

**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.**

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

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

1. The coefficient of static friction for steel on steel is 0.58. If the normal force is 60 N, what is the maximum static friction you can have?

**Solution:** Static friction can be anything between zero and  $0.58 \times F_N$ . So the maximum friction is

$$0.58 \times 60 \text{ N} = 34.8 \text{ N}$$

2. If the kinetic friction is 30 N and the normal friction is 100 N, what is the kinetic coefficient of friction?

**Solution:**

$$\begin{aligned} F_{fr} &= \mu \times F_N \\ 30 &= \mu \times 100 \\ \mu &= \frac{30}{100} = 0.3 \end{aligned}$$

3. An earthmover slows from 15.0 km/h to 3.00 km/h in 2.70 s. What is its rate of deceleration?

**Solution:** The speed changes from 4.167 m/s to 0.833 m/s in 2.70 s

$$\text{acceleration} = \frac{0.833 - 4.167}{2.70} = -1.23 \frac{\text{m}}{\text{s}^2}$$

4. A rocket accelerates at  $10.0 \frac{\text{m}}{\text{s}^2}$  from rest for 20.0 s. Find its increase in speed?

**Solution:**

$$\begin{aligned} \text{speed} &= \text{initial speed} + \text{acceleration} \times \text{time} \\ \text{Increase in speed} &= 10.0 \frac{\text{m}}{\text{s}^2} \times 20.00 \text{ s} = 200 \text{ m/s} \end{aligned}$$

5. Find the weight of a 1150-kg automobile in N?

**Solution:**

$$1,150 \text{ kg} \times 9.8 \frac{\text{m}}{\text{s}^2} = 11,270 \text{ N}$$

6. What is the mass of a 20,000-N truck?

**Solution:**

$$\begin{aligned} \text{weight} &= mg \\ m &= \frac{\text{weight}}{g} = \frac{20,000}{9.8} = 2,040 \text{ kg} \end{aligned}$$

7. Find the acceleration produced by a total force of 93.0 N on a mass of 6.00 kg

**Solution:**

$$a = \frac{93.0}{6.00} = 15.5 \frac{\text{m}}{\text{s}^2}$$

8. Find the total force necessary to give each an object with mass 15.0 kg an acceleration of  $2.00 \frac{\text{m}}{\text{s}^2}$ .

**Solution:**

$$F = 15.0 \times 2.00 = 30.00 \text{ N}$$

9. Find the total force necessary to give an automobile of mass 120 slugs an acceleration of  $11.0 \text{ ft/s}^2$ .

**Solution:** We do not need to convert in the metric units. Both numbers are consistent and will give us the answer in force lb

$$120 \times 11.0 = 1,320 \text{ lb}$$

10. A truck of mass 13,100 kg is acted upon by a driving force of 8900 N. The motion is opposed by a frictional force of 2230 N. Find the acceleration

**Solution:** If 8,900 N act on the truck, but 2230 N of friction oppose it, then the total force on the truck is  $8,900 - 2,230 = 6670$  N.

$$F_{net} = ma$$

$$6670 = (13,100 \text{ kg}) \times (a)$$

$$a = \frac{6670}{13,100} = 0.51 \frac{\text{m}}{\text{s}^2}$$

11. A force of 20.0 N is applied at a distance of 0.3 m, what is the torque N.m?

**Solution:**

$$20.0 \text{ N} \times 0.3 \text{ m} = 6.0 \text{ N.m}$$

12. If you apply 35.0 lb force at a distance of 0.5 ft, what is the torque in ft.lb?

**Solution:**

$$35.0 \text{ lb} \times 0.5 \text{ ft} = 17.5 \text{ ft.lb}$$

13. If the torque on a shaft of radius 2.37 cm is 38.0 N.m, what force is applied to the shaft?

**Solution:** We need to convert the units for the radius from cm to m:  $2.37 \text{ cm} = 0.0237 \text{ m}$

$$\text{torque} = \text{force} \times \text{lever arm}$$

$$\text{force} = \frac{\text{torque}}{\text{lever arm}} = \frac{38.0}{0.0237} = 1,603 \text{ N}$$