Chap 1.

60. (a) $\vec{A} + \vec{B} + \vec{C} + \vec{D} = (-2\hat{i} - 3\hat{j}) + (\hat{i} + 2\hat{j} + 3\hat{k}) + (3\hat{j} + 3\hat{k}) + (-2\hat{i} - \hat{k}) = \boxed{-3\hat{i} + 2\hat{j} + 5\hat{k}}$.

(b) $\vec{A} - \vec{D} = (-2\hat{i} - 3\hat{j}) - (-2\hat{i} - \hat{k}) = \boxed{-3\hat{j} + \hat{k}}$.

(c) $\vec{A} + \vec{D} - \vec{B} = (-2\hat{i} - 3\hat{j}) + (-2\hat{i} - \hat{k}) - (\hat{i} + 2\hat{j} + 3\hat{k}) = \boxed{-5\hat{i} - 5\hat{j} - 4\hat{k}}$.

(d) $\vec{A} - \vec{C} = (-2\hat{i} - 3\hat{j}) - (3\hat{j} + 3\hat{k}) = -2\hat{i} - 6\hat{j} - 3\hat{k}$; $|\vec{A} - \vec{C}| = \sqrt{2^2 + 6^2 + 3^2} = \boxed{7}$.

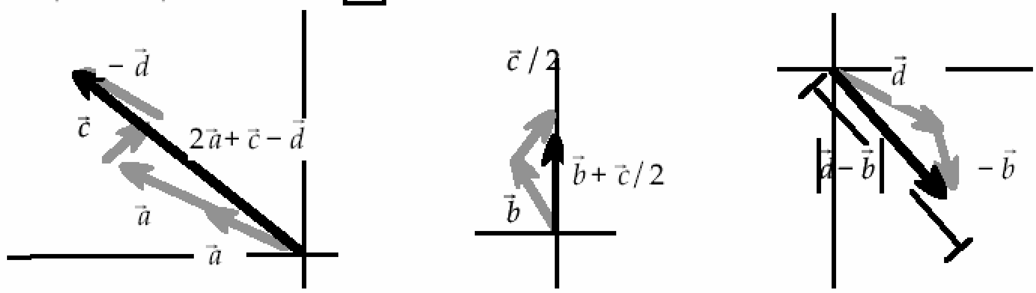
$\boxed{61}$. (a) $\vec{A} = -4\hat{i} + 2\hat{j}$, $\vec{B} = -\hat{i} + 4\hat{j}$, $\vec{C} = 2\hat{i} + 2\hat{j}$, $\vec{D} = 5\hat{i} - 3\hat{j}$.

(b) $2\vec{A} + \vec{C} - \vec{D} = 2(-4\hat{i} + 2\hat{j}) + (2\hat{i} + 2\hat{j}) - (5\hat{i} - 3\hat{j}) = \boxed{-11\hat{i} + 9\hat{j}}$.

$\vec{B} + \vec{C}/2 = (-\hat{i} + 4\hat{j}) + (2\hat{i} + 2\hat{j})/2 = \boxed{5\hat{j}}$.

$\vec{D} - \vec{B} = (5\hat{i} - 3\hat{j}) - (-\hat{i} + 4\hat{j}) = \boxed{6\hat{i} - 7\hat{j}}$.

$|\vec{D} - \vec{B}| = \sqrt{6^2 + 7^2} = \boxed{9.2}$.



64. If we estimate that the area of the head on which hair grows is 1/3 of the surface area of a sphere of diameter 20 cm, then the fraction = area of lock/scalp area:

fraction $= \pi(R_{\text{lock}})^2/[\pi(D_{\text{head}})^2/3] = (2\text{ cm})^2/[(20\text{ cm})^2/3] = \boxed{0.03}$.

The number of hairs is N = area of lock/area of one hair:

$N = [\pi(D_{\text{lock}})^2/4]/[\pi(D_{\text{hair}})^2/4] = [(4\text{ cm})/(10^{-4}\text{ m})(10^2\text{ cm/m})]^2 \approx \boxed{2 \times 10^5\text{ hairs}}$.

68. $m = 18\text{ g}\,(1\text{ kg}/10^3\text{ g})/(6.02 \times 10^{23}\text{ molecules}) = \boxed{3.0 \times 10^{-26}\text{ kg/molecule}}$.

72. The gasoline usage $\propto$ mass $\propto$ volume $\propto$ (dimension)^3. A 20% decrease in each dimension means the volume changes by $(0.80)^3 = 0.512$. Thus there would be a $\boxed{49\%\text{ savings}}$.

76. If the side length of the room is L and the area is A, then $A = L^2$ and

$\Delta A \approx (dA/dL)\,\Delta L = (dL^2/dL)\,\Delta L = 2L\,\Delta L$, or $\Delta A/A = 2L\,\Delta L/L^2 = 2\,\Delta L/L$. Thus

$\Delta L/L \approx (\Delta A/A)/2 = (5\%)/2 = \boxed{2.5\%}$.

80. $\eta = Fy/vA$, so

$[\eta] = [F][y]/([v][A]) = [MLT^{-2}][L]/([LT^{-1}][L^2]) = \boxed{[ML^{-1}T^{-1}]}$.

84. (a) $\hat{i}_r = (1)\cos\theta\,\hat{i} + (1)\sin\theta\,\hat{j} = \cos\theta\,\hat{i} + \sin\theta\,\hat{j}$.

(b) $i_{ry} = \boxed{\sin\theta}$.

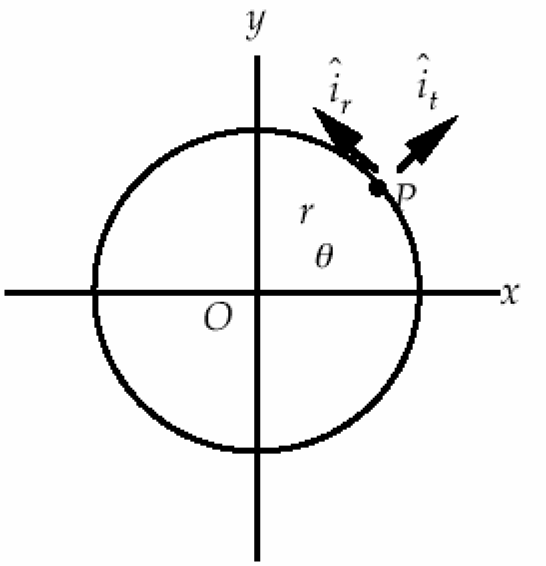
(c) $\hat{i}_t = (1)(-\sin\theta)\hat{i} + (1)\cos\theta\,\hat{j} = \boxed{-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}}$.

85. (a) The component of $\vec{r}$ in the xy-plane is $r \sin \theta$ at an angle of ϕ with the x-axis.

Thus the x-component of $\vec{r}$ is $r \sin \theta \cos \phi$.

(b) Since $\vec{r}$ is at an angle of θ from the z-axis, the z-component is $r \cos \theta$.

(c) The y-component of $\vec{r}$ is $r_y = \boxed{r \sin \theta \sin \phi}$.



86. If we assume 20 breaths/min and that each breath involved different molecules, then we can find the number of molecules Michelangelo breathed during his lifetime from the product of the number of molecules in each breath and the number of breaths in 91 years:

N = (2.5 L)(6.0 × 10^{23}/22.4 L)(20/min)(91 yr)(365 day/yr)(24 h/day)(60 min/h)

$\approx 6.4 \times 10^{31}$ molecules.

We assume that these molecules are dispersed uniformly in the volume of the atmosphere:

$V = 4\pi R^2 H \approx (4)(3)(6.4 \times 10^6 \text{ m})^2(8 \times 10^3 \text{ m}) \approx 5 \times 10^{18} \text{m}^3$.

If the lungs contain 2.5 L of air, the number of these molecules in the lungs is

$N(\text{lungs}) = [(6.4 \times 10^{31} \text{ molecules})/(5 \times 10^{18} \text{m}^3)](2.5 \text{ L})(10^{-3} \text{m}^3/\text{L}) \approx \boxed{3 \times 10^{10} \text{ molecules}}$.