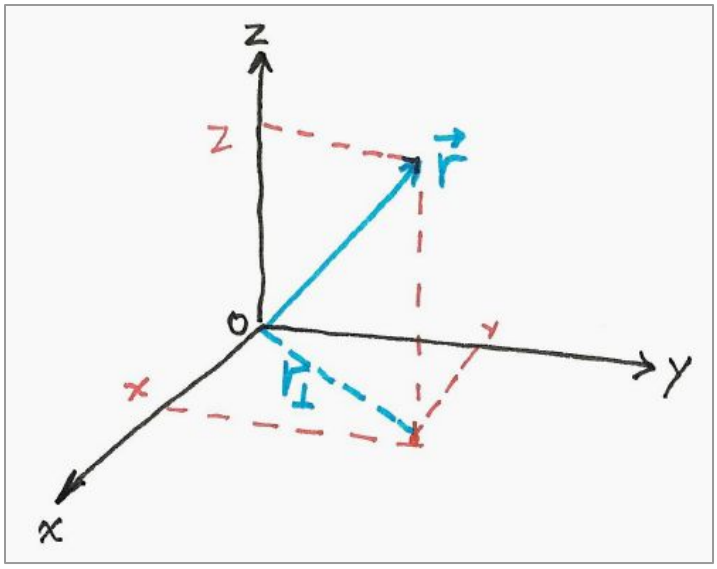
Homework Assignment #1

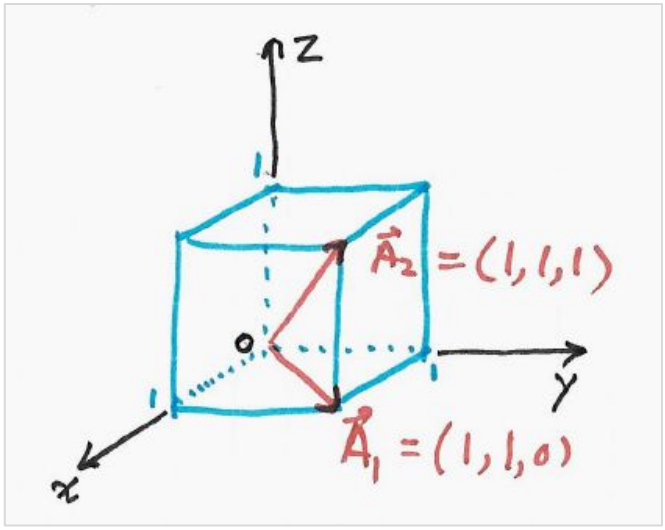


Problem 1.3

$r_\perp^2 = x^2 + y^2$ (Pyth. theorem)

$r^2 = r_\perp^2 + z^2$ (Pyth. theorem)

Therefore $r^2 = x^2 + y^2 + z^2$.



Problem 1.5

The two vectors $\mathbf{A}_1$ and $\mathbf{A}_2$ are shown;

$\mathbf{A}_1 = \{1,1,0\}$ and $\mathbf{A}_2 = \{1,1,1\}$.

$\mathbf{A}_1 \cdot \mathbf{A}_2 = 2$

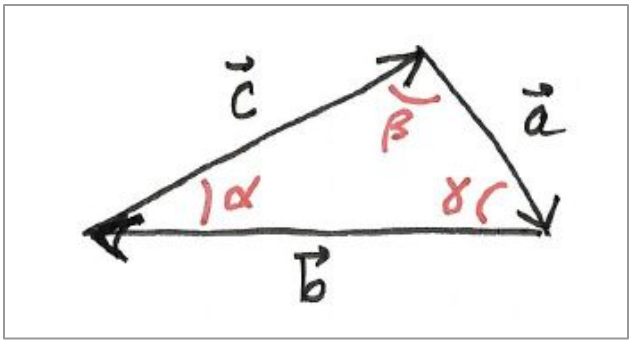
$\mathbf{A}_1 \cdot \mathbf{A}_2 = A_1 A_2 \cos\theta = \sqrt{2}\ \sqrt{3}\ \cos\theta$

where θ is the angle between the vectors.

Therefore $\cos\theta = \sqrt{(2/3)}$.

$\theta = \arccos[\sqrt{(2/3)}] = 0.615$ rad $= 35.3$ degrees .

Problem 1.18



(a) $|\mathbf{a} \times \mathbf{b}| = a\, b \sin\gamma$

The area of the triangle is A = 1 /2 × base × height

$= 1/2\ b\, a \sin\gamma$.

Thus $A = 1/2\,|\mathbf{a} \times \mathbf{b}| = 1/2\,|\mathbf{b} \times \mathbf{c}| = 1/2\,|\mathbf{c} \times \mathbf{a}|$

similarly similarly

(b) From part (a)

$$a\, b \sin\gamma = b\, c \sin\alpha = c\, a \sin\beta$$

Divide by abc ; then

$$(\sin\gamma)/c = (\sin\alpha)/a = (\sin\beta)/b$$

which is the law of sines.

Problem 1.24

Solving a diff. eq. by separation and integration

Given the equation $df / dt = f$.

Thus $df / f = dt$ and $\int df / f = \int dt$

Using *indefinite integrals,* $\ln f + \text{constant} = t$

Or, $\ln f = t + C$

Thus $f(t) = e^C e^t = A e^t$ where A is a constant.

The general solution depends on one constant, A.

Problem 1.30

An inelastic collision ...

Before the collision –

After the collision
the masses stick together –

Momentum is conserved, so

$m_1 \mathbf{v} = (m_1 + m_2)\, \mathbf{v}'$; that is, $\mathbf{v}' = \mathbf{v}\ m_1 / (m_1 + m_2)$.