Momentum & Impulse Worksheet

1. Calculate the momentum of the following objects:
   a) A 100. kg football player running at 12 km/hr.
   b) A blue whale of mass 150 tonnes moving at 30 km/hr.
   c) The Saturn V rocket blasting into space with a mass of 8.7×10^6 kg and velocity of 28000 km/hr.

2. A golfer hits a ball (m = 50. g) causing it to the leave its fairway lie with a velocity of 32 m/s. Determine the change in momentum of the ball. If the ball strikes the club face for only .05 s, what force is applied by the club to the ball?

3. During instruction on parachuting, rookies are told to flex their knees while landing. Determine the force of impact on an 80. kg parachutist falling at a terminal velocity of 10 m/s who flexes her knees and takes 0.80 s to land. Consider the case where the rookie does not flex his legs, and stops in 0.050 s. How much force is applied in this case?

4. Explain the concept of the importance of the follow through in sports in terms of momentum and impulse. Use your favorite sport as an example: hockey, golf, baseball, football, soccer, rugby, etc… all have relevant examples.

5. Find the impulse of a 50. kg object under the following scenarios:
   a) The object accelerate to 7.5 m/s from rest.
   b) The object stops from a velocity of 12.0 m/s.
   c) The object change in velocity from 2.2 m/s to 6.3 m/s.
   d) The object hits the ground with 2.5 m/s and rebounds with the same ***speed***.

6. For all 4 impulses in (5), determine the force required if the change in velocity occurred over .45 s.

7. One of the dangers an astronaut faces when performing a space walk is tiny pieces of debris striking them at incredibly high speeds. Determine the velocity a golf ball of 45 g would require to have the same momentum as a 2 mm piece of paint moving (m = 5.0 g) at 8.1×10^3 m/s (a fairly normal velocity in the vacuum of space). Express your answer in km / hr.

8. A bullet of 0.0500 kg is fired into a block of wood. Knowing that the bullet left the gun with a muzzle velocity of 350. m/s, and the bullet penetrates .15 m into the block of wood, determine:
   a) The average force required to stop the bullet.
   b) The impulse exerted by the wood on the bullet.
   c) The change in momentum of the bullet.

Answers: 1) 330kg.m/s, $1.3\text{x}10^6$kg.m/s, $6.8\text{x}10^{10}$kg.m/s 2) 32N 3) –1000N, -16000N 5) 380N.s, -600N.s, 210N.s, -250N.s 6) 830N, -1300N, 470N, -560N 7) 3,200 km/hr 8) $2.0\text{x}10^4$N, -17.5N.s, -17.5kg.m/s