Oxford Cambridge and RSA

A Level Physics A

H556/01 Modelling physics

Question Set 14

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

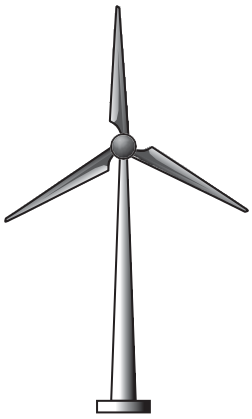

Fig. 18

(a) When the wind speed is 8.0 m s^{-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, t 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 = …… 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 = …….. **[2]**

Total Marks for Question Set 14: 9