Practice

Understanding Concepts

1. Calculate the acceleration in each situation.
   (a) A net force of 27 N [W] is applied to a cyclist and bicycle having a total mass of 63 kg.
   (b) A bowler exerts a net force of 18 N [fwd] on a 7.5-kg bowling ball.
   (c) A net force of 32 N [up] is applied to a 95-g model rocket.
2. Find the magnitude and direction of the net force in each situation.
   (a) A cannon gives a 5.0-kg shell a forward acceleration of 5.0×10^3 m/s^2 before it leaves the muzzle.
   (b) A 28-g arrow is given an acceleration of 2.5×10^3 m/s^2 [E].
   (c) A 500-passenger Boeing 747 jet (with a mass of 1.6×10^5 kg) undergoes an acceleration of 1.2 m/s^2 [S] along a runway.
3. Write an equation expressing the mass of an accelerated object in terms of its acceleration and the net force causing that acceleration.
4. Determine the mass of a regulation shot in the women's shot-put event (**Figure 1**) if a net force of 7.2×10^2 N [fwd] is acting on the shot, giving the shot an average acceleration of 1.8×10^2 m/s^2 [fwd].
5. Derive an equation for net force in terms of mass, final velocity, initial velocity, and time.
6. Assume that during each pulse a mammalian heart accelerates 21 g of blood from 18 cm/s to 28 cm/s during a time interval of 0.10 s. Calculate the magnitude of the force (in newtons) exerted by the heart muscle on the blood.

Answers

1. (a) 0.43 m/s^2 [W]
   (b) 2.4 m/s^2 [fwd]
   (c) 3.4×10^2 m/s^2 [up]
2. (a) 2.5×10^4 N [fwd]
   (b) 7.0×10^1 N [E]
   (c) 1.9×10^5 N [S]
4. 4.0 kg
6. 2.1×10^{-2} N

Figure 1
For question 4

Understanding Concepts

1. When the Crampton coal-fired train engine was built in 1852, its mass was 48.3 t (1.0 t = 1.0×10^3 kg) and its force capability was rated at 22.4 kN. Assuming it was pulling train cars whose total mass doubled its own mass and the total friction on the engine and cars was 10.1 kN, what was the magnitude of the acceleration of the train?
2. Determine the net force needed to cause a 1.31×10^3-kg sports car to accelerate from zero to 28.6 m/s [fwd] in 5.60 s.
3. As you have learned from Chapter 1, the minimum safe distance between vehicles on a highway is the distance a vehicle can travel in 2.0 s at a constant speed. Assume that a 1.2×10^3-kg car is travelling 72 km/h [S] when the truck ahead crashes into a northbound truck and stops suddenly.
   (a) If the car is at the required safe distance behind the truck, what is the separation distance?
   (b) If the average net braking force exerted by the car is 6.4×10^3 N [N], how long would it take the car to stop?
   (c) Determine whether a collision would occur. Assume that the driver's reaction time is an excellent 0.09 s.

#1 $\vec{a} = 8.48 \times 10^{-2}$ m/s^2 [fwd]

#2 $F_{NET} = 6.69 \times 10^3$ N [fwd]

#3 a) $\Delta \vec{d} = 4.0 \times 10^1$ m [fwd]
b) $\Delta t = 3.8$ sec.