Name _____

Using the Laws of Motion Answer Key

1. Using Newton's second law (F = ma), the acceleration can be calculated as a = F / m = 10 N / 2 kg = 5 m/s².

2. The final velocity is 0 m/s since the car comes to rest. Using the equation v = u + at, where v = 0 m/s (final velocity), u = 20 m/s (initial velocity), a is the acceleration, and t = 10 s (time), we can solve for a. Rearranging the equation, a = (v - u) / t = (0 m/s - 20 m/s) / 10 s = -2 m/s².

3. The frictional force can be calculated as F_friction = μ * F_normal, where F_normal is the normal force. Assuming the object is on a horizontal surface, the normal force is equal to the weight of the object, which is F_normal = m * g. Therefore, F_friction = 0.4 * (5 kg * 9.8 m/s²) ≈ 19.6 N.

4. Using Newton's second law (F = ma), the mass can be calculated as m = F / a = 50 N / 8 m/s² = 6.25 kg.

5. On its way up, the object's velocity decreases at a rate of approximately 9.8 m/s² (acceleration due to gravity) until it reaches zero velocity at the maximum height. On its way down, the object's velocity increases at the same rate. Therefore, when the object returns to its starting point, its velocity will be -30 m/s (negative sign indicating downward direction).

6. The time it takes for the ball to hit the ground can be determined using the equation: h = (1/2) * g * t^2, where h is the initial height (80 meters), g is the acceleration due to gravity (approximately 9.8 m/s²), and t is the time. Rearranging the equation, t = √(2h/g) = √(2*80/9.8) ≈ 4.04 seconds.

7. Using Newton's second law (F = ma), the mass can be calculated as m = F / a = 15 N / 6 m/s² = 2.5 kg.

8. The magnitude of the car's acceleration can be calculated using the equation a = v² / r, where v is the velocity (25 m/s) and r is the radius (100 meters). Therefore, a = (25 m/s)² / 100 m = 6.25 m/s².

9. The maximum height can be determined using the kinematic equation: v² = u² - 2as, where v = 0 m/s (at the maximum height), u = 10 m/s, a = -9.8 m/s² (acceleration due to gravity), and s is the maximum height. Rearranging the equation, s = (u² - v²) / (2a) = (10 m/s)² / (2 * -9.8 m/s²) ≈ 5.1 meters.

10. The average acceleration can be calculated using the equation a = (v - u) / t, where v = 20 m/s (final velocity), u = 0 m/s (initial velocity), and t = 10 s (time). Therefore, a = (20 m/s - 0 m/s) / 10 s = 2 m/s².