13. Calculate the momentum of the following objects:

a) A 100. kg football player running at 12 km/hr.

$p = mv \qquad 100\ kg \cdot 12\ km/h = 1200\ kg \cdot km/h$

b) A blue whale of mass 150 tonnes moving at 30 km/hr.

$150\ tons \cdot 30\ km/h = 4500\ tons \cdot 30\ km/h$

c) The Saturn V rocket blasting into space with a mass of 8,700,000 kg and velocity of 28,000 km/hr.

$8{,}700{,}000\ kg \cdot 28{,}000\ km/h = 2.4 \times 10^{11}\ kg \cdot km/h$

14. 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?

Change in momentum = $50g \cdot 32\ m/s = 1600\ g \cdot m/s$

impulse = change in momentum

$\frac{1600}{t} = Ft = \frac{1600}{.5} = 3200N$

15. A 1000 kg car traveling South at 20.0 m/s collides with a 1200 kg car traveling East at 20m/s. The two vehicles entangle after the collision and head off as one. What is the velocity of the combined wreckage immediately after the collision?

$(1000\ kg \cdot 20\ m/s) + (1200\ kg \cdot 20\ m/s) = (1000\ kg + 1200\ kg)v$

$20{,}000\ kg \cdot m/s + 24{,}000\ kg \cdot m/s = (2200\ kg)v$

$\frac{44{,}000\ kg \cdot m/s}{2200\ kg} = \frac{(2200\ kg)v}{2200\ kg} = 20\ m/s$