Total time: 1 hr **Total Points: 10 pt** **Student Name:**

Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

$$\text{speed} = \frac{\text{distance}}{\text{time}} \qquad \text{velocity} = \frac{\text{displacement}}{\text{time}} \qquad \text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

$$\text{velocity} = \text{initial velocity} + \text{acceleration} \times \text{time}$$

$$g = 9.8 \text{ m/s}^2 \qquad F = ma \qquad F_g = mg \qquad F_{fr} = \mu F_N \qquad \text{Torque} = \text{Force} \times \text{Lever Arm}$$

$$\text{momentum} = mv \qquad \text{change in momentum} = \text{impulse} = (\text{force})(\text{time})$$

$$\text{work} = (\text{force})(\text{distance}) \qquad \text{power} = \frac{\text{work}}{\text{time}} \qquad \text{K.E.} = \frac{1}{2}mv^2 \qquad \text{P.E.} = mgh$$

$$\text{rotational speed} = \frac{\text{angle swept}}{\text{time}} \qquad \text{power} = \text{torque} \times \text{angular velocity}$$

$$\text{speed} = \text{rotational speed} \times 0.5 \times \text{wheel diameter} \qquad \text{rpm} = \frac{\text{mph} \times \text{gear ratio} \times 336}{\text{tire diameter in inches}}$$

1. A flywheel of radius 27.0 cm has an angular speed of 47.0 rpm. What is that in rad/s?

Solution: $47.0 \times \frac{2\pi}{60} = 4.92$ rad/s

2. Convert 620 rad/s into rpm

Solution: $600 \times \frac{60}{2\pi} = 5,920$ rpm

3. A shaft of radius 8.50 cm rotates 7.00 rad/s. Through what angular displacement does it go in 1.20 s?

Solution: rotational speed $= \frac{\text{angle swept}}{\text{time}}$

$$7.00 = \frac{\text{angle}}{1.2} \rightarrow \text{angle} = 7.00(1.2) = 8.4 \text{ rad} = 1.24 \text{ revolutions}$$

4. Find the angular speed in rpm of the second hand of a wall clock.

Solution: 60 rpm

5. Find the angular speed in rpm of the minute hand of a wall clock.

Solution: 1 rpm

6. Find the angular speed in rad/s of the hour hand of a wall clock.

Solution: $\frac{1\text{rev}}{12\text{ hr}} = \frac{2(3.14)\text{ rad}}{12(60)(60)\text{ s}} = 1.45 \times 10^{-4}$ rad/s

7. What power is delivered by an enginer with torque 130 N.m at angular velocity of 65 rad/s.

Solution: power $= (130)(65) = 8450$ W

8. A motor develops 0.75 kW of power at 200 rpm. What torque is applied to the motor shaft?

Solution: power = torque $\times$ angular velocity

$$200 \text{ rpm} = 200 \times \frac{2\pi}{60} = 20.94 \text{ rad/s}$$

$$750 \text{ W} = \text{torque} \times (20.94) \rightarrow \text{torque} = \frac{750}{20.94} = 35.8 \text{ N.n}$$

9. Find the angular velocity for a motor developing 650 W of power with a torque of 130 N.m.

Solution: power = torque $\times$ angular velocity

$$650 \text{ W} = (130) \times \text{angular velocity} \rightarrow \text{angular velocity} = \frac{650}{130} = 5 \text{ rad/s}$$

Gears: $T_1 N_1 = T_2 N_2$

Levers, Wheel-and-Axel: $F_1 \times (\text{lever arm}_1) = F_2 \times (\text{lever arm}_2)$

$$\text{Mech. Advantage} = \frac{\text{F}_{\text{resistancea}}}{\text{F}_{\text{effort}}}$$

10. A driver gear has 72 teeth and makes 85.0 rpm. Find the rpm of the driven gear with 144 teeth.

Solution: $42.5rpm$

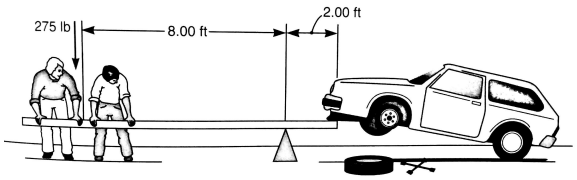
11. A driver gear with 40 teeth makes 154 rpm. How many teeth must the driven gear have if it makes 220 rpm?

Solution: 28 teeth

12. The larger of two gears in a clock has 36 teeth and tuns at a rate of 0.50 rpm. How many teeth does the smaller gear have if it rotates at 1/30 rev/s?

Solution: 9 teeth

13. A pole is used to lift a car that fell off a jack. The pivot is 2.00 ft from the car. Two people tegether exert 275 lb of force 8.00 ft from the pivot. What force is applied to the car?



Solution: 1100 lb force

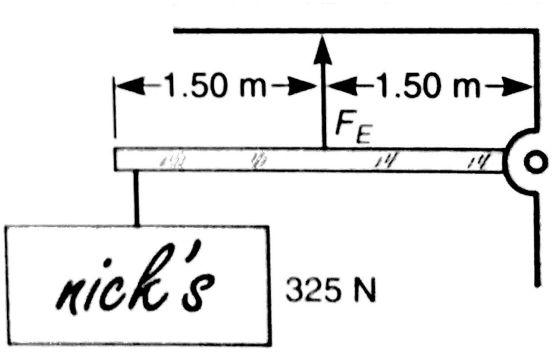
14. A wheelbarrow 6.00 ft long is used to haul a 120-lb load. How far from the wheel is the load placed so that a person can lift the load with a force of 45.0 lb force?

Solution: 2.25 ft

15. Find the Mechanical Advantage (MA) of the wheelbarrow

Solution: 2.67

16. Find the force F_E, pulling up on the beam holding the sign.



Solution: 650 N

17. An axle of radius 12.0 cm is used with a wheel of radius 62.0 cm. What force must be applied to the rim of the wheel to lift a weight of 975 N?

Solution: 188.7 N

18. Find the Mechanical Advantage (MA) in the previous problem.

Solution: 5.2

19. A wheel-and-axle has an effort force of 125 N and an effort radius of 17.0 cm. If the resistance force is 325 N, what is the resistance radius. Find the mechanical advantage.

Solution: 6.54 cm; 2.6