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Chapter 9 # Problem Set: Acceleration **BLM 3-17**

Goal • Solve the following acceleration problems. Be sure to show all your work.

1. A motorcycle accelerates from rest to 15 m/s [E] in 2.5 s. What is the motorcycle's acceleration?

$a = \frac{\Delta v}{t} = \frac{15\ m/s}{2.5\ s} = 6\ m/s^2\ [E]$

2. A car travelling forward at 22 m/s stops in a time of 2.0 s. What is the car's acceleration?

$a = \frac{\Delta v}{t} = \frac{-22\ m/s}{2.0\ s} = -11\ m/s^2$

3. A bicycle speeds up from 3.0 m/s [N] to 12 m/s [N] in 4.0 s. What is the bicycle's acceleration?

$a = \frac{v_f - v_i}{t} = \frac{12\ m/s - 3.0\ m/s}{4\ s} = 2.25\ m/s^2\ [N]$

4. A train travelling west at 18 m/s slows to a velocity of 6.0 m/s [W] in a time of 24 s. What is the train's acceleration?

$v_f = 6\ m/s \quad v_i = 18\ m/s \quad t = 24\ s$

$a = \frac{v_f - v_i}{\Delta t} = \frac{6\ m/s - 18\ m/s}{24\ s} = -0.5\ m/s^2\ [W]$

5. A sprinter, starting from rest, accelerates at 2.0 m/s^2 [forward]. What is the sprinter's velocity after 1.5 s?

$a = 2.0\ m/s^2 \quad \Delta t = 1.5\ s \quad v_f = ?$

$\Delta v = a \cdot \Delta t = 2.0\ m/s^2 \times 1.5\ s$

$\Delta v = 3\ m/s$

$\Delta v = v_f - v_i$

$3 = v_f - 0$

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6. By applying its brakes, a car can decelerate at 3.0 m/s^2. If it takes this car 6.0 s to stop, how fast was it originally moving?

$a = -3.0\ m/s^2$
$t = 6.0\ s$
$V_i = ?$
$V_f = 0\ m/s$

$V_i = V_f - \Delta V$
$= V_f - a \cdot \Delta t$
$= 0\ m/s - (-3.0\ m/s^2) \cdot 6.0\ s$
$= 18\ m/s$

7. What is the final velocity of a boat travelling 3.0 m/s [E] if it accelerates at 1.2 m/s^2 [E] for 5.0 s?

$V_f = ?$
$V_i = 3.0\ m/s\ [E]$
$a = 1.2\ m/s^2\ [E]$
$t = 5.0\ s$

$V_f = V_i + \Delta V$
$= V_i + a \cdot \Delta t$
$= 3.0\ m/s\ [E] + 1.2\ m/s^2\ [E] \cdot 5.0\ s$
$= 9\ m/s\ [E]$

8. What is the final velocity of a boat travelling 11.0 m/s [E] if it accelerates at 1.2 m/s^2 [W] for 5.0 s?

$V_f = ?$
$V_i = 11.0\ m/s\ [E]$
$a = -1.2\ m/s^2\ [E]$
$t = 5.0\ s$

$V_f = V_i + a \cdot \Delta t$
$= 11.0\ m/s\ [E] + [-1.2\ m/s^2\ (E)] \cdot 5.0\ s$
$= 5\ m/s\ [E]$

9. How long would it take to stop an airplane, landing at 45 m/s [N] if it decelerates at 5.0 m/s^2 [S]?

$\Delta t = ?$
$V_f = 0\ m/s$
$V_i = 45\ m/s\ [N]$
$a = -5.0\ m/s^2$

$\Delta t = \frac{V_f - V_i}{a} = \frac{0\ m/s - 45\ m/s\ [N]}{-5.0\ m/s^2\ [N]} = 9\ s$

10. How long would it take a race-car to accelerate from 12 m/s to 25 m/s if its forward acceleration is 2.0 m/s^2?

$\Delta t = ?$
$V_i = 12\ m/s$
$V_f = 25\ m/s$
$a = 2.0\ m/s^2$

$\Delta t = \frac{V_f - V_i}{a}$
$= \frac{25\ m/s - 12\ m/s}{2.0\ m/s^2} = \frac{13\ m/s}{2\ m/s^2} = 6.5\ s$