

3.5 Power

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on **power**.

You must be able to:

- define **power** 功率 as $P = \frac{W}{\Delta t}$
- calculate **average power** 平均功率 from work done over a time interval
- relate **instantaneous power** to force and velocity, $P = Fv$
- use the SI unit **watt** 瓦特 and convert between energy and power

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Power is the rate of energy transfer

$P = \frac{W}{\Delta t}$, measured in watts ($1 \text{ W} = 1 \text{ J s}^{-1}$). A motor that does 600 J of work in 3.0 s delivers $P = 200 \text{ W}$.

■ Power from force and speed

For a force acting at speed v , $P = Fv$. A car engine providing 50 N of drive at 4.0 m s^{-1} : $P = 200 \text{ W}$.

■ Energy from power

$W = P \Delta t$. A 100 W bulb left on for 60 s uses 6000 J.

2 Practice

2.1 A crane does 9000 J of work in 6.0 s. Find its power. [1]

2.2 A car engine pushes with 800 N at a steady 20 m s^{-1} . Find the power delivered. [2]

2.3 A 60 W device runs for 120 s. Find the energy it uses. [1]

3 Exam-style questions

3.1 One watt is equal to [1]

- **A** 1 J
 - **B** 1 J s⁻¹
 - **C** 1 N
 - **D** 1 J s
-

3.2 A motor lifts a 200 N weight at a constant 0.50 m s⁻¹. Its power output is [1]

- **A** 100 W
 - **B** 200 W
 - **C** 400 W
 - **D** zero
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3.3 A 500 kg lift rises 20 m at constant speed in 10 s (take $g = 10 \text{ m s}^{-2}$).

(a) Find the work done against gravity. [2]

(b) Find the power output of the motor. [1]

4 Go further

- work through the **3.5 Power** lesson on the **Learn** page;
- read the **Work, Energy, and Power** section of the AP Physics 1 handout on the **Know** page.

Solutions

2.1 $P = \frac{W}{\Delta t} = \frac{9000}{6.0} = 1500 \text{ W}.$

2.2 $P = Fv = 800 \times 20 = 16\,000 \text{ W}.$

2.3 $W = P \Delta t = 60 \times 120 = 7200 \text{ J}.$

3.1 B.

3.2 A — $P = Fv = 200 \times 0.50 = 100 \text{ W}.$

3.3 (a) $W = mgh = 500 \times 10 \times 20 = 1.0 \times 10^5 \text{ J}.$ (b) $P = \frac{1.0 \times 10^5}{10} = 1.0 \times 10^4 \text{ W}.$