Answer on Question #41473, Physics, Mechanics

A 2400 W engine pulls a 200 kg block at constant speed up a 12.0 m long, 25.0° incline. Determine long does it takes to cover this distance.

Solution:

Given:

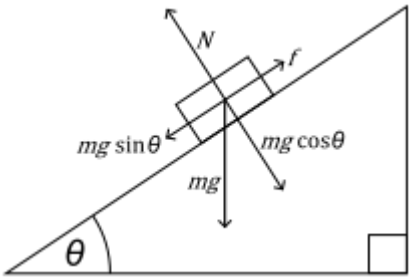
$P = 2400$ W,

$m = 200$ kg,

$d = 12.0$ m,

$\theta = 25°$,

$t = ?$



A load moving with constant speed on an inclined plane, when considered as a free body has three forces acting on it:

- The applied force, F exerted on the load to move it, which acts parallel to the inclined plane.
- The weight of the load, mg, which acts vertically downwards
- The force of the plane on the load. This can be resolved into two components:

The normal force N of the inclined plane on the load, supporting it. This is directed perpendicular (normal) to the surface.

Using Newton's second law of motion the load will be in steady motion if the sum of the forces on it is zero.

$$F - mg\sin\theta = 0$$

Thus,

$$F = mg\sin\theta$$

Work done by the engine is

$$A = Fd = mgd\sin\theta$$

The equation for the power is

$$P = \frac{A}{t}$$

Thus, time is

$$t = \frac{A}{P} = \frac{mgd\sin\theta}{P}$$

$$t = \frac{200 \cdot 9.8 \cdot 12 \cdot \sin 25°}{2400} = 4.14 \approx 4.1 \text{ s}$$

Answer. time is $t = 4.1$ s.