3.5 Power

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS power • watt • average power • energy • work

Objective

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

You must be able to:

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

1 Key knowledge and worked examples

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

> ■ **Power is the rate of energy transfer**
>
> $P = \dfrac{W}{\Delta t}$, measured in watts (1 W = 1 J s^{-1}). A motor that does 600 J of work in 3.0 s delivers $P = 200$ 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}: $P = 200$ 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

3.3 A 500 kg lift rises 20 m at constant speed in 10 s (take $g = 10$ m s^{-2}).

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

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

Solutions

Each answer shows the steps, then the **result**.

2.1

- $P = \dfrac{W}{\Delta t} = \dfrac{9000}{6.0} = 1500 \text{ W}$

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

- 1 J s^{-1}.

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)

- $P = \dfrac{1.0 \times 10^5}{10} = 1.0 \times 10^4 \text{ W}$