

Science 1.1 AS 90940 Demonstrate understanding of aspects of mechanics

Writing Excellence answers to **Work and Power** questions

Work and Power QUESTION

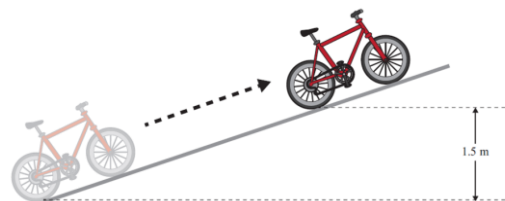
Question: A bike with a mass of 20 kg is lifted onto a shelf that is 1.5 metres high.

It takes 3 seconds to lift the bike.

Calculate the power required to lift the bike onto the shelf.

Before you calculate the power, you will need to:

- determine the weight force of the bike
- calculate the work done in lifting the bike.



A person pushed the same bike up a ramp that it was also at a height of 1.5m. It then took them a longer time to do this than lifting the bike. Explain whether the power needed to push the bike up the ramp is more or less than when it is lifted straight up to the same height. Refer to force and energy.

ANSWER

1. calculate the **weight** (force) of the object (bike) with units

$$F_w = m \times g$$

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$$F = 20 \times 10 = 200 \text{ N}$$

2. calculate the **work done** by the bike with units

$$W = F \times d$$

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$$W = 200 \times 1.5 = 300 \text{ J}$$

3. calculate the **power** required to lift the object (bike) with units

$$P = W / t$$

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$$P = 300 / 3 = 100 \text{ W}$$

4. link the same height above ground to same work required

As the height above the ground is the same, **the same work is required** to travel up the ramp as lifting the bike straight up.

5. link the same work done to the same amount of energy gained

If the same amount of work is done, the same amount of energy is gained.

6. explain the **$W = F \times d$** in words comparing the differences in F and d in both situations – with both equalling the same work done.

As $W = F \times d$, if d is increased, the amount of force required to do the same amount of work will be less, ie a ramp allows the same amount of work to be done with a smaller force over a greater distance.

7. Compare the power required in both situations by explaining **$P = W / t$** in words

The energy gained by the bike is the same in both cases, but the **time taken** to go up the ramp is greater than lifting it vertically. As $P = W / t$, a greater time would mean **less power is required**.

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.