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Fluid Mechanics Fundamentals and Applications

(3rd Edition)

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Chapter 1, Problem 30P

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Problem

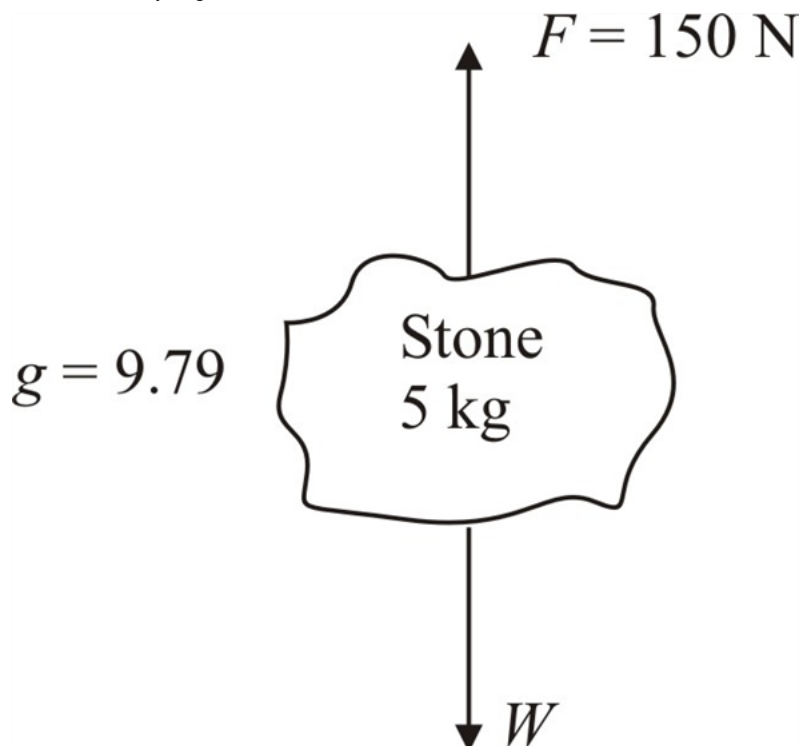


A 5-kg rock is thrown upward with a force of 150 N at a location where the local gravitational acceleration is 9.79 m/s². Determine the acceleration of the rock, in m/s².

Step-by-step solution

Step 1 of 3

Draw the free body diagram of the rock.



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Step 2 of 3

Mass of rock $m = 5 \text{ kg}$

The acceleration due to gravity $g = 9.79 \text{ m/s}^2$

Find the weight of rock.

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gravity.

Substitute 5 kg for m and 9.79 m/s^2 for g .

$$\begin{aligned} W &= 5 \times 9.79 \\ &= 48.95 \text{ N} \end{aligned}$$

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Step 3 of 3

Find the net force acting on the stone.

$$F_{\text{net}} = F_{\text{th}} - W$$

Here, F_{th} is the force with which the rock is thrown and F_{net} is the net force acting on the rock.

Substitute 150 N for F_{th} and 48.95 N for W .

$$\begin{aligned} F_{\text{net}} &= 150 - 48.95 \\ &= 101.05 \text{ N} \end{aligned}$$

By Newton's second law, the net force is given by:

$$F_{\text{net}} = ma$$

Here, a is the acceleration of the rock.

Substitute 101.05 N for F_{net} and 5 kg for m .

$$\begin{aligned} F_{\text{net}} &= ma \\ a &= \frac{F_{\text{net}}}{m} \\ a &= \frac{101.05}{5} \end{aligned}$$

$$a = 20.21 \text{ m/s}^2$$

Therefore, the acceleration of the rock 20.21 m/s^2 (\uparrow).

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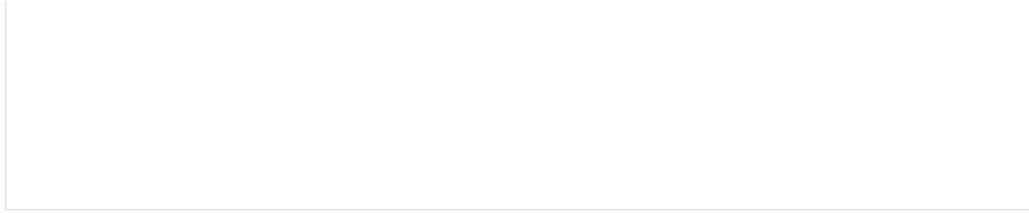
What is a steady-flow process?

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Chapter 1, Problem 23P

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