

Activity 1.1.2 Simple Machines Practice Problems Answer Key

Procedure

Answer the following questions regarding simple machine systems. Each question requires proper illustration and annotation, including labeling of forces, distances, direction, and unknown values. Illustrations should consist of basic simple machine functional sketches rather than realistic pictorials. Be sure to document all solution steps and proper units.

All problem calculations should assume ideal conditions and no friction loss.

Simple Machines – Lever

A first class leverin static equilibrium has a 50lb resistance force and 15lb effort force. The lever’s effort force is located 4 ft from the fulcrum.

1. Sketch and annotate the lever system described above.

|  |
| --- |
|  |

1. What is the actual mechanical advantage of the system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  | AMA = 3.33 |

1. Using static equilibrium calculations, calculate the length from the fulcrum to the resistance force.

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

A wheelbarrow is used to lift a 200 lb load. The length from the wheel axle to the center of the load is 2 ft. The length from the wheel and axle to the effort is 5 ft.

1. Illustrate and annotate the lever system described above.

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|  |

1. What is the ideal mechanical advantage of the system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

1. Using static equilibrium calculations, calculate theeffort force needed to overcome the resistance force in the system.

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

A medical technician uses a pair of four inch long tweezers to remove a wood sliver from a patient. The technician is applying 1 lb of squeezing force to the tweezers. If more than 1/5 lb of force is applied to the sliver, it will break and become difficult to remove.

1. Sketch and annotate the lever system described above.

|  |
| --- |
|  |

1. What is the actual mechanical advantage of the system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

1. Using static equilibrium calculations, calculate how far from the fulcrum the tweezers must be held to avoid damaging the sliver

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

Simple Machines – Wheel and Axle

1. What is the linear distance traveled in one revolution of a 36 in. diameter wheel?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |



An industrial water shutoff valve is designed to operate with 30 lb of effort force. The valve will encounter 200 lb of resistance force applied to a 1.5 in. diameter axle.

1. Sketch and annotate the wheel and axle system described above.

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1. What is the required actual mechanical advantage of the system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

1. What is the required wheel diameter to overcome the resistance force?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  | 10.0in. |

Simple Machines – Pulley System

A construction crew lifts approximately 560 lb of material several times during a day from a flatbed truck to a 32 ft rooftop. A block and tackle system with 50 lb of effort force is designed to lift the materials.

1. What is the required actual mechanical advantage?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

1. How many supporting strands will be needed in the pulley system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  | 12 |

A block and tackle system with nine supporting strands is used to lift a metal lathe in a manufacturing facility. The motor being used to wind the cable in the pulley system can provide 100 lb of force.

1. What is the mechanical advantage of the system?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |

1. What is the maximum weight of the lathe?

|  |  |  |
| --- | --- | --- |
| Formula | Substitute / Solve | Final Answer |
|  |  |  |