Physics 1

Tests 1 to 4

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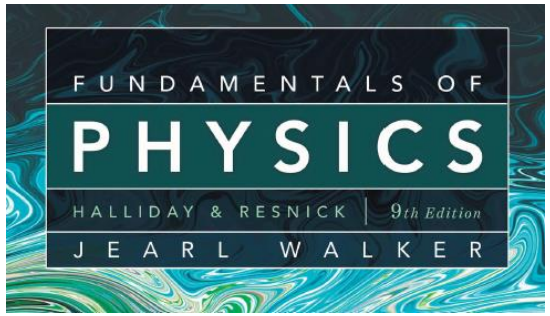

Name : Matr nr.

Physics 1 for Nanoscience & Nanotechnology

Level of knowledge 1 23.10.19

1. Give the equation of linear motion ?

$$X = X_0 + v\,t + \tfrac{1}{2}\,at^2$$

2. Give the 3 Newton´s laws

1st. If no force acts on a body, body´s velocity cannot change, the body cannot accelerate

2nd: $F = ma$

3rd : $F_{BC} = -F_{CB}$

3. What is the maximum hight to be reached by shooting a ball vertical up

$$y = (v^2 - v_0^2)/2a$$

4. What is „work“ in terms of kinetic energy ?

$$W = K_f - K_i$$

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Physics 1 for Nanoscience & Nanotechnology

Level of knowledge 2 06.11.18

1. Give the definition of mechanical work ? And for mechnacial power ?

$$W = F\,d \qquad P = dW/dt$$

2. Give expression for kinetic and potential energy of graviation

$$K=1/2\ mv^2 \qquad U = m\,g\,h$$

3. Demonstrate the law of conservation of energy at example of a pendulum

$$K + U = \text{const};\ K(\max) \text{ at } h = 0;\ U(\max) \text{ at } h=h(\max)$$

4. Give a definition of linear momentum and demonstrate the conservation of linear momentum for the case of an elastic linear collision of two objects.

$$p= mv \qquad p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

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Physics 1 for Nanoscience & Nanotechnology

Level of knowledge 2 06.11.19

1. Give the relation between angular velocity and trangential velocity ? Give a relation for kinetik energy of translation and for rotation ?

$V = \omega r$ $K = \frac{1}{2} m v^2$ $K = \frac{1}{2} \Theta \omega^2$

2. Give expression for angular force (torque) and angular momentum. For which quantity yields the law of conservation ?.

$\vec{\tau} = \vec{r} \times \vec{F}$ $\vec{\ell} = \vec{r} \times \vec{p} = m(\vec{r} \times \vec{v})$ conserved

3. Give the relation between Force and potential energy

$$F(x) = -\frac{dU(x)}{dx}$$

4. What characterized a „conservative force“ ?

The work done by a conservative force on a particle moving between two points does not depend on the path taken by the particle.

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Physics 1 for Nanoscience & Nanotechnology

Level of knowledge 3

20.11.19

1. What is the kinetic energy of a harmonic oscillation of a spring ?

$$E = K + U = \frac{1}{2}ku^2$$

2. Give ansatz to derive the eigen frequency of a harmonic oscillator ? What is the period of scillation of a spring oscillator ?

$m\, d^2x/dt^2 + k\, x = 0$; $x(t) = x_0 \cos(\omega t)$; $T = 2\pi\sqrt{\frac{m}{k}}$ (period).

3. Express the wave equation ?

$$\frac{d^2y}{dx^2} = \frac{1}{v^2}\frac{d^2y}{dt^2}$$

4. What is the relation between speed, frequency and wavelengh of a travelling wave

$v = \lambda f$

5. Give a relation between length of wire and the harmonics that can be excited

$\lambda = \frac{2L}{n}$, for $n = 1, 2, 3, \ldots$. $f = \frac{v}{\lambda} = n\frac{v}{2L}$, for $n = 1, 2, 3, \ldots$.

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Physics 1 for Nanoscience & Nanotechnology

Level of knowledge 4

04.12.19

1. Express the Coulomb law ?

$$\vec{F} = \frac{1}{4\pi\varepsilon_0}\frac{qq_0}{r^2}\hat{\mathbf{r}}.$$

2. Express Guass´s law ? What it is its meaning ?

$$\varepsilon_0 \oint \vec{E}\cdot d\vec{A} = q_{enc} \quad \text{(Gauss' law).}$$

Gauss' law relates the electric fields at points on a (closed) Gaussian surface to the net charge enclosed by that surface.

3. Express the relation between electric potential energy U and electric potental V and applied work and electric potential ?

$$V = \frac{U}{q}. \qquad W_{appl} = q\,\Delta V$$

4. How one calculate the electric potential V knowing and electric field E and how to calculate electric field knowing V ?

$$V = -\int_i^f \vec{E}\cdot d\vec{s}, \qquad \vec{E} = -gradV = -\left(\frac{\delta V}{\delta x}\vec{e_x} + \frac{\delta V}{\delta y}\vec{e_y} + \frac{\delta V}{\delta z}\vec{e_z}\right)$$

5. By which time relation the charge of a capacitor changes loading a RC circut ?

$$q = C\mathscr{E}(1 - e^{-t/RC}) \qquad \text{(charging a capacitor).}$$