 m/s². What is the net force acting on the car?

$F_{net} = (1000)(1.5) = 1500\ N$

5. An airplane is accelerating down the runway. The mass of the airplane is 15,000 kg. If the engines are producing a net thrust of 45,000 N, what is the acceleration of the airplane?

$45{,}000 = (15{,}000)a$ $a = 3\ m/s^2$

6. There is a net force of 200 N acting on a girl on a skateboard. If her acceleration is 4 m/s², what is her mass?

$200 = m(4)$ $m = 50\ kg$

7. What net force is needed to accelerate a 5 kg object straight up at 3 m/s²?

$F_{net} = (5)(3) = 15\ N$ up

8. What is the net force acting on a 1200 kg car that has a constant velocity of 20 m/s?

Careful! $a = 0$! So $F_{net} = 0$

9. An astronaut in space pushes a 2000 kg satellite with a force of 100 N. What is the acceleration of the satellite?

$100 = (2000)a$ $a = 0.05\ m/s^2$

10. If a net force of 500 N causes something to accelerate at 15 m/s², what is its mass?

$500 = m(15)$ $m = 33.3\ kg$

$\Sigma F = F_{net} = ma$

Force Problems I

Now some problems where you have to calculate the acceleration first!

11. What net force is needed for a 1700 kg car to go from 0 m/s to 30 m/s in 6 seconds?

$v_i = 0$ m/s
$v_f = 30$ m/s
$t = 6$ s

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

$a = \frac{30 - 0}{6}$

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

$F_{net} = ma$

$F_{net} = (1700)(5)$

$F_{net} = 8500 \text{ N}$

12. What net force is needed if a 60 kg person covers 5 meters in 1.3 seconds, assuming she starts from rest and has a constant acceleration?

$d = 5$ m
$v_i = 0$ m/s
$t = 1.3$ s

$d = \frac{1}{2}at^2 + v_i t$

$5 = \frac{1}{2}a(1.3)^2 + (0)(1.3)$

$a = 5.9 \text{ m/s}^2$

$F_{net} = ma$

$= (60)(5.9)$

$F_{net} = 354 \text{ N}$

13. What net force is needed to accelerate a 4 kg object from 10 m/s to 25 m/s in 5 seconds?

$v_i = 10$ m/s
$v_f = 25$ m/s
$t = 5$ s

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

$a = \frac{25 - 10}{5} = \frac{15}{5}$

$a = 3 \text{ m/s}^2$

$F_{net} = ma$

$= (4)(3)$

$F_{net} = 12 \text{ N}$

14. What is the net force on a 65 kg person who slides to a stop in a distance of 3.2 meters in 1.5 seconds?

$d = 3.2$ m
$t = 1.5$ s
$v_f = 0$ m/s

$\bar{v} = \frac{d}{t} = \frac{3.2}{1.5} = 2.13 \text{ m/s}$

$\bar{v} = \frac{v_i + v_f}{2}$

$2.13 = \frac{v_i + 0}{2}$

$v_i = 4.27 \text{ m/s}$

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

$a = \frac{0 - 4.27}{1.5}$

$a = -2.84 \text{ m/s}^2$

$F_{net} = ma$

$= (65)(-2.84)$

$= -185 \text{ N}$

15. You are in your car, mass 1500 kg, traveling down the highway with a speed of 25 m/s. You see traffic ahead and apply the brakes. You slow down to 15 m/s in 4 seconds. What was the net force on the car?

$v_i = 25$ m/s
$v_f = 15$ m/s
$t = 4$ s

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

$a = \frac{15 - 25}{4}$

$a = -2.5 \text{ m/s}^2$

$F_{net} = ma$

$= (1500)(-2.5)$

$F_{net} = -3750 \text{ N}$

remember: acceleration is the slope of velocity!

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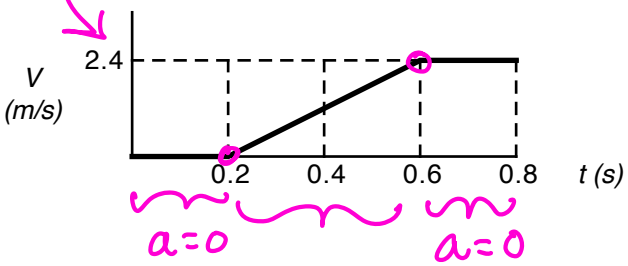
Force Problems I

16. The velocity vs time graph for a 0.75 kg cart is shown in the diagram to the right:



$a = \frac{2.4-0}{.6-.2} = \frac{2.4}{.4} = 6\ m/s^2$

a. What is the net force on the cart at time 0.1 seconds?

$F_{net} = ma = (.75)(0)$

$F_{net} = 0\ N$

b. What is the net force on the cart at time 0.4 seconds?

$F_{net} = (.75)(6) = 4.5\ N$

c. What is the net force on the cart at time 0.7 seconds?

$F_{net} = (.75)(0) = 0\ N$

17. A 0.025 kg steel spheres is launched with a speed of 3 m/s by quickly pushing it 2 cm (0.02 m).

a. What is the net force on a steel sphere while being launched?

$v_i = 0\ m/s$
$v_f = 3\ m/s$
$d = .02\ m$

$\bar{v} = \frac{v_i + v_f}{2}$

$\bar{v} = \frac{0+3}{2}$

$\bar{v} = 1.5\ m/s$

$\bar{v} = \frac{d}{t}$

$1.5 = \frac{.02}{t}$

$t = .013\ s$

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

$= \frac{3-0}{.013}$

$a = 225\ m/s^2$

b. Once it is in the air, what is the net force on the steel sphere?

Just gravity! (It's a projectile)

So $F_g = mg = (.025)(10)$

$F_{net} = F_g = 0.25\ N$

$F_{net} = ma$

$= (.025)(225)$

$F_{net} = 5.63\ N$

Answers:

1) 200 N to the left *2) 2.5 m/s² to the right* *3) 2.5 m/s² down*

4) 1500 N *5) 3 m/s²* *6) 50 kg* *7) 15 N up* *8) 0 N* *9) 0.05 m/s²*

10) 33.3 kg *11) 8500 N* *12) 355 N* *13) 12 N* *14) (–)185 N*

15) (–)3750 N (& a = (–)2.5 m/s²) *16. a) 0 N* *b) 4.5 N* *c) 0 N*

17. a) 5.63 N *b) 0.25 N (gravity!)*