PHYSICS IN MOTION
gpb.org/physics-motion

Unit 4D
Work
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

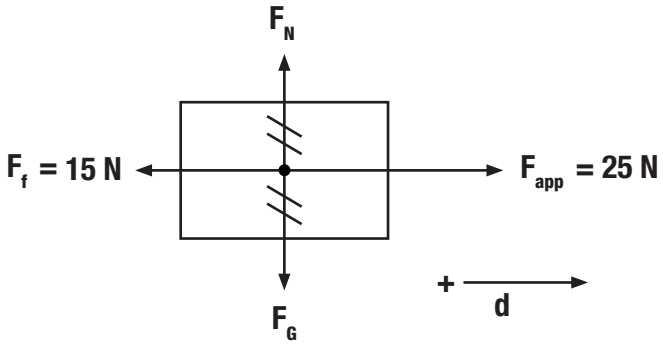
1. **A 25 N force pushes a block across a surface for 6 m. How much work is done by the applied force?**

$$W = Fd$$
$$W = (25\ N)(6\ m)$$
$$W = 150\ J$$

2. **If, in the previous question, there is a 15 N kinetic frictional force opposing the motion, how much work is done by the force of friction? Does friction do positive work or negative work on the block? Draw a free-body diagram to support your answer.**

The work done by friction is negative because it acts opposite to the direction of motion.

$$W_f = F_f d$$
$$W_f = (15\ N)(-6\ m)$$
$$W_f = -90\ J$$



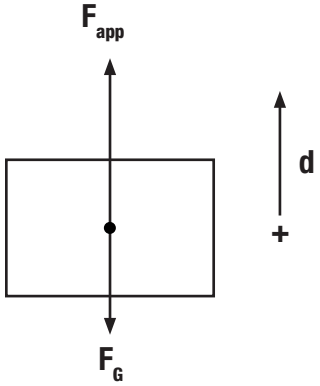
3. **A forklift applies a force of 2,000 N to raise a box 3 m. How much work is done by the forklift in raising the box?**

$$W_{app} = F_{app}\, d$$
$$W_{app} = (2000\ N)(3\ m)$$
$$W_{app} = 6000\ J$$

4. **If the box weighs 1,500 N, how much work does the force of gravity do on the box? Is the work positive or negative? Draw a free-body diagram to support your answer.**

The force of gravity does negative work on the box as it is raised. The work is negative because gravity acts opposite to the direction of motion.

$$W_G = F_G\, d$$
$$W_G = (1500\ N)(-3\ m)$$
$$W_G = -4500\ J$$



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5. Using the information from the previous two questions, what is the total, or net, work done to the box?

The net work is the total work done on the box. The applied force does 6,000 J of positive work, and the force of gravity does 4,500 J of negative work, so the net work is 1,500 J.

$$W_{net} = W_{app} + W_G$$
$$W_{net} = 6000\,J - 4500\,J$$
$$W_{net} = 1500\,J$$

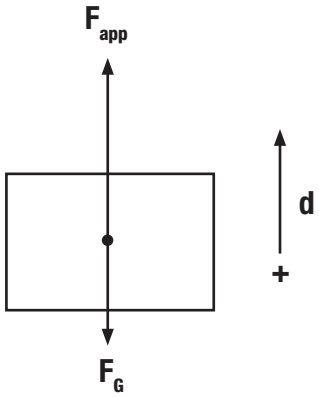
6. A 50 N block is raised 2 m. If the net work done on the block is 50 J, what is the applied force on the block?

$$W_{net} = 50\,J$$

$$W_G = F_G d$$
$$W_G = (50\,N)(-2\,m)$$
$$W_G = -100\,J$$

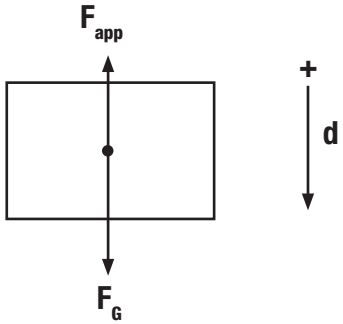
$$W_{net} = W_{app} + W_G$$
$$50\,J = W_{app} - 100\,J$$
$$W_{app} = 150\,J$$

$$W_{app} = F_{app} d$$
$$150\,J = F_{app}(2\,m)$$
$$F_{app} = 75\,N$$



7. A 25 N block is lowered 1.2 m by a 20 N force.

a. Draw a free-body diagram of the forces acting on the block.



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Work each of the following problems. SHOW ALL WORK.

b. How much work does the force of gravity do on the box? Is this work positive or negative?

The force of gravity does positive work because it acts in the same direction as the motion of the block.

$$W_G = F_G d$$
$$W_G = (25\ N)(1.2\ m)$$
$$W_G = 30\ J$$

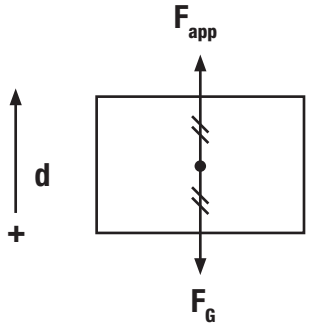
c. How much work does the applied force do on the box? Is this work positive or negative?

The applied force does negative work because it acts in the opposite direction as the motion of the block.

$$W_{app} = F_{app} d$$
$$W_{app} = (20\ N)(-1.2\ m)$$
$$W_{app} = -24\ J$$

8. Does it require more work to raise a 15 kg block by 4 m or to raise a 20 kg block by 2 m, if both are moving at a constant velocity? Draw a free-body diagram to help solve the problem.

If the blocks are raised at a constant velocity, then the applied force must be equal to the force of gravity because the blocks are not accelerating.



$$F_{net} = 0$$
$$F_{app} - F_G = 0$$
$$F_{app} = F_G$$

$$W_{app} = F_{app} d$$
$$W_{app} = (15\ kg)(9.8\ {}^{m}/_{s^2})(4\ m)$$
$$W_{app} = 588\ J$$

$$W_{app} = F_{app} d$$
$$W_{app} = (20\ kg)(9.8\ {}^{m}/_{s^2})(2\ m)$$
$$W_{app} = 392\ J$$

It requires more work to raise a 15 kg block 4 meters.