Description: ± Includes Math Remediation. Several conceptual and computational questions: Given force and displacement, what is the work done?

Learning Goal:

To be able to calculate work done by a constant force directed at different angles relative to displacement

If an object undergoes displacement while being acted upon by a force (or several forces), it is said that *work is being done* on the object. If the object is moving in a straight line and the displacement and the force are known, the work done by the force can be calculated as

$$W = Fs \cos \theta,$$

where W is the work done by force $\vec{F}$ on the object that undergoes displacement $\vec{s}$ directed at angle θ relative to $\vec{F}$.

Note that depending on the value of $\cos \theta$, the work done can be positive, negative, or zero.

In this problem, you will practice calculating work done on an object moving in a straight line. The first series of questions is related to the accompanying figure.
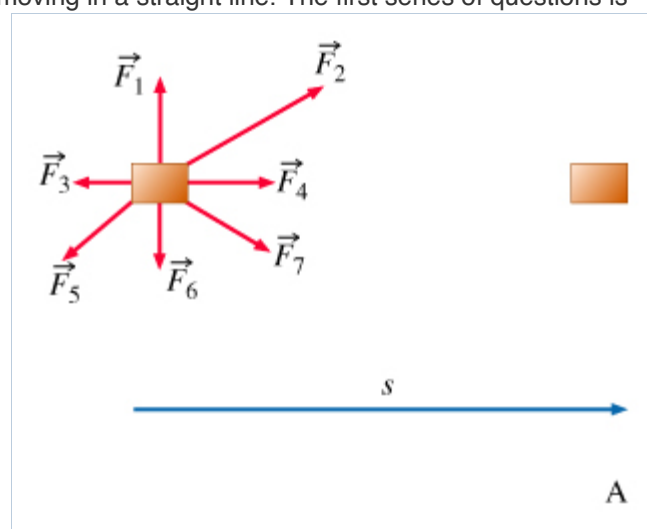
Part A

What can be said about the sign of the work done by the force $\vec{F}_1$?

ANSWER:

- ○ It is positive.
- ○ It is negative.
- ● It is zero.
- ○ There is not enough information to answer the question.

When $\theta = 90°$, the cosine of θ is zero, and therefore the work done is zero.

Part B

What can be said about the work done by force $\vec{F}_2$?

ANSWER:

⦿ It is positive.

◯ It is negative.

◯ It is zero.

When $0° < \theta < 90°$, $\cos\theta$ is positive, and so the work done is positive.

Part C

The work done by force $\vec{F}_3$ is

ANSWER:

◯ positive

⦿ negative

◯ zero

When $90° < \theta < 180°$, $\cos\theta$ is negative, and so the work done is negative.

Part D

The work done by force $\vec{F}_4$ is

ANSWER:

⦿ positive

◯ negative

◯ zero

Part E

The work done by force $\vec{F}_5$ is

ANSWER:

○ positive

◉ negative

○ zero

Part F

The work done by force $\vec{F}_6$ is
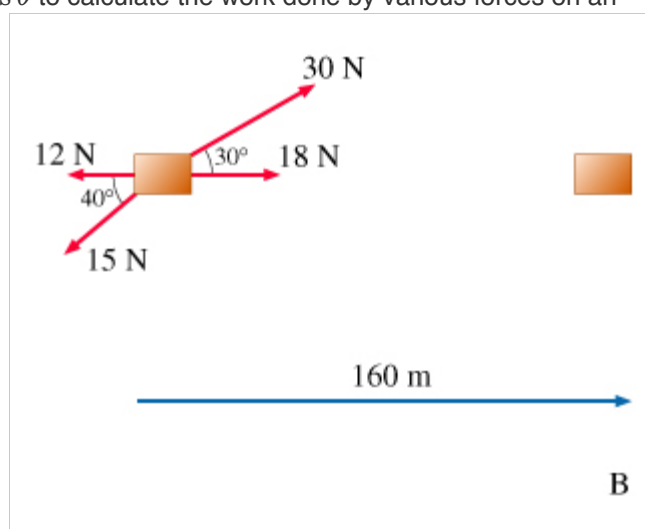
ANSWER:

○ positive

○ negative

◉ zero

Part G

The work done by force $\vec{F}_7$ is

ANSWER:

◉ positive

○ negative

○ zero

In the next series of questions, you will use the formula $W = Fs \cos \theta$ to calculate the work done by various forces on an object that moves 160 meters to the right as shown in .

Part H

Find the work W done by the 18-newton force.

Use two significant figures in your answer. Express your answer in joules.

ANSWER:

W = 2900 J

Part I

Find the work W done by the 30-newton force.

Use two significant figures in your answer. Express your answer in joules.

ANSWER:

W = 4200 J

Part J

Find the work W done by the 12-newton force.

Use two significant figures in your answer. Express your answer in joules.

ANSWER:

W = -1900 J

Part K

Find the work W done by the 15-newton force.

Use two significant figures in your answer. Express your answer in joules.

ANSWER:

W = -1800 J