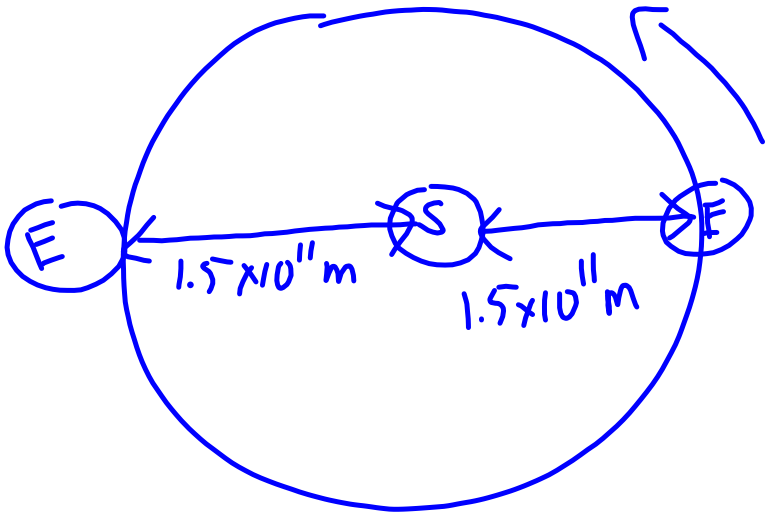
6. What is the average velocity of the Earth the instant it has traveled half of its circular orbit about the Sun in m/s? (v_{avg} = 19 025 m/s)

$$\vec{v} = \frac{\vec{d}}{t}$$



$\vec{d} = 3.0 \times 10^{11}$ m

$t = \frac{1}{2}$ year

$= 0.5 \times 365 \times 24 \times 3600 s = 15,768,000 s$

$$\vec{v} = \frac{3.0 \times 10^{11} m}{15768000} = \boxed{19025 \text{ m/s}}$$

4.7 Acceleration

- Define acceleration.
- Give examples of acceleration.
- Describe how it feels to accelerate.

Defining Acceleration

Acceleration is a measure of the change in velocity of a moving object. It measures the rate at which velocity changes. Velocity, in turn, is a measure of the speed and direction of motion, so a change in velocity may reflect a change in speed, a change in direction, or both. Both velocity and acceleration are vectors. A vector is any measurement that has both size and direction. People commonly think of acceleration as in increase in speed, but a decrease in speed is also acceleration. In this case, acceleration is negative and called deceleration. A change in direction without a change in speed is acceleration as well.

4.8 Calculating Acceleration from Velocity and Time

- Explain how to calculate average acceleration when direction is constant.
- Identify the SI unit for acceleration.
- Solve simple acceleration problems.

Calculating Average Acceleration in One Direction

Calculating acceleration is complicated if both speed and direction are changing or if you want to know acceleration at any given instant in time. However, it's relatively easy to calculate average acceleration over a period of time when only speed is changing. Then acceleration is the change in velocity (represented by Δv) divided by the change in time (represented by Δt):

$$acceleration = \frac{\Delta v}{\Delta t} \quad \Rightarrow \vec{a} = \frac{\vec{v}_f - \vec{v}_o}{t}$$

Guidance

- Acceleration is the rate of change of velocity. So in other words, acceleration tells you how quickly the velocity is increasing or decreasing. An acceleration of 5 m/s^2 indicates that the velocity is increasing by $5m/s$ in the positive direction every second.
- Gravity near the Earth pulls an object downwards toward the surface of the Earth with an acceleration of 9.8 $m/s^2 (\approx 10\ m/s^2)$. In the absence of air resistance, all objects will fall with the same acceleration. The letter g is used as the symbol for the acceleration of gravity.
  - When talking about an object's acceleration, whether it is due to gravity or not, the acceleration of gravity is sometimes used as a unit of measurement where $1g = 9.8m/s^2$. So an object accelerating at 2g's is accelerating at $2 * 9.8m/s^2$ or $19.6m/s^2$
- *Deceleration* is the term used when an object's *speed* (i.e. magnitude of its velocity) is decreasing due to acceleration in the opposite direction of its velocity.

Problem Set

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