Equations of motion with a uniform acceleration

v_0	Initial velocity
v	Final velocity
t	Time
a	Acceleration
x	Displacement

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$$v = v_0 + at \qquad x = v_0 t + \frac{1}{2} a t^2 \qquad v^2 = v_0^2 + 2ax$$

$$a = \frac{\Delta v}{\Delta t} = \frac{v - v_0}{t}$$
$$v - v_0 = at$$
$$v = v_0 + at$$

$$X = v'_{av} t = \frac{v + v_0}{2} * t$$
$$\because v = v_0 + at$$
$$\therefore X = \frac{v_0 + at + v_0}{2} * t$$
$$X = v_0 t + \frac{1}{2} a t^2$$

$$X = v'_{av} t = \frac{v + v_0}{2} * t$$
$$\because t = \frac{v - v_0}{a}$$
$$\therefore X = \frac{v + v_0}{2} * \frac{v - v_0}{a}$$
$$2aX = v^2 + v_{0_n}^2$$

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Free Falling: **It is the falling of objects under Gravity.**

g=-ive if the body is thrown upward i.e g =-9.8m/s^2

g=+ive if the body is thrown downward i.e g= 9.8m/s^2

***Free falling acceleration g*:** **It is the uniform acceleration gained by the body due to gravity.**

Problems

1- A motorcyclist, travelling initially at 12 m/s changes gears and speeds up for 3.5 s with a constant acceleration of 5.1 m/s^2 . What is the motorcyclist's displacement over this time interval?

2- A person travels by car from one city to another with different constant speeds between pairs of cities. She drives for 30.0 min at 80.0 km/h, 12.0 min at 100 km/h, and 45.0 min at 40.0 km/h and spends 15.0 min eating lunch and buying gas.
(a) Determine the average speed for the trip.
(b) Determine the distance between the initial and final cities along the route. SER/47

3- A ball is thrown vertically upward with a speed of 25.0 m/s.
(a) How high does it rise? (b) How long does it take to reach its highest point? (c) How long does the ball take to hit the ground after it reaches its highest point? (d) What is its velocity when it returns to the level from which it started? SER/50P43

Problems

4- A bullet is fired through a board 10.0 cm thick in such a way that the bullet's line of motion is perpendicular to the face of the board. If the initial speed of the bullet is 400 m/s and it emerges from the other side of the board SER/51P55

5- A ball is thrown upward from the ground with an initial speed of 25 m/s; at the same instant, another ball is dropped from a building 15 m high. After how long will the balls be at the same height?

Newton's Laws of Motion

The first law

An object at rest will stay at rest, and an object in motion will stay in motion at constant velocity, unless acted upon by an external net force.

$$\Sigma F = 0$$

The Force: Is an external factor that affects the body and changes its state of rest or motion.

Inertia : Is the tendency of body to keep its state of rest or motion in a straight line with a uniform velocity

Air track Exp.

Air Track: is a tube used for lowering friction between the body and the surface.

$$m_1 v_1 = m_2 v_2$$

$$\frac{m_1}{m_2} = \frac{v_2}{v_1}$$

Inertial mass: It is the ratio between the velocity of a body of 1 kg mass and the velocity of the body when it is affected by the same force

Or

Is the resistance of the body to change its velocity after collision .

The Second law

The resultant force acting on a body equals the rate of change of its momentum.

$$F = \frac{\Delta P_l}{\Delta t} = \frac{\Delta (mv)}{\Delta t}$$

If m = constant

$$F = \frac{m\Delta v}{\Delta t} = ma$$

$$F = ma$$

1 N ≡ 1 kg_m/s^2

The Newton: It is the force acts on an object that has a mass of 1 kg, produces an acceleration of 1 m/s^2 in the object.

If two equal forces acted on two objects of masses m_1 & m_2

$$\mathbf{m_1 a_1 = m_2 a_2}$$

$$m_1 = \frac{a_2}{a_1} m_2$$

Gravititional mass

Problems

1- A 15 kg object experiences an applied force of 5.5 N and an opposing frictional force of 2.5 N. If the object starts from rest,how far will it have traveled after 4.0 s?

2- A 6.0 kg object experiences an applied force of 4.4 N and an opposing frictional force of 1.2 N. Calculate the acceleration of the object.

3- A 45 kg student rides his 4.0 kg bicycle, exerting an applied force of 325 N.
(a) Calculate the acceleration of the cyclist if frictional resistance sums to 50.0 N.
(b) How far will the student have travelled if he started with a velocity of at 3.0 m/s and accelerated for 8.0 s?

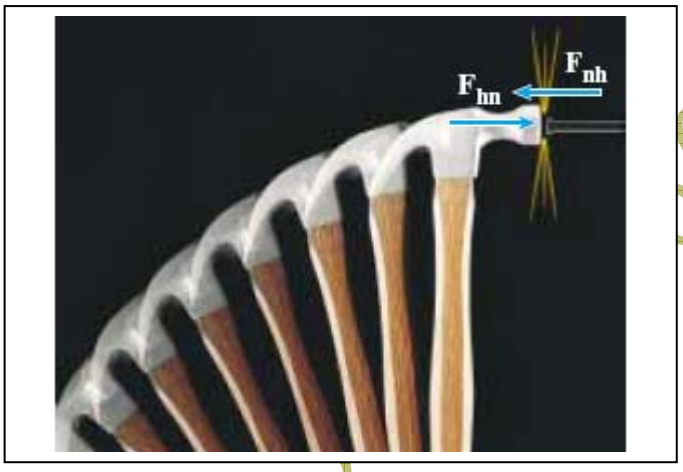
4- In target archery, the magnitude of the maximum draw force applied by a particular bow is 1.24 x 10^2 N. If this force gives the arrow an acceleration of magnitude 4.43 x 10^3 m/s^2, what is the mass, in grams, of the arrow?

5-. A karate expert shatters a brick with a bare hand. The expert has a mass of 65 kg, of which 0.65 kg is the mass of the hand. The velocity of the hand changes from 13 m/s [down] to zero in a time interval of 3.0 ms. The acceleration of the hand is constant.
(a) Determine the net force acting on the hand. What object exerts this force on the hand?
(b) Determine the ratio of the magnitude of the net force acting on the hand to the magnitude of the expert's weight.

The Third law

For every action, there is a reaction equal to it in magnitude and opposite in direction.

$$F_1 = -F_2$$



Problems

1 - Magnetic forces act on the electron beams in television tubes. If a magnetic force of magnitude 3.20×10^{-15} N is exerted on an electron ($m_e = 9.11 \times 10^{-31}$ kg), determine the magnitude of the resulting acceleration. (The mass of an electron is so low that gravitational forces are negligible.)

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