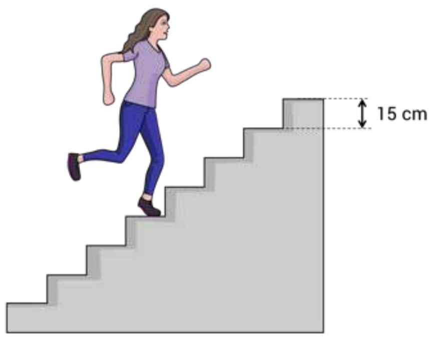
0 1

Late for an appointment, Gillian is running up a set of eight steps. As shown in the below diagram, each of the steps is 15 cm high.



0 1 . 1

Gillian has a mass of 60 kg. Calculate the increase in her gravitational potential energy store between the bottom and the top of the set of steps. Take g = 9.8 N/kg

Total change in height, h = 8 × 0.15 = 1.2 m
Increase in GPE = m g h = 60 × 9.8 × 1.2 = **705.6 J**

0 1 . 2

Whilst running up the steps, she developed an average power of 250 W. How long did it take her to get from the bottom to the top of the steps?

E = P t
t = E ÷ P = 705.6 ÷ 250 = **2.8 s** (1 d.p.)

0 2

The generator of a nuclear power station supplies 4.32×10^{13} J of electrical energy per day on average.

0 2 . 1

Calculate the average power output of the above generator.

Number of seconds in 1 day = 24 × 60 × 60 = 86,400 s
Power, P = E ÷ t = 4.32×10^{13} ÷ 86,400 = 500,000,000 W = **5×10^{8} W**

0 2 . 2

A developer is considering building a wind farm close to the nuclear power station. Each of its wind turbines would deliver an average power output of 2 MW.

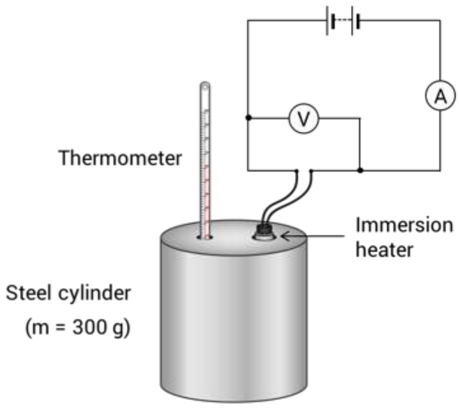
How many such turbines would the wind farm require for its power output to equal that of the generator of the nuclear power station?

Power output of nuclear power station generator, P_1 = 500 MW
Power output of wind turbine, P_2 = 2 MW
Number of wind turbines required = 500 ÷ 2 = **250**

Don't forget: 1 MW = 1,000,000 W = 10^{6} W

0 3

Alan is using the voltmeter-ammeter method to determine the specific heat capacity of a type of steel. The experimental setup used and data obtained are as shown below.



Initial temperature of steel, T_1 = 24 °C

Final temperature of steel, T_2 = 64 °C

Current, I = 2 A

Potential difference, V = 12 V

Heating time, t = 260 seconds

0 3 . 1

Write down one safety precaution which Alan should have taken in carrying out his experiment.

Place steel cylinder on a heatproof mat / ensure that temperature of steel cylinder does not get too high / allow steel cylinder to cool down before handling / ensure that circuit has been properly connected before switching on / after experiment, allow immersion heater to cool to room temperature before removing. Any ONE.

0 3 . 2

Use the above data to determine a value for the specific heat capacity of the steel used. Include an appropriate unit with your answer.

Mass, m = 0.3 kg
Increase in temperature, $\Delta\theta$ = 40 °C

$E = m\,c\,\Delta\theta$
$P\,t = m\,c\,\Delta\theta$
$I\,V\,t = m\,c\,\Delta\theta$
$2 \times 12 \times 260 = 0.3 \times c \times 40$
$6240 = 12\,c$
c = **520 J/kg °C**

Equations to learn: the equation for electrical power (P = IV) appears in the *Electricity* section. You'll have to remember both this and E = P t for your exam!

0 3 . 3

Alan discovers that the actual value of the specific heat capacity of the steel used is slightly smaller than that which calculated from the results of his experiment. Describe and explain one change which he could have made to the experiment to improve the accuracy of this value.

Insulate the cylinder to reduce heat loss to the surroundings [1]. In our calculation for the specific heat capacity of the steel, we assumed that all of the thermal/heat energy supplied by the (immersion) heater was transferred to the steel, but in reality some of this energy would have been dissipated / transferred to the surroundings [1].