Solutions

Each answer shows the steps, then the **result**.

2.1

- 50 N in the opposite direction (back on the hammer)

2.2

- Equal in size and opposite in direction (and they act on different objects)

2.3

- They act on different objects, so they never appear together on one free-body diagram

2.4

- The ground pushes you forward (the reaction to your foot pushing back on it)

2.5

- negligible mass
- rotates on its axle with negligible friction

3.1 C

- equal and opposite, on different objects

3.2 C

- the reaction is equal, 2000 N

3.3

(a)

- The book's gravitational pull on the Earth, equal and upward

(b)

- The normal force acts on the book from the table, a different pair; the reaction to gravity acts on the Earth

3.4

(a)

- The swimmer pushes water back; the water pushes the swimmer forward

(b)

- The forward push of the water on the swimmer

3.5

(a)

- at R the rope supports only the block: $T_R = 5.0 \times 9.8 = \mathbf{49}$ N
- at Q it supports the block and the lower half of the rope: $T_Q = 6.0 \times 9.8 = \mathbf{59}$ N
- at P it supports the block and the whole rope: $T_P = 7.0 \times 9.8 = \mathbf{69}$ N

(b)

- each higher segment must also hold up the weight of the rope below it; an ideal string is massless, so it has no weight to add

3.6 B

- an ideal string over an ideal pulley has the same tension at all points