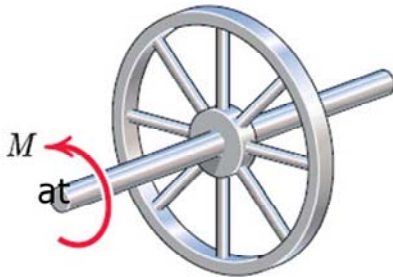The **50-kg** flywheel has a **radius of gyration** of **0.4 m** about its shaft axis and is subjected to the **torque M = 2(1-$e^{-0.1\theta}$) Nm**, where θ is in radians.

M at

Determine its **angular velocity** after **5 revolutions** if it starts

rest when θ = **0**.

ME 231: Dynamics

6/132 $T_1 + U_{1-2} = T_2$

$T_1 = 0$

$$U_{1-2} = \int_1^2 M d\theta = \int_0^{5(2\pi)} 2(1-e^{-0.1\theta}) d\theta$$

$$= \left. (2\theta + 20 e^{-0.1\theta}) \right|_0^{5(2\pi)}$$

$$= 2(5)(2\pi) + 20 e^{-0.1(5)(2\pi)} - 20$$

$$= 43.7 \text{ J}$$

$$T_2 = \tfrac{1}{2} I \omega^2 = \tfrac{1}{2}(50)(0.4)^2 \omega^2 = 4\omega^2$$

So $0 + 43.7 = 4\omega^2$, $\underline{\omega = 3.31 \text{ rad/s}}$

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