Final test note

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1 Orbits

Force that causes circuit An orbit is the gravitationally curved path of an object around a point in space, for example the orbit of a planet around the center of a star system, such as the Solar System.[1][2] Orbits of planets are typically elliptical, but unlike the ellipse followed by a pendulum or an object attached to a spring, the central object is at a focal point of the ellipse and not at its center.

Force that causes centripetal

"Centripetal force"

$$Fe = \frac{m \times v^2}{r}$$

Period of orbit T

$$w = \frac{2\pi}{T}$$

Launch velocity for circular orbit: All bounded orbits where the gravity of a central body dominates are elliptical in nature. A special case of this is the circular orbit, which is an ellipse of zero eccentricity. The formula for the velocity of a body in a circular orbit at distance r from the center of gravity of mass M is $\mathrm{v} = \sqrt{\frac{GM}{r}}$

Launch velocity for escape: If the kinetic energy of an object launched from the Earth were equal in magnitude to the potential energy, then in the absence of friction resistance it could escape from the Earth.

Elliptical orbits: In astrodynamics or celestial mechanics an elliptic orbit is a Kepler orbit with the eccentricity less than 1; this includes the special case of a circular orbit, with eccentricity equal to zero.

2 Circular motion

Circular motion is a movement of an object along the circumference of a circle or rotation along a circular path. It can be uniform, with constant angular rate of rotation and constant speed, or non-uniform with a changing rate of rotation. Polar coordinates r, theta

Angular velocity

$$w = \frac{\Delta\theta}{\Delta T}$$

Angular acceleration

$$a = \frac{\Delta w}{\Delta T}$$

Centripetal acceleration

$$a = \frac{v^2}{r}$$

Tangential speed

$$v = w \times r$$

3 Gravity

Gravity or gravitation is a natural phenomenon by which all things with mass are brought towards (or 'gravitate' towards) one another including stars, planets, galaxies and even light and sub-atomic particles. Gravity is responsible for the complexity in the universe, by creating spheres of hydrogen — where hydrogen fuses under pressure to form stars — and grouping them into galaxies. Without gravity, the universe would be an uncomplicated one, existing without thermal energy and composed only of equally spaced particles. On Earth, gravity gives weight to physical objects and causes the tides. Gravity has an infinite range, and it cannot be absorbed, transformed, or shielded against.

The value, denoted g, is g = 9.80665 m/s2 (32.1740 ft/s2).

$$F = \frac{mMG}{r^2}$$

$$PE = \frac{-mMG}{r}$$

4 Electric

An electric field can be visualized by drawing field lines, which indicate both the magnitude and direction of the field. Field lines start on positive charges and end on negative charges. The direction of the field line at a point is the direction of the field at that point.

An electric dipole is a separation of positive and negative charges. The simplest example of this is a pair of electric charges of equal magnitude but opposite sign, separated by some (usually small) distance.

Equipotential lines are always perpendicular to the electric field. In three dimensions, the lines form equipotential surfaces. Movement along an equipotential surface requires no work because such movement is always perpendicular to the electric field.

5 circuits

An electronic circuit is composed of individual electronic components, such as resistors, transistors, capacitors, inductors and diodes, connected by conductive wires or traces through which electric current can flow.

V=I.R P=I.V

6 Force

A force is a push or pull upon an object resulting from the object's interaction with another object. Whenever there is an interaction between two objects, there is a force upon each of the objects. When the interaction ceases, the two objects no longer experience the force.

$$Fnormal + Fgravity = m \times \frac{v^2}{2}$$

$$Fnormal = \frac{mv^2}{r} - Fgravity$$

$$Fnormal = \frac{mv^2}{r} - mg$$

$$Fnet = ma$$

$$Fg = m \times \frac{v^2}{r}$$

(no normal force)

$$mg = m \times \frac{v^2}{r}$$

$$g = \frac{v^2}{r}$$

$$v^2 = gr$$

- Acceleration due to the surface of the earth

$$mg = \frac{mMG}{r^2}$$

$$G = \frac{r^2 \times g}{M}$$

- Find KE for kg

$$KE = \frac{mMG}{2r}$$

- PE for surface to the earth

$$PE = mgh$$

- PE away from earth's surface

$$PE = \frac{-mMG}{r}$$

- For object to escape the earth's gravity, it must have positive total energy E = 0

$$KE + PE = 0$$

$$\frac{-mMG}{r} + \frac{mv^2}{2} = 0$$

$$\frac{mv^2}{2} = \frac{mMG}{r}$$

$$v^2 = \frac{2MG}{r}$$

- Consider the earth moving around the sun
a. Determine the orbital angular velocity of the earth.

$$\omega = \frac{2\pi}{T}$$

$$\omega = \frac{2 * 3.14}{365.24 * 24 * 60 * 60}$$

$$\omega = 1.99 \times 10^{-7} \frac{rad}{sec}$$

b. Determine the speed of the earth relative to the sun.

$$ma = \frac{GmM}{r^2}$$

$$a = \frac{6.67 * 10^{-11} * 5.98 * 10^{14}}{1.50 * 10^{11}}$$

$$a = 1.77 \times 10^{-8}$$

$$v = \sqrt{r \times a}$$

$$v = \sqrt{1.50 \times 10^{11} \times 1.77 \times 10^{-8}}$$

$$v = 2.655 \times 10^{11}$$

c. Determine centripetal acceleration of the earth relative to the sun.

$$a = \frac{v^2}{r}$$

$$a = \frac{(1.7 * 10000)^2}{1.5 * 10^{11}}$$

$$a = 19.5$$

d. Determine the net force on the earth considering this acceleration.

$$Fg = m \times a$$

$$Fg = 5.98 * 10^{24} \times 1.77$$

$$Fg = 1.05846 \times 10^{25} N$$

e. Determine the mass of the sun from the above.

$$\frac{GmM}{r} = 1.05846 \times 10^{25}$$

$$m = \frac{1.05846 * 10^{25} * 1.50 * 10^{11}}{6.67 * 10^{-11} * 5.98 * 10^{24}}$$

$$m = 3.98 \times 10^{21} Kg$$

- Consider gravitation at the surface of the moon

a. Determine the acceleration due to gravity on the surface of the moon.

$$Fnet = ma$$

$$Fg = ma$$

$$ma = \frac{GmM}{r^2}$$

$$a = \frac{MG}{r^2}$$

b. Determine the launch velocity for circular orbit.

$$m \times \frac{v^2}{r} = \frac{GmM}{r^2}$$

$$\frac{v^2}{r} = \frac{MG}{r^2}$$

$$v^2 \times r^2 = rMG$$

$$v^2 = \frac{MG}{r}$$

c. Determine the launch velocity for escape from the moon's gravity.

$$PE + KE = 0$$

$$\frac{mMG}{r} + \frac{mv^2}{2} = 0$$

$$v^2 = \frac{2MG}{r}$$

d. Determine the result of launching an object at 2000 m/s into the moon's horizon.

- Consider a capacitor. Two very large parallel conducting plates are connected to the leads of a 9 Volt battery.

a. Determine the separation between the plates to generate a 30.0 $\frac{N}{C}$ electric field.

$$E = \frac{\Delta v}{\Delta x}$$

b. Determine the force of this electric field on a 0.012 Coulomb charge.

$$Fe = \frac{kqQ}{r^2}$$

$$Fe = Eq$$

c. Determine the change in potential energy for the 0.012 C charge moving from the 9V plate to the 0V plate.

d. Draw the parallel plates and the electric field between them.

7 Current

Current is a flow of electrical charge carriers, usually electrons or electron-deficient atoms. The common symbol for current is the uppercase letter I.

$$V = IR$$

$$E = -\frac{\Delta V}{\Delta inx}$$

$$C = \frac{Q}{V}$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$P = IV$$

$$Parallel : \frac{1}{Req} = \frac{1}{R1} + \frac{1}{R2}$$

$$Series : Req = R1 + R2$$

Capacitor: Current is a flow of electrical charge carriers, usually electrons or electron-deficient atoms. The common symbol for current is the uppercase letter I.