

A Level Physics A
H556/01 Modelling physics

Question Set 14

- 1 Wind turbines convert the kinetic energy of the wind into electrical energy. Fig. 18 shows a wind turbine.

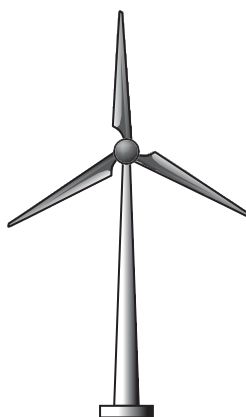


Fig. 18

- (a) When the wind speed is 8.0 ms^{-1} , the kinetic energy of the air incident at the turbine per second is 1.2 MJ s^{-1} .
Calculate the mass of the air incident at the turbine per second.

mass per second = kg s^{-1} [2]

- (b) A group of engineers are investigating the design of wind turbines.
The maximum **input** power P from the wind is given by the equation

$$P = \frac{1}{2} \rho A v^3$$

where A is the area swept out by the rotating blades, ρ is the density of air and v is the speed of the wind.

- (i) Show that the equation is homogeneous with both sides of the equation having the same base units. [3]

- (ii) The input power to the wind turbine is 1.2 MW when the wind speed is 8.0 m s^{-1} .
The density of air is 1.3 kg m^{-3} .

Calculate the length L of the turbine blades.

$L = \dots\dots\dots \text{ m}$ [2]

- (iii) A wind farm is required to produce an output power of 50 MW when the average wind speed is 8.0 m s^{-1} . The efficiency of each wind turbine is 42% .

Calculate the minimum number N of wind turbines required to meet this demand.

$N = \dots\dots\dots$ [2]

Total Marks for Question Set 14: 9

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