Ch 8.1 and 8.2 Study Guide

Write the word from Column B in the space before its description in Column A.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>Machine</td>
</tr>
<tr>
<td>Joule</td>
<td>Watt</td>
</tr>
<tr>
<td>Watt</td>
<td>Force</td>
</tr>
<tr>
<td>Force</td>
<td>Work Output</td>
</tr>
<tr>
<td>Power</td>
<td>Power</td>
</tr>
<tr>
<td>Machine</td>
<td>Work Input</td>
</tr>
<tr>
<td>Effort</td>
<td>Joule</td>
</tr>
<tr>
<td>pull</td>
<td>Work</td>
</tr>
<tr>
<td>1. Force x Distance</td>
<td>force</td>
</tr>
<tr>
<td>2. 1 Newton x 1 meter</td>
<td>force</td>
</tr>
<tr>
<td>3. 1 joule per second</td>
<td>force</td>
</tr>
<tr>
<td>4. Effort or resistance (push or pull)</td>
<td>force</td>
</tr>
<tr>
<td>5. Ratio of work to time</td>
<td>force</td>
</tr>
<tr>
<td>6. An instrument that makes work easier</td>
<td>force</td>
</tr>
<tr>
<td>7. Effort force</td>
<td>force</td>
</tr>
<tr>
<td>8. Force done by the machine</td>
<td>force</td>
</tr>
</tbody>
</table>

\[
\text{Work} = \text{Force} \times \text{Distance}
\]

\[
\text{Power} = \frac{\text{Work}}{\text{Time}}
\]

Find the missing variable. Show all work!

9. Madi used 50 N to move a box 6 meters.
   \[
   W = F \times D = 50 \text{ N} \times 6 \text{ m} = 300 \text{ J}
   \]
   Answer (with units) : 300 J

10. Joaquin used 150 J of work to move a box 25 meters. What force did he apply?
   \[
   F = \frac{W}{D} = \frac{150 \text{ J}}{25 \text{ m}} = 6 \text{ N}
   \]
   Answer (with units) : 6 N

11. A force of 10,000 N is applied to a brick wall. It doesn’t move. How much work is performed?
   \[
   \text{None!}
   \]

12. A 950N skydiver jumps from the plane. When he lands on the ground, there was 38,000,000 J of work performed. How far did he fall?
   \[
   D = \frac{W}{F} = \frac{38,000,000 \text{ J}}{450 \text{ N}} = 84,444 \text{ m}
   \]
   Answer (with units) : 84,444 m

13. You are walking from your math class to your science class. You are carrying a stack of books that weigh 20 N. You walk 45 m down the hall, climb 15 m up the stairs, and then walk another 30 m through the hallway to your science class. What is the total work performed on your books?
   \[
   W = F \times D = 20 \text{ N} \times 15 \text{ m} = 300 \text{ J}
   \]

13. Ramez got 4500 J of work done in 5 seconds.
   \[
   P = \frac{W}{t} = \frac{4500 \text{ J}}{5} = 900 \text{ W}
   \]
   Answer (with units) : 900 W

14. How much work did Mariam perform if she lifted a barbell in 12 seconds with 12.5 Watts?
   \[
   W = P \times t = 12.5 \text{ W} \times 12 \text{ s} = 150 \text{ J}
   \]
   Answer (with units) : 150 J

15. Two-Step Problem: A 750 N pole-vaulter lifts himself 5 m high in 2.5 seconds. What is his power?
   Solve for WORK first:
   \[
   W = F \times D = 750 \text{ N} \times 5 \text{ m} = 3750 \text{ J}
   \]
   Solve for POWER:
   \[
   P = \frac{W}{t} = \frac{3750 \text{ J}}{2.5 \text{ s}} = 1500 \text{ W}
   \]
   Final Answer: 1,500 Watts
16. A tow truck pulls a car out of a ditch in 6.5 seconds. If 6000 Watts of power is used, how much work is performed?

\[ W = P \times t = 6000 \times 6.5 = 39,000 \text{ J} \]

17. A horse performs 15,000 J of work pulling a wagon for 20 seconds. What is the horse’s power?

\[ P = \frac{W}{t} = \frac{15000}{20} = 750 \text{ W} \]

\[ \text{MA} = \frac{\text{Output Force}}{\text{Input Force}} \quad \text{ME} (\%) = \frac{\text{Output Work}}{\text{Input Work}} \times 100 \]

Calculate the mechanical efficiency of the following machines. Show all work!

18. A man expends 100 J of work to move a box up an inclined plane. The amount of work produced is 80 J. What is the ME?

\[ \text{ME} = \frac{80 \times 100}{100} = 80\% \text{ ME} \]

19. A pulley operates with 40% efficiency. If the work put in is 200 J, how much work is produced (work output)? Solve using algebraic ratios.

\[ \text{ME} = \frac{W_0}{W_I} \times 100 \quad \frac{40}{100} = \frac{W_0}{200} \times 100 \quad 0.4 \times 200 = W_0 \]

\[ W_0 = 80 \text{ J} \]

Calculate the Mechanical Advantage for the following problems. Show all work!!

20. A claw hammer is used to pull a nail that exerts an output force of 3000 N. The input force is 200 N. What is the MA for the claw hammer?

\[ \text{MA} = \frac{3000 \text{ N}}{200} = 15 \]

21. A pulley system is used to lift a box of bricks. The box weighs 6400 N. The force applied to the pulley system is 400 N. Find the MA of the pulley system.

\[ \text{MA} = \frac{6400 \text{ N}}{400} = 16 \]

22. An iron bar is used to lift a slab of marble. The MA of the iron bar is 8. If the slab weighs 6400 N (output force), what is the input force required to lift the slab of marble? (Hint: make a triangle for the MA equation using M = O/I)

\[ I = \frac{O}{\text{MA}} = \frac{6400 \text{ N}}{8} = 800 \text{ N} \]