Phys 1003: Tutorial Test 1 Assigned Problems

Useful formulae

$G = 6.67\times10^{-11}\ \mathrm{Nm^2kg^{-2}};\ g = 9.81\mathrm{m/s^2};\ N_A = 6.02\times10^{23}\ \mathrm{mol^{-1}}$

$If\ ax^2+bx+c=0\ then\ x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a};\ \dfrac{d}{dx}(x^n)=nx^{n-1};\ \dfrac{d}{dx}(\sin ax)=a\cos ax;$

$\dfrac{d}{dx}(a\cos x)=-a\sin ax;\quad \int x^n dx=\dfrac{x^{n+1}}{n+1}+C;\ \int\sin ax=-\dfrac{1}{a}\cos ax+C;\ \int\cos ax=\dfrac{1}{a}\sin ax$

$\vec{a}\cdot\vec{b}=a_xb_x+a_yb_y+a_zb_z=ab\cos\theta;\ \vec{a}\times\vec{b}=\begin{vmatrix}\hat{i}&\hat{j}&\hat{k}\\a_x&a_y&a_z\\b_x&b_y&b_z\end{vmatrix}\ \text{Surface area of circle}=\pi\,\mathrm{r}^2;$

$\text{Circle Circumf.}=2\pi\mathrm{r};\ \text{Volume of sphere}=\dfrac{4}{3}\pi r^3;\ \text{Area of Sphere}=4\pi\,\mathrm{r}^2;$

$v=\dfrac{dx}{dt};\ a=\dfrac{dv}{dt}=\dfrac{d^2x}{dt^2};\ \vec{x}=\vec{x}_0+\vec{v}_0t+\dfrac{1}{2}\vec{a}t^2;\ \vec{v}=\vec{v}_o+\vec{a}t;\ \vec{v}_{av}=\dfrac{\vec{v}_0+\vec{v}}{2};\ v^2=v_0^2+2a(x-x_0);$

Assigned problems

Chapter 1, problem 28

You are told that the speed of sound in a metal depends only on the density ρ (rho) with dimensions [ML^{-3}] and on the bulk modulus of the metal, β (beta), which has dimensions [$ML^{-1}T^{-2}$]. Express the speed of sound in a metal in terms of ρ and β.

Chapter 1, problem 34

Estimate the volume of concrete used for the construction of the tunnel under the English Channel. The system consists of two railway tunnels and a service tunnel and is 30 km long.

Chapter 1, problem 60

Consider the following vectors: $\vec{A}=-2\hat{i}-3\hat{j}$, $\vec{B}=\hat{i}+2\hat{j}+3\hat{k}$, $\vec{C}=3\hat{j}+3\hat{k}$, and $\vec{D}=-2\hat{i}-\hat{k}$. Find

(a) $\vec{A}+\vec{B}+\vec{C}+\vec{D}$,

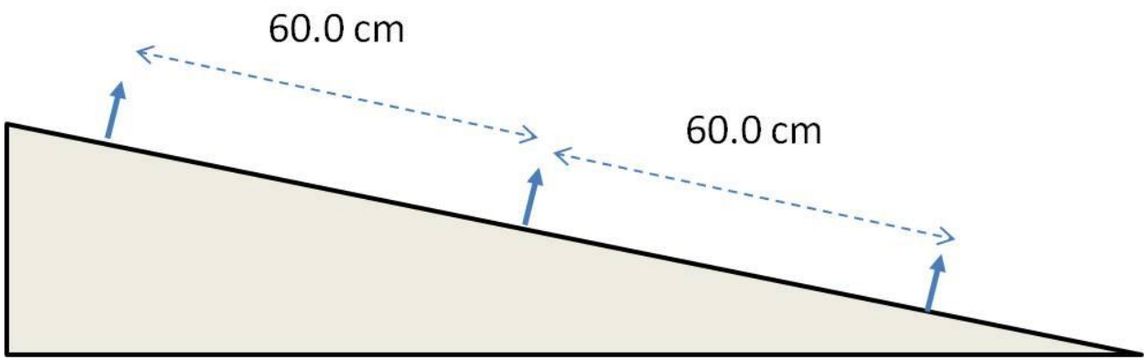
(b) $\vec{A}-\vec{D}$,

(c) $\vec{A}+\vec{D}-\vec{B}$,

(d) $\left|\vec{A}-\vec{C}\right|$.

Chapter 2, problem 22

Inclined planes are convenient tools to study motion under a constant acceleration. The time of passage of a ball rolling on an inclined plane is measured by three light gates positioned 60 cm apart. The ball passes the light gates at 0.30, 1.15, and 1.70 s. Find the acceleration of the ball.



Chapter 2, problem 34

A bowling ball is rolled down the alley with an initial velocity of +10.0 m/s. There is a small amount of friction, and it produces an acceleration of -0.20 m/s^2.

a) What is the velocity at 1.0 and 2.0 s?

b) What is the average velocity over the first 2.0 s?

Chapter 2, problem 62

A ball is thrown upward from the ground. It passes a window 10 m above the ground and is seen to descend past the window 2.2 s after it went by on its way up (see figure). It reaches the ground 3.6 s after it was thrown. Use this information to calculate the acceleration due to gravity, g.