AL Physics Notes

Circular Motions

Definition

- Uniform Circular Motion:
  - motion going around the circle at constant speed
- Radian:
  - One radian is the angle **subtended** at the centre of a circle by an arc of length equal the **radius** of the circle
  - $1\ rad = \frac{180^\circ}{\pi}$
  - $1^\circ = \frac{\pi}{180^\circ}$
- Angular displacement:
  - angle θ of rotation if the angle is **in radian**
- Angular velocity:
  - angular speed is the rate of change of angle **in radian**
  - $\omega = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T}$
- Period
  - T time for make one **complete** revolution
  - $T = \frac{1}{f}$
- Frequency
  - f number of revolution per second
  - $f = \frac{1}{T}$

Key Points

- Linear velocity:
  - $v = \frac{s}{t} = \frac{2\pi r}{T} = 2\pi r f = r\omega$
  - if not specify, speed for UCM means linear speed
  - numerical value for velocity is the same as speed, the direction is always the tangent with the direction of moving
- Acceleration
  - $a = \frac{\overrightarrow{\Delta \mathrm{v}}}{\Delta t} = \frac{v^2}{r} = r\omega^2$
  - notice that the velocity here used to derive the acceleration must have the vector notation

- derivation obtained by consider isosceles triangle and take ratio for similar triangle. Cord approximate to arc and obtain the answer under the consideration of small amount of time
- Centripetal force
  - $F = \frac{mv^2}{r} = mr\omega^2$
  - tension changes during rotation vertically
  - at the top, $T + mg = \frac{mv^2}{r}$
  - at the bottom, $T - mg = \frac{mv^2}{r}$
- Energy & Work
  - Work = 0
  - Energy not used
  - $W = Fd\cos\theta$ since the direction of movement is always perpendicular so no work is done, hence no energy is used
- Origin of centripetal force
  - resolving the vector results in two direction of force, and that will be one which provide centripetal force

Oscillations

Definition

- Angular frequency:
  - number of oscillation made in 1s
- Phase difference:
  - phase difference for same curve, two point: $\phi = \frac{2\pi}{T} * \Delta t$
  - phase difference for different curve: draw vertical line and compare
- SHM
  - type f motion when at **any moment of time**, a is **proportional** to x in **opposite direction** and always **towards e.p**.
  - $a = -\omega^2 x$
- Oscillations
  - Free Oscillation - harmonic
    - the only external force acting on it is the restoring force
    - it vibrates at its natural frequency(f_0)
  - Forced Oscillation - non harmonic
    - there is external driving force with driving frequency acting periodically on the oscillation
  - Damped Oscillation
    - External resistive and frictional force cause the oscillator's energy to dissipate into heat
    - amplitude will decreased
    - A-f diagram will not be sharp
- Resounance

- Natural frequency is equal to the frequency of the driver
- Amplitude is maximum (dramaticaly increased amplitude)
- Absorbs the greatest possible energy from the driver

key Points

Formula for SHM

- $x = X_0 \sin \omega t$
- $v = \omega X_0 \cos \omega t$
- $a = -\omega^2 X_0 sin\omega t$

Formula in SHM

- $v_{max} = x_0 \omega$
- $a_{max} = x_0 \omega^2$
- $v = v_0 \cos \omega t = \omega \sqrt{x_0^2 - x^2}$

Period of mass-spring system

- $T = 2\pi \sqrt{\frac{m}{k}}$

Period of mathematical simple pendulum

- $T = 2\pi \sqrt{\frac{l}{g}}$
- mass of the bulb is larger than mass of string
- size of the bulb is negligible compare with length of string
- angle should be small

Energy changes during oscillation

- $E_k = \frac{1}{2} m\omega^2 (x_0^2 - x^2)$, maximum when going through e.p.
- $E_p = \frac{1}{2} m\omega^2 x^2$, maximum when at the two ends of oscillation
- $E_t = \frac{1}{2} m\omega^2 x_0^2$, note the total energy don't change

Gravitational Fields

Electric Fields

Magnetic Fields

Electromagnetism

Alternative Current

Capacitance

Electronics

Thermodynamics

Communication

Quantum Physics

Nuclear Physics

Medical Imaging

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