

## More Work

Use work/energy arguments to solve each of the following problems.

- A baseball ( $m = 0.150 \text{ kg}$ ) is traveling  $20 \text{ m/s}$  when it hits Ian's glove. Ian moves his glove  $25 \text{ cm}$  as he slows the ball to rest.
  - What is the work done by the glove on the ball? *Ans:  $-30 \text{ J}$*
  - What is the average force of the glove on the ball? *Ans:  $120 \text{ N}$*
  - What would happen to the force of the ball on the glove if the initial speed were doubled but the stopping distance stayed the same? *Ans:  $4X$*
  
- A pole vaulter ( $m = 60 \text{ kg}$ ) falls  $15 \text{ feet}$  from rest onto a large mat. Treat the mat like a spring for the  $0.5 \text{ meters}$  it takes to bring the vaulter to rest.
  - How much work is done by the mat on the vaulter? *Ans:  $-2981 \text{ J}$*
  - What is the effective spring constant for the mat? *Ans:  $23850 \text{ N/m}$*
  
- A  $75 \text{ kg}$  meteorite buries itself  $5.0 \text{ meters}$  into soft mud. The force of the mud on the meteorite is approximated by  $F(x) = 640x^3 \text{ Newtons}$  where  $x$  is the depth in the mud. What was the speed of the meteorite when it initially impacted the mud? *Ans:  $50.7 \text{ m/s}$*
  
- The barrel of a gun on a World War II battleship is  $15 \text{ m}$  long. The shells had a mass of  $1250 \text{ kg}$  and were fired with a muzzle speed of  $750 \text{ m/s}$ . Assume the gun is inclined to a  $45^\circ$  angle.
  - What is the average force of the explosion on the shell in the barrel? *Ans:  $2.34 \times 10^7 \text{ N}$*
  - What is the maximum height of the shell above the ground? *Ans:  $14.3 \times 10^3 \text{ m}$*
  
- When a  $1100 \text{ kg}$  car is in neutral, it slows from  $60 \text{ mi/h}$  to  $40 \text{ mi/h}$  in  $7 \text{ seconds}$  due to air resistance. What is the power output needed to maintain  $50 \text{ mi/h}$ ? *Ans:  $31260 \text{ Watts}$*
  
- A  $1400 \text{ kg}$  sports car speeds up from rest to  $95 \text{ km/h}$  in  $7.5 \text{ s}$ . What is the average power of the road on the car? *Ans:  $65000 \text{ Watts}$*
  
- A pump lifts  $21.0 \text{ kg}$  of water per minute through a height of  $3.5 \text{ m}$ . What minimum output rating must the pump motor have? *Ans:  $12 \text{ Watts}$*