4 Each blade on a turbine wheel is attached separately on a small section of the rim of the wheel as shown in Fig. 4.1. The blades are small and each behaves like a point mass of 0.72 kg at a distance of 0.65 m from the axis of rotation.

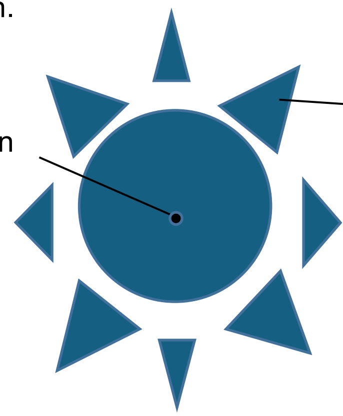

Fig. 4.1 Turbine wheel (top view)

The wheel is tested by spinning it at high speed. The plane of the wheel is kept horizontal with the axis of rotation vertical. It is found that the blades broke and flew off when the wheel is rotating at angular velocities greater than 540 rad s ^{1}.

(a) When the angular velocity of the wheel is 540 rad s^{-1}, calculate

(i) the linear speed of each blade,

linear speed = ______________________ m s^{-1} [2]

(ii) the centripetal acceleration.

centripetal acceleration = ______________________ m s^{-2}

[2]

(b) Use Newton's laws to explain why a blade might break and fly off when wheel is rotating at high angular velocities.

.____.

.____.

.____.

.____.

.____.

.____.[3]

(c) Use answer in **(a)(i)** to calculate the minimum radial force required to pull a blade off the wheel.

minimum radial force = ______________________ N [2]

[Total: 9]