36.75 The output shaft of an engine accelerates from $1000rpm$ at idle to $6000rpm$ at red line in $5seconds$. What is the rotational acceleration?

A. $105\frac{rad}{s^2}$

B. $521\frac{rad}{s^2}$

C. $727\frac{rad}{s^2}$

D. $1000\frac{rad}{s^2}$

Use the definition for rotational acceleration under Rigid Body Rotation. Re-write the derivative expression as a change in rotational velocity over time. No calculus is required.

$$\alpha = \frac{d\omega}{dt}$$

$$\alpha = \frac{\Delta\omega}{t}$$

Subtract to find the change in rotational velocity and convert units to $\frac{rad}{s}$.

$$\Delta\omega = \omega_2 - \omega_1 = 6000rpm - 1000rpm = 5000rpm$$

$$\Delta\omega = 5000\frac{rev}{min}\left(\frac{2\pi rad}{rev}\right)\left(\frac{1min}{60s}\right) = 523.6\frac{rad}{s}$$

Divide by the time to determine the rotational acceleration.

$$\alpha = \frac{523.6\frac{rad}{s}}{5s} = 104.7\frac{rad}{s^2}$$

Answer A