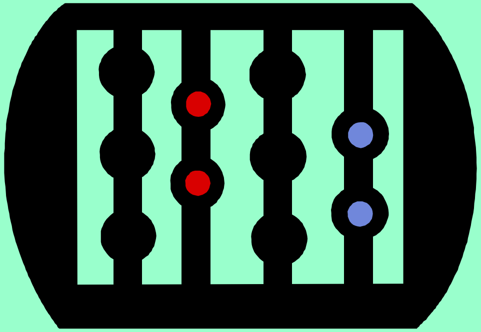
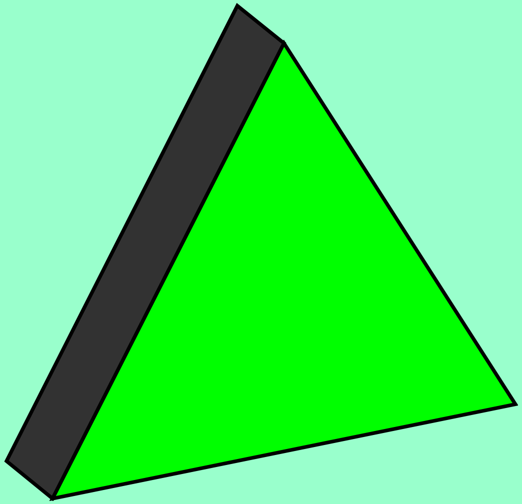
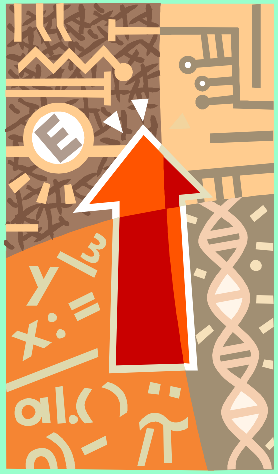
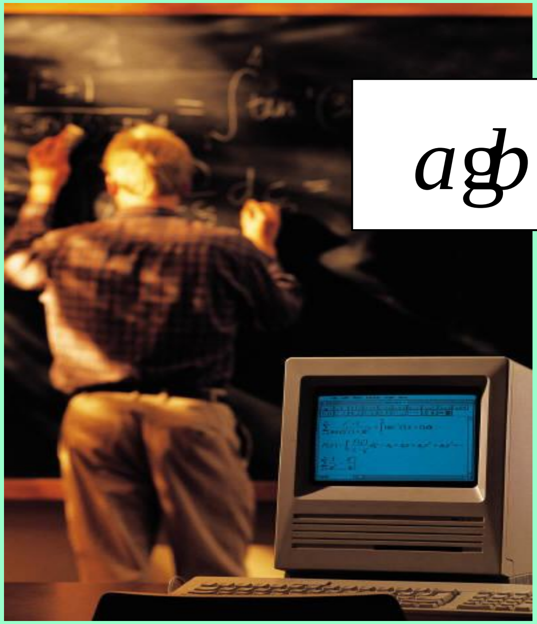






12.

Perpendicular Vectors



$$a \cdot b = 0 \Leftrightarrow \text{vectors are perpendicular}$$

PERPENDICULAR VECTORS

If θ = 90° then cosθ = 0

So a . b = | a || b |cosθ = | a | X | b | X 0 = 0

So a.b = 0 is a way of testing for perpendicular vectors.

Example 1

p = 5i + j + 4k and q = 2i – 10j.

$$\underline{p} = \begin{pmatrix} 5 \\ 1 \\ 4 \end{pmatrix} \quad \underline{q} = \begin{pmatrix} 2 \\ -10 \\ 0 \end{pmatrix}$$

Prove that p & q are perpendicular.

****

Solution:

p.q = (5 X 2) + (1 X (-10)) + (4 X 0) = 10 – 10 + 0 = 0

Since p.q = 0 then vectors p & q must be perpendicular.

Heinemann:
p.254, Ex 13R, Q1, 2, 5

This is not the end

Example 2

Paper 1

$\underline{c} = 3\underline{i} + 2\underline{j} - \underline{k}$ and $\underline{d} = 3\underline{i} + x\underline{j} + 5\underline{k}$.

Given that $\underline{c}$ & $\underline{d}$ are perpendicular then find x.

****

Vectors are perpendicular so we know $\underline{c}.\underline{d} = 0$

$(3 \text{ X } 3) + (2 \text{ X } x) + (-1 \text{ X } 5) = 0$

$2x + 4 = 0$

$x = -2$

Extra

Scalar Product & Type of Angle

Since $|\underline{a}| > 0$ and $|\underline{b}| > 0$

If $\underline{a}.\underline{b} > 0$ then $\cos\theta > 0$ so θ is acute.

If $\underline{a}.\underline{b} = 0$ then $\cos\theta = 0$ so θ is right.

If $\underline{a}.\underline{b} < 0$ then $\cos\theta < 0$ so θ is obtuse.

Heinemann:
p.254, Ex 13R, Q6