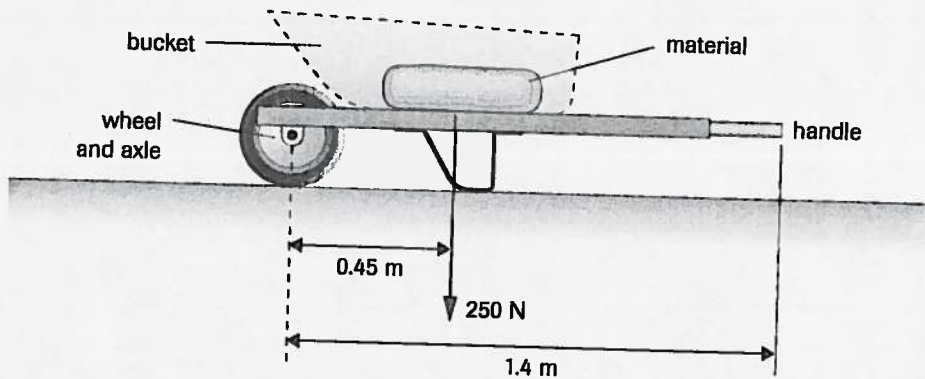


Torque and Levers—Additional Practice

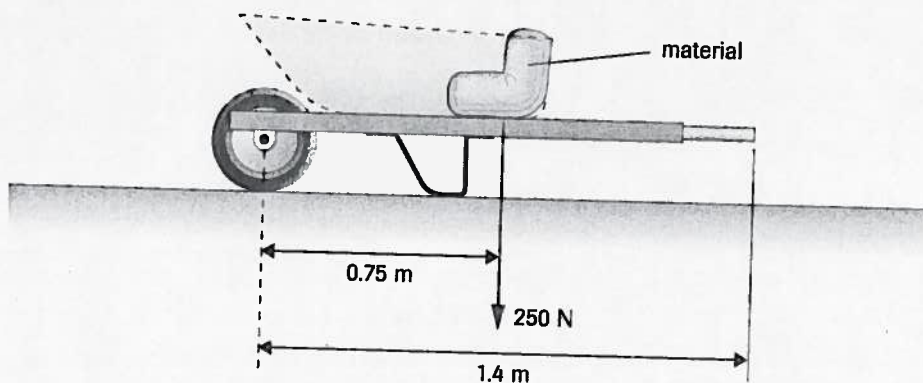
1. A wheelbarrow is a lever used to move heavy objects or materials from one place to another. **Figure 1** is a system diagram of a simple wheelbarrow. The load force for the material acts through the centre as shown.

Figure 1



- (a) Label the fulcrum, effort force, effort arm, and load arm. What class of lever is a wheelbarrow?
- (b) Calculate the magnitude of the load torque and the magnitude of the effort force required to support the wheelbarrow if the effort force is placed at the end of the handle.
2. In **Figure 2** the material has been shifted to the back of the bucket as shown, changing the position of the load force.

Figure 2

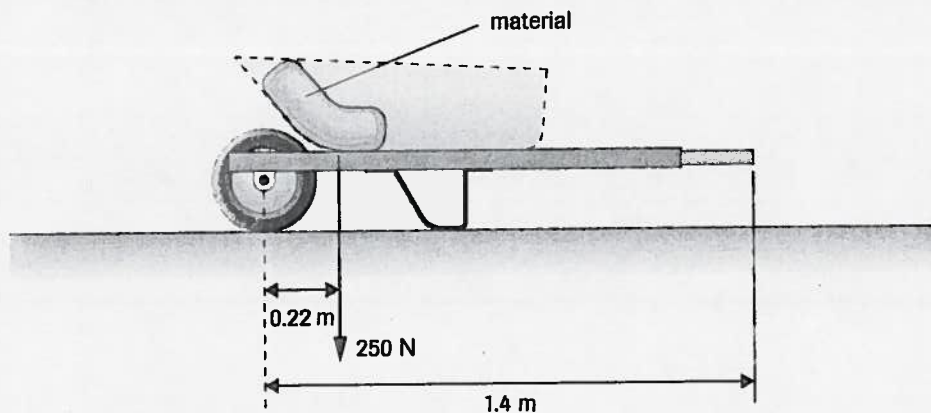


- (a) Predict what will happen to the magnitude of the load torque and effort force. Explain your reasoning.

- (b) Calculate the magnitude of the load torque and the magnitude of the effort force required to support the wheelbarrow if the effort force is placed at the end of the handle.

3. In **Figure 3** the material has been shifted to the front of the bucket as shown, changing the position of the load force.

Figure 3



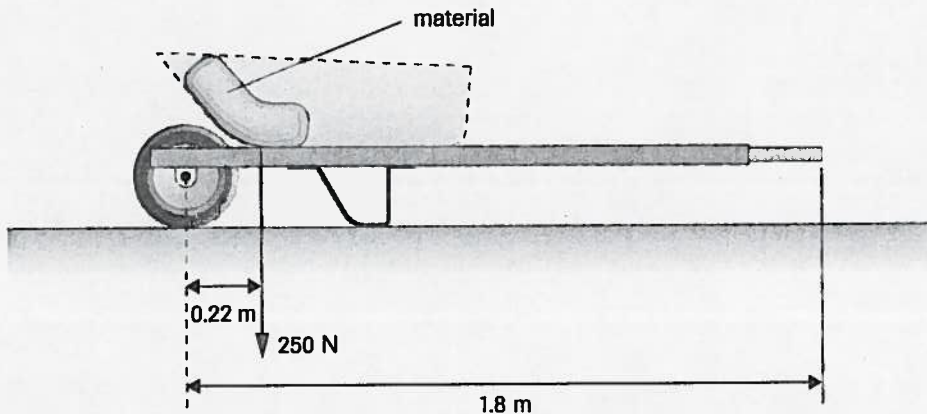
- (a) Predict what will happen to the magnitude of the load torque and effort force. Explain your reasoning.

- (b) Calculate the magnitude of the load torque and the magnitude of the effort force required to support the wheelbarrow if the effort force is placed at the end of the handle.

4. Where should the materials in a wheelbarrow be placed to reduce the effort force as much as possible? Explain.

5. In **Figure 4** the material has been shifted to the front of the bucket as shown, changing the position of the load force, and the handle has also been extended.

Figure 4



- (a) Predict what will happen to the magnitude of the load torque and effort force. Explain your reasoning.
- (b) Calculate the magnitude of the load torque and the magnitude of the effort force required to support the wheelbarrow if the effort force is placed at the end of the handle.
- (c) What happens to the effort force required to support the wheelbarrow if the handle is extended?
6. Use what you have learned about torque to design a better wheelbarrow. Consider changing both the size and position of different parts of the wheelbarrow. Draw a simple labelled diagram with reasonable lengths indicated and justify any changes you have made. Discuss any problems or limitations of your wheelbarrow.