

# PHYSICS 534

EXERCISE-07

Intro to Mechanics



John Strutt was awarded the Nobel prize for physics in 1904 for his work on gases and his discovery of argon.

STRUTT

Mechanics is the branch of physics which studies forces. For convenience, we divide mechanics into three parts:

- **STATICS** - The study of forces producing equilibrium (system at rest).
- **DYNAMICS** - The study of forces producing acceleration (system in motion).
- **WORK** - The study of energy.

Mechanics is built upon three basic quantities. They are:

The three basic quantities of mechanics

QUANTITY	SYMBOL	UNIT
Length	L	metre (m)
Mass	M	kilogram (kg)
Time	T	second (s)

➤ **IMPORTANT:** In solving physics problems, the quantities used in formulas *must* be expressed in the basic units. The distance must be in metres, the mass in kilograms and the time in seconds. Thus, although we may write 5 days as the time, in a formula requiring time we must enter  $4.32 \times 10^5$  s ( $5 \times \frac{24 \text{ h}}{\text{day}} \times \frac{60 \text{ min}}{\text{h}} \times \frac{60 \text{ sec}}{\text{min}} = 432\,000 \text{ s}$ ).

Although mechanics is derived from the three basic quantities of length, mass and time, note that there is nothing natural or special about these three basic quantities. It is only a matter of convenience that they have been chosen.

All other quantities are derived from the three basic quantities. Here are some examples:

Some derived quantities in mechanics

QUANTITY	DERIVATION	SYMBOL	UNIT
Velocity	Length/Time	L/T	m/s
Acceleration	Length/Time/Time	L/T/T	m/s/s or $\text{m/s}^2$
Momentum	Mass x Length/Time	ML/T	$\text{kg}\cdot\text{m/s}$
Force	Mass x Length/Time/Time	ML/T/T	$\text{kg}\cdot\text{m/s}^2$ or newton
Work	Mass x Length/Time/Time x Length	ML/T/TxL	$\text{kg}\cdot\text{m}^2/\text{s}^2$ or joule
Power	Mass x Length/Time/Time x Length/Time	ML/T/TxL/T	$\text{kg}\cdot\text{m}^2/\text{s}^3$ or watt

1. In what way did Aristotle *impede* the progress of science?

He did not approve of experimentation.



2. What was the *central idea* in Aristotle's philosophy?

**Good and evil; material things are evil, immaterial things are good.**

3. Aristotle reduced the world into *four* basic elements. List these elements.

**Earth**

**Fire**

**Water**

**Air**

4. What is the importance of Galileo's work?

**He made experimentation the official scientific method.**

5. What is the importance of Newton's work?

**He added theorization to the scientific method.**

6. Define *mechanics*.

**The study of forces.**

7. State and define the **three** main branches of mechanics.

① **Statics**

② **Dynamics**

③ **Work**

8. State the three **basic** quantities of mechanics and the unit for each.

① **Length (meter, m)**

② **Mass (kilogram, kg)**

③ **Time (second, s)**

9. State any three **derived** quantities in mechanics and the unit for each.

① Area (m<sup>2</sup>)

② Volume (m<sup>3</sup>)

③ Velocity (m/s)

10. Convert each of the following quantities into their *basic* units:

- |            |                               |                                |  |
|------------|-------------------------------|--------------------------------|--|
| a) 3 km    | <u>3000 m</u>                 | f) 1.8 mm                      | <u>1.8 x 10<sup>-3</sup> m</u>   |
| b) 600 g   | <u>0.6 kg</u>                 | g) 36 us                       | <u>36 x 10<sup>-6</sup> m</u>  |
| c) 4 hours | <u>14400 s</u>                | h) 100 km/h                    | <u>27.8 m/s</u> (100 x $\frac{1000}{3600}$ )   |
| d) 20 ms   | <u>20 x 10<sup>-3</sup> s</u> | i) 3.5 minutes                 | <u>210 s</u>   |
| e) 6 weeks | <u>3.6 x 10<sup>6</sup> s</u> | j) 1.8 RPM<br>(radius = 60 cm) | <u>0.1 m/s</u><br>$\frac{1.8}{60\text{ s}} \times 2\pi r = \frac{1.8}{60\text{ s}} \times 2 \times 3.14 \times 0.6\text{ m}$ |

