**Acceleration Problems**

1. Distinguish between velocity and acceleration.

2. Can an automobile having a velocity toward the north have an acceleration in a different direction (i.e. south)? Explain your answer.

3. If you were standing on a bus moving at constant velocity, would you have to lean in some special way to compensate for the bus’s motion? What if the bus were accelerating? Explain.

4. What is the acceleration of a vehicle that changes its speed from 100 km/h to a dead stop in 10 s? Is this acceleration (positive) or deceleration (negative)?

5. A car speeds up from 64 km/h to 112 km/h in 5 seconds. What is the car’s acceleration in that time period?

6. A roller coaster’s velocity at the top of a hill is 10 meters/second. Two seconds later it reaches the bottom of the hill. If the roller coaster's acceleration is 3 m/s/s, what is its velocity at the bottom of the hill?

7. A car is traveling at 60 km/hr. It needs to accelerate 5 km/hr/s up to 85 km/hr in order to pass a car on the highway. How long did it take to change its speed?

8. A swimmer speeds up from 1.1 m/s to 1.3 m/s during the last 20 seconds of a race. What is the swimmer’s acceleration during that interval of time?

9. A child runs out into the road in front of an oncoming truck. The truck, traveling 48 km/h slams on the breaks immediately and decelerates at a rate of 16 km/hr/s to a stop. The child was 3.5 seconds away from the truck. Did the truck hit the child?

**Acceleration Problems KEY**

1. Distinguish between velocity and acceleration.

*Velocity is motion produced by a force (energy). Acceleration (∆v/t) is the change in motion or velocity (v = d/t) over time. Both are vector quantities possessing magnitude and direction.*

2. Can an automobile having a velocity toward the north have an acceleration in a different direction (i.e. south)? Explain your answer.

*Yes, when the car is heading north, its velocity is north, but if it slows down or decelerates, its acceleration is negative or to the south (in the opposite direction).*

*With circular motion, a car can be heading north for a moment (while going in a circle) and its centripetal force will cause the car to accelerate towards the center of the circular motion.*

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*Also with circular motion, a hockey puck rotates (towards the center) while heading north. This is rotational motion.*

3. If you were standing on a bus moving at constant velocity, would you have to lean in some special way to compensate for the bus’s motion? What if the bus were accelerating? Explain.

*Constant velocity involves balanced forces, making it seem that one is not even moving. Acceleration involves unbalanced net force and would shift one's weight.*

4. What is the acceleration of a vehicle that changes its speed from 100 km/h to a dead stop in 10 s? Is this acceleration (positive) or deceleration (negative)?

*a = (vf – vi) / t = (0 – 100 km/h) / 10 s = -10 km/h/s → deceleration*

5. A car speeds up from 64 km/h to 112 km/h in 5 seconds. What is the car’s acceleration in that time period?

*a = (vf – vi) / t = (112 km/h – 64 km/h) / 5 s = 9.6 km/h/s*

6. A roller coaster’s velocity at the top of a hill is 10 meters/second. Two seconds later it reaches the bottom of the hill. If the roller coaster's acceleration is 3 m/s/s, what is its velocity at the bottom of the hill?

*a = (vf – vi) / t → at = vf – vi → vf = vi + at*

*vf = vi + at = 10 m/s + 3 m/s/s x 2 s = 16 m/s*

7. A car is traveling at 60 km/hr. It needs to accelerate 5 km/hr/s up to 85 km/hr in order to pass a car on the highway. How long did it take to change its speed?

*a = (vf – vi) / t → t = (vf – vi) / a = (85 km/hr – 60 km/hr) / 5 km/h/s = 5 s*

8. A swimmer speeds up from 1.1 m/s to 1.3 m/s during the last 20 seconds of a race. What is the swimmer’s acceleration during that interval of time?

*a = (vf – vi) / t = (1.3 m/s – 1.1 m/2) / 20 s = 0.01 m/s/s*

9. A child runs out into the road in front of an oncoming truck. The truck, traveling 48 km/h slams on the breaks immediately and decelerates at a rate of 16 km/h/s to a stop. The child was 3.5 seconds away from the truck. Did the truck hit the child?

*a = (vf – vi) / t → t = (vf – vi) / a = (0 km/hr – 48 km/hr) / 16 km/hr/s* *= 3 s*

*Since the truck stops in 3 seconds and the child is 3.5 seconds away, the truck will stop in time and not hit the child.*