Answer on Question #47831 – Engineering – Other

1. An aeroplane is flying at 100 m/s, it dives along a vertical circle of radius 200m. Mass of pilot is 75 kg. What force is on pilot by seat of plane when it is at maximum and minimum height?

$v = 200\,m/s$
$r = 200\,m$
$m = 75\,kg$
$F_1, F_2 - ?$

Solution.

The acceleration of the plane is centripetal: $a = \frac{v^2}{r}$.

When the plane is at maximum height, the acceleration is directed downwards, so the weight of the pilot is $P = m(g - a)$. When the plane is at minimum height, the acceleration is directed upwards, so the weight of the pilot is $P = m(g + a)$.

The force acting upon the pilot equals to pilot's weight, but the direction of it is opposite. Thus,

$$\boxed{F_1 = m\left(g - \frac{v^2}{r}\right)}, \quad \boxed{F_2 = m\left(g + \frac{v^2}{r}\right)}.$$

Let check the dimension: $[F_1] = [F_2] = kg \cdot \left(\frac{m}{s^2} + \frac{(m/s)^2}{m}\right) = \frac{kg \cdot m}{s^2} = N$.

Let evaluate the quantities: $F_1 = 75 \cdot \left(9.81 - \frac{100^2}{200}\right) = -3010(N)$,

$$F_2 = 75 \cdot \left(9.81 + \frac{100^2}{200}\right) = 4490(N).$$

Answer: $-3010\,N$, $4490\,N$.