# Power

**Starter**

1. A bicycle of mass $30$ kg is pushed up a hill inclined at $15°$ to the horizontal. Calculate the work done, to the nearest J, in moving the bicycle $70$ m, starting and finishing at rest.

**Notes**

Power is measured in joules per second and this is given a special name — watt (W).
$1$ J/s = 1 W

$$\text{Average power} = \frac{\text{work done}}{\text{time taken}} = \frac{WD}{t}$$

***E.g. 1*** A hotel lift, of total mass $1200$ kg, rises a distance of $60$ m in $20$ s. What is the power output of the motor?

***Power and speed***

How is power connected to speed?

$$\text{Average power} = \frac{\text{work done}}{\text{time taken}} = \frac{\text{force} \times \text{distance}}{\text{time taken}} = \text{force} \times \frac{\text{distance}}{\text{time taken}} = \text{force} \times \text{speed}$$

$$P = Fv$$

***E.g. 2*** A $160$ kg barrel of bricks is raised vertically by a $2$ kW engine. Calculate the distance the barrel will move in $7$ seconds travelling at a constant speed.

***Working:*** $P = Fv$: $2000 = 160g \times v \Rightarrow v \approx 1.2755$ m/s
Distance, $s = 7 \times 1.2755... \approx 8.93$ m
The distance the barrel will move in $7$ seconds is $8.93$ m (3 s.f.).

***E.g. 3*** A swimmer of mass $50$ kg pushes off from the side with speed $0.8$ m/s. She can develop power of $200$ W, and the resistance of the water is $220$ N.
(a) At what rate will she accelerate from the side of the pool?
(b) Assuming resistance is constant, what is her greatest possible speed?

***E.g. 4*** A winch operating at $1$ kW pulls a box of weight $980$ N up a smooth slope at a constant speed of $2$ m/s. Calculate the angle the slope makes with the horizontal.

Video: Power (constant speed then uphill)
Video: Power (accelerating then uphill)

Power EQ

Solutions to Starter and E.g.s

**Exercise**

p20 1E Qu 1-12

**Summary**

Power is measured in watts where 1 W = $1$ J/s

$$\text{Average power} = \frac{\text{work done}}{\text{time taken}} = \frac{WD}{t}$$

Average power = force × speed i.e $P = Fv$