Rotational Kinematics

1/ Complete the following table of frequency, periodic time, and angular velocity. The first line is done as an example.

Period (s)	Frequency (Hz)	Angular velocity (rad s^{-1})
12	0.0833	0.524
1.6		
		0.6
	45	
1500		

2/ Express:

i) 550Hz in rads s^{-1}
ii) A period of 0.076s in terms of frequency
iii) An angular velocity of 120rads s^{-1} in terms of periodic time
iv) A period of $9x10^{-5}$s in terms of angular velocity
v) A frequency of 30.4Hz in terms of periodic time

3/ A turbine spins at 600 RPM. Calculate the frequency of rotation in hertz and the angular velocity in radians per sec.

[10Hz, 62.8rad s^{-1}]

4/ An object moves on a circular path of radius 0.04m with a frequency of 8 Hz. Calculate;

- the angular velocity, ω.
- the velocity, v.
- the radial acceleration, a_r.

[50.3 rad s^{-1}, 2.011 ms^{-1}, 101.1 ms^{-2}]

5/ A golf ball spins at 3500RPM (366.5 rads s^{-1}). The ball has a radius of 2.134cm. Calculate the velocity and centripetal acceleration of a point of the equator of the ball as it spins.

[7.82ms^{-1}, 2.87$x10^3 ms^{-2}$]

6/ A 1500kg car takes a corner at 20ms^{-1}. The corner has a turning radius of 65m. Calculate the centripetal acceleration of the car and the friction force needed to make it take the corner.

[6.15ms^{-2}, 9230N]

7/ A pilot flying at 50 ms^{-1} does a loop the loop. At the top of the loop he feels weightless because the centrifugal acceleration just balances out gravity. Calculate the radius of the loop.

[255m]

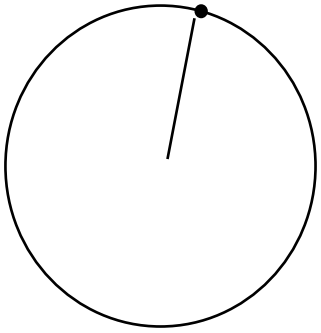
8/ During a tennis stroke, the racket accelerates from 0 rads s^{-1} to 18 rads s^{-1}. The execution of the stroke moves the racket through 3 rads. Calculate the angular acceleration and the time for the stroke.

[54 rads s^{-2}, 0.33s]

9/ A ferris wheel is set in motion by an angular acceleration of 0.015rads s^{-1}. Calculate the angular velocity of the wheel at 25s and calculate how far the wheel has rotated at this time.

[0.375rads s^{-1}, 4.69rads = ¾ of a revolution]

10/ The diagram below shows an object moving in a clockwise direction in a circular path at the end of a string. Draw vectors showing the direction of instantaneous velocity and acceleration of this particle.



11/ A basketball shot is released from the fingertips. A force of 4.64N is exerted at the edge of the basketball which has a radius of 0.113m and a mass of 0.6kg. The force is exerted for a time of 0.1s.

i) Calculate the acceleration of the ball as it is being thrown.
ii) Calculate the velocity of the ball just after it has been thrown.
iii) Calculate the kinetic energy of the ball just after it has been thrown.
iv) Calculate the torque on the basketball.
v) Calculate the ball's moment of inertia.
vi) Calculate the angular acceleration of the ball as it is being thrown.
vii) Calculate the angular velocity of the ball just after it has been thrown.
viii) Why is it advantageous to impart backspin to a basketball shot?

[7.74ms^{-2}, 0.774m/s, 0.18J, 0.5243Nm, 5.1x10^{-3}kgm^2, 103 rads s^{-2}, 10.3 rads s^{-1}]