HW 1.1 – Acceleration

Name: ……

Reading *(copied and edited from Wikipedia)*

Acceleration, in physics, is the rate of change of velocity of an object with respect to time. An object's acceleration is the net result of any and all forces acting on the object, as described by Newton's Second Law. The SI unit for acceleration is metre per second squared (m/s^2). Accelerations are vector quantities (they have magnitude and direction) and add according to the parallelogram law. As a vector, the calculated net force is equal to the product of the object's mass (a scalar quantity) and its acceleration.

For example, when a car starts from a standstill (zero relative velocity) and travels in a straight line at increasing speeds, it is accelerating in the direction of travel. If the car turns, an acceleration occurs toward the new-direction. In this example, we can call the forward acceleration of the car a "linear acceleration", which passengers in the car might experience as a force pushing them back into their seats. When changing direction, we might call this "non-linear acceleration", which passengers might experience as a sideways force. If the speed of the car decreases, this is an acceleration in the opposite direction from the direction of the vehicle, sometimes called **deceleration**. Passengers may experience deceleration as a force lifting them forwards. Mathematically, there is no separate formula for deceleration: both are changes in velocity. Each of these accelerations (linear, non-linear, deceleration) might be felt by passengers until their velocity (speed and direction) matches that of the car.

Conceptual Question

If a car is travelling eastwards, can its acceleration be westwards? Explain, you may use a diagram if that helps. (2)

Multiple Choice (1 for circling the correct answer, 1 for reasoning**)**

A bike is travelling at an unknown velocity. It accelerates at a constant rate of 3.0 m/s^2 for 5.0 s to reach a final velocity of 30 m/s. What was the original velocity of the car?

A) 1.0 m/s
B) 5.0 m/s
C) 10 m/s
D) 15 m/s
E) 20 m/s

Free Response

The first stage of the Saturn V moonrocket accelerated it at a rate of 45 m/s2 (4.5 g) for 160 seconds before its fuel was exhausted and the second stage ignited.

a) What was its speed at that point? (3)

b) The rocket at first stage cut off had reached an altitude of 67 km. Despite the huge speed of the rocket, explain why it hadn't gone very high up in the sky? (2)