Revision for the 2nd small test on:.....
Oscillations:
Oscillator – a device able to freely to oscillate – make a periodic motion
(a spring oscillator, pendulum)

Period:

T – time needed to make one complete cycle (s)

Frequency:

f - gives number of complete cycles per a time (s-1)
- if the time is given in seconds, frequency is measured in s-1 – Hz (hertz)
- there might be frequency given in revs per minute (revs/min)
- f = 1/T (kilohertz – 1 kHz = 103 Hz, megahertz – 1 MHz = 106 Hz)

- A heart makes beats 75 times per minute. Calculate frequency and period of human heart.

- A body oscillating on a spring – deflections from the equilibrium – y (m).
- A maximum of deflections – amplitude – ym (m).

$y = y_m \sin \varphi = y_m \sin \omega t$

$\omega = 2\pi / T = 2\pi f$ (ω – angular frequency) (rad.s-1)

Velocity and acceleration of oscillations

$a_0 = -\omega^2 y$

$v_0 = \omega r$

- **A point object oscillates with amplitude of 0.2 m. Calculate deflection of the point object at ¼ T, 1/3 T, ½ T. Use $y = y_m \sin \omega t$.**

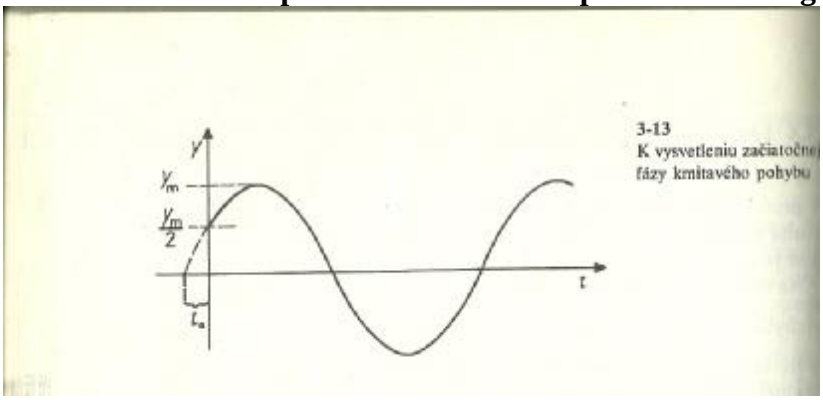
- **Harmonic oscillation is described by $y = 8 \sin 4\pi t$ cm. Calculate amplitude and frequency of the oscillator.**

- **What is the time needed to reach deflection of - 8 cm for an oscillator described by equation $y = 8 \sin 4\pi t$ cm?**

Phase of oscillations

- **$y = y_m \sin \varphi = y_m \sin (\omega t + \varphi)$**
- **φ – initial phase**

Calculate the initial phase of oscillation depicted in the diagram:



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- **Calculate initial phase of the harmonic oscillation which is in equilibrium in time t = T/8. Write equation of the oscillation.**

Dynamics of oscillations

$F = F_G – F_P = m g - k (\Delta l + y) = - k y$

k – spring constant (N.m-1)

$a = F / m = - k y / m$

$\omega_0^2 = k / m$

$\omega_0 = \sqrt{(k / m)}$

$T = 2\pi \sqrt{(m / k)}$ (s)

$f = (1 / 2\pi) \sqrt{(k / m)}$ (Hz)

- **There is a body hanging on a spring of a mass of 10 kg, which extension is 15cm. Calculate period of an oscillator.**

Energy of an oscillator

Work done by oscillator:

$W = ½ F y = ½ k y2$

Comparision

Mechanic oscillator

- **deflection – y**
- **velocity – v**
- **PE: Ep = ½ ky2**
- **KE: EK = ½ m v 2**
- **force – F**
- **mass – m**
- **spring constant – k= F/y**
- **period: $T = 2\pi\sqrt{(m/k)}$**

Electromagnetic oscillator

- charge – Q
- current – I
- Electric energy: Ee = ½ QU = ½ Q2/C (C= Q/U)
- Magnetic energy: $Em = ½LI^2$
- p.d.
- inductance
- 1/C (C – capacity)
- $T = 2\pi\sqrt{(LC)}$ (Thomson´s formula)

- **Calculate period of the oscillations of the curcuit with parametres:**
- **a) C = 50 µF (micro farrad), L = 50 H**
- **b) C = 0.2 µF, L = 0.79 H**
- **c) C = 6 nF, L = 11 µH**

In which case can we hear the oscillations? (16 Hz – 20 kHz)