

Period 8 Exercises

E.1 A machine that is so well built that friction and other energy losses may be ignored is used to perform a task. The amount of work required to perform the task is _____ the amount of work required without the machine.

- a) less than
- b) more than
- c) the same as

E.1 = c

E.2 Susan raises an 800 lb upright piano 10 feet to the second floor of her house by using a frictionless pulley system. If she raises the piano by exerting a force of 50 lbs on the rope, what length of rope will she have to pull through the pulley?

$$F_{in} \times D_{in} = F_{out} \times D_{out}$$

$$D_{in} = \frac{F_{out} D_{out}}{F_{in}} =$$

$$\frac{800 \text{ lbs} \times 10 \text{ ft}}{50 \text{ lbs}} = 160 \text{ ft}$$

E.2 = d

E.3 What is the efficiency of a lever if 5 newtons of force are required to move the end of the lever arm 30 cm, which lifts a load of 10 newtons a distance of 5 cm?

- a) 3%
- b) 8%
- c) 33%
- d) 83%
- e) 300%

$$Eff = \frac{Work_{out}}{Work_{in}} = \frac{F_{out} D_{out}}{F_{in} D_{in}} = \frac{10 \text{ N} \times 5 \text{ cm}}{5 \text{ N} \times 30 \text{ cm}} = \frac{50}{150} = \frac{1}{3}$$

E.3 = c

E.4 In his job as a bricklayer, Ian must move a load of bricks to the top of a building. There are two winches Ian can choose to use. The first winch requires 50 turns and the second winch requires 100 turns to pull up the load. Which of the following statements is TRUE if we assume that friction is very small?

- a) Each of the winches will require the same force.
- b) The first winch will require more energy than the second.
- c) The first winch will require less energy than the second.
- d) The first winch will require half as much force as the second.
- e) The first winch will require twice as much force as the second.

The winch requiring 50 turns has **one-half the distance in** as the winch requiring 100 turns. Thus the 50 turn winch requires **twice as much force in** as the 100 turn winch.

E.4 = e

E.5 A complex machine is composed of a block and tackle and a lever. The mechanical advantage of the block and tackle is 4, and the mechanical advantage of the lever is 5. What is the mechanical advantage of the machine?

$$MA_{complex} = MA_{block} \times MA_{lever} = 4 \times 5 = 20$$

- a) 1
- b) 1.67
- c) 8
- d) 15
- e) 20

E.5 = e

E.6 In question E.5, if the efficiency of the lever is 60% and the efficiency of the block and tackle is 20%, what is the efficiency of the machine?

$$Eff_{complex} = Eff_{block} \times Eff_{lever} = 0.20 \times 0.60 = 0.12$$

- a) 3%
- b) 12%
- c) 33%
- d) 40%
- e) 80%

E.6 = b

E.7 The mechanical advantage of a complex stapling machine is 10. The machine includes a lever with a mechanical advantage of 2.5. What is the mechanical advantage of the rest of the machine?

$$MA_{\text{complex}} = MA_{\text{lever}} \times MA_{\text{rest}}$$

$$MA_{\text{rest}} = \frac{MA_{\text{complex}}}{MA_{\text{lever}}} = \frac{10}{2.5} = 4$$

- a) 1
- b) 2.5
- c) 4
- d) 7.5
- e) 10

E.7 = c

Solutions to Period 8 Exercises

$$\mathbf{E.1 = c}$$

$$\mathbf{E.2 = d}$$

$$\mathbf{E.3 = c}$$

$$\mathbf{E.4 = e}$$

$$\mathbf{E.5 = e}$$

$$\mathbf{E.6 = b}$$

$$\mathbf{E.7 = c}$$