

## 3.5 Power

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

**Total: 14 marks****KEY WORDS** power 功率 • work 功

### Objective

Build the skills to answer exam questions on **power**.**You must be able to:**

- use **power** 功率 as the rate of doing work:  $P = \frac{W}{t}$
- use  $P = Fv$  for a force moving at speed  $v$
- state the unit of power (the watt,  $1 \text{ W} = 1 \text{ J s}^{-1}$ )
- compare machines by their power output

### 1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

#### ■ Power is work per time

$$P = \frac{W}{t}.$$

Doing 600 J of work in 3 s gives  $P = 600/3 = 200 \text{ W}$ .

#### ■ Power as force times speed

For a force  $F$  moving an object at steady speed  $v$ ,

$$P = Fv.$$

A 50 N driving force at  $4 \text{ m s}^{-1}$  delivers  $P = 50 \times 4 = 200 \text{ W}$ .

#### ■ The watt

One watt is one joule per second. A 100 W bulb uses 100 J every second.

## 2 Practice

Now apply the methods above.

**2.1** A motor does 900 J of work in 3 s. Find its power. [2]

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**2.2** A 20 N force moves an object at  $5 \text{ m s}^{-1}$ . Find the power. [2]

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**2.3** State the unit of power and what it equals. [1]

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**2.4** Two motors do the same work; motor A takes less time. Which has the greater power? [1]

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## 3 Exam-style questions

**3.1** Power is defined as [1]

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|---|---|
| A | B |
| C | D |
- A** force times distance  
**B** the rate of doing work  
**C** work times time  
**D** energy times speed

**3.2** A car engine provides 3000 N of force at  $20 \text{ m s}^{-1}$ . Its power output is [1]

- |   |   |
|---|---|
| A | B |
| C | D |
- A** 150 W  
**B**  $6.0 \times 10^4 \text{ W}$   
**C** 3000 W  
**D** 20 W

**3.3** A crane lifts a 500 kg load at a steady  $0.4 \text{ m s}^{-1}$  ( $g = 10 \text{ m s}^{-2}$ ).

(a) Find the upward force needed. [1]

(b) Find the power output of the crane. [2]

**3.4** A pump does 12 000 J of work in 40 s.

(a) Find its power. [2]

(b) State how much energy it uses in one minute at this rate. [1]