MATH181 Homework Sheet 2

(Due 17/10/2011)

To be handed in by 5:00 pm on Monday October 17th.

For reference you can consult the book by Stroud, section 6 (vectors).

1. $\underset{\sim}{\mathbf{u}} = 2\,\underset{\sim}{\mathbf{i}} + 2\,\underset{\sim}{\mathbf{j}}$ and $\underset{\sim}{\mathbf{v}} = \underset{\sim}{\mathbf{i}} - 2\,\underset{\sim}{\mathbf{j}}$. Find the angle between $\underset{\sim}{\mathbf{u}}$ and $\underset{\sim}{\mathbf{v}}$.

2. $\underset{\sim}{\mathbf{u}} = 2\,\underset{\sim}{\mathbf{i}} + \underset{\sim}{\mathbf{j}} - 2\,\underset{\sim}{\mathbf{k}}$ and $\underset{\sim}{\mathbf{v}} = 3\,\underset{\sim}{\mathbf{j}} + 4\,\underset{\sim}{\mathbf{k}}$. Find

(*i*) $\underset{\sim}{\mathbf{u}} + \underset{\sim}{\mathbf{v}}$

(*ii*) $2\,\underset{\sim}{\mathbf{u}} - \underset{\sim}{\mathbf{v}}$

(*iii*) $|\underset{\sim}{\mathbf{u}}|$

(*iv*) $\underset{\sim}{\mathbf{u}} \cdot \underset{\sim}{\mathbf{v}}$

(*v*) The angle between $\underset{\sim}{\mathbf{u}}$ and $\underset{\sim}{\mathbf{v}}$.

3. Shortly after launch the rocket engines on a spaceship of mass 10^5 kg give a thrust of $10^6\,\underset{\sim}{\mathbf{i}} + 10^6\,\underset{\sim}{\mathbf{j}} + 2 \times 10^6\,\underset{\sim}{\mathbf{k}}$ (in Newtons).
(i) Assuming the z axis is vertical, what is the total force acting on the spaceship, from the engines and from gravity? ($g = 9.8$ ms^{-2}).
(ii) What is its acceleration? [Remember $\underset{\sim}{\mathbf{F}} = m\,\underset{\sim}{\mathbf{a}}$]
(your answers to (i) and (ii) should be vectors).

4. Two forces

$$\vec{\mathrm{F}}_1 = (2\mathbf{i} - 3\mathbf{j} + 7\mathbf{k})N$$

and

$$\vec{\mathrm{F}}_2 = (-\mathbf{i} - 4\mathbf{j} + \mathbf{k})N$$

act at a point P. Find the resultant force at P, expressing the result in terms of its magnitude and a unit vector in the direction of the force.

5. Find the component of the force

$$\vec{\mathrm{F}} = (3\mathbf{i} + 5\mathbf{j} + 7\mathbf{k})N$$

along the direction of the vector $2\mathbf{i} + 2\mathbf{j} - \mathbf{k}$.

6. Find the work done by the force

$$\vec{\mathrm{F}} = (2\mathbf{i} - \mathbf{j} + 4\mathbf{k})N$$

in moving a particle of mass 2kg in a straight line from the point $(1, 2, 5)$m to the point $(2, 0, 6)$m.

7. Find the vector product of the vectors

$$\vec{\mathrm{a}} = (2\mathbf{i} - \mathbf{j} + 3\mathbf{k})N$$

and

$$\vec{\mathrm{b}} = (\mathbf{i} + 3\mathbf{j} - 4\mathbf{k})N$$