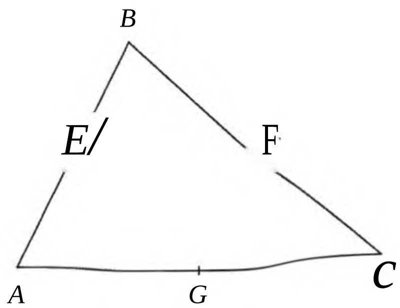
Name..

Department..

Whilst answering the test you may use the Formula Sheet or the Engineering Data Book, depending on your department, and a calculator but please do NOT consult the Module or any book.

TEST 14.1

1. *ABC* is a plane triangle in which *AB* = a, *BC* = b and the midpoints of the sides are *E*, *F* and *G* as shown



Express the following vectors in terms of a and b:

(D)AC ,

AC = AB + B- -

() Fa. E? =Rlc= 4 Be + ì

-2 1g 1 (a42-)

i- CA 2~

■ r 4--2.,.) !

- — L.

1 —

2. Suppose that the points *A* and *B* have coordinates (1,- L -1) and (2,1, -2) respectively with respect to rectangular cartesian axes.

Obtain AB in terms of i, j and k.

-2 — p

AB = OB - OA

8(2,1,-) A8 - (2 ,1, -)-(3-11)

3. If a = 2i + 3j — 6k and b = i+j+k find

(i) 3b — a

30 -Q - $3(\underline{i}+\underline{j}+\underline{k})-(2\underline{i}+3\underline{j}-6\underline{k}) = \underline{i}+9\underline{k}$

(ii) |a| $|\underline{a}| = (2^2+3^2+(-6)^2)^{\frac{1}{2}} = (4+9+36)^{\frac{1}{2}} = 7$

(iii) a unit vector parallel to a

$\text{parallel to } \underline{a} = \frac{\underline{a}}{|Q|} = \frac{1}{7}(2\underline{i}+3\underline{j}-6\underline{k})$

(iv) the component of b in the direction of a.

$\text{cpt. of } \underline{b} \text{ in direction of } \underline{a} = \underline{b}\cdot\hat{\underline{a}} = (1,1,1)\cdot\frac{1}{7}(2,3,-6)$

$= \frac{1}{7}(2+3-6) = -\frac{1}{7}$

4. Given that a = i + k and b = j + k find

(i) a.b

$\underline{a}\cdot\underline{b} = (1,0,1)\cdot(0,1,1) = 0+0+1 = 1$

(ii) the angle between a and b.

$\cos\theta = \frac{\underline{a}\cdot\underline{b}}{|\underline{a}||\underline{b}|} = \frac{1}{(1^2+1^2)^{1/2}(1^2+1^2)^{1/2}} = \frac{1}{\sqrt{2}\sqrt{2}} = \frac{1}{2}$

$\therefore \theta = \frac{\pi}{3} \quad (\text{or } 60^\circ)$

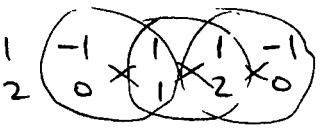
5. A force F of magnitude 4 *N* acts on a body in the direction of the vector 2i - j + 2k.

(i) Determine the vector force F.

(ii) Calculate the work done by the force when the body is displaced by i + j + k.

6. Given that a=i-j+k and b=2i+k find

$$\underline{a}\times\underline{b} = (1,-1,1)\times(2,0,1)$$
$$= (-1(1)-1(0),\ 1(2)-(1)1,\ -1(0)-(-1)2)$$
$$= (-1-0,\ 2-1,\ 0+2)$$
$$= \underline{(-1,1,2)}$$



(ii) a unit vector perpendicular to a and b.

$$\text{unit vector perp. to } \underline{a} \text{ and } \underline{b} = \frac{\underline{a}\times\underline{b}}{|\underline{a}\times\underline{b}|} = \frac{(-1,1,2)}{((-1)^2+1^2+2^2)^{1/2}}$$

$$= (1,1,2)$$

UG

7. A body is rotating with angular velocity 3 rads/s in a positive sense about an axis from the point (2,1, —1) to the point (0,3, —2) (distance in metres). Calculate

(i) the angular velocity vector w

Ui is pa-4Da4 + (o-2,3-1, - -2+Gi)-(-331)

$$g\_ 3 - 3\ \frac{(-2,2,-1)}{((2*1+(-))''} \qquad \frac{(-2,2,-1)}{3} = (-2,2,-1)$$

(ii) the velocity of the body at the point (1,2,1).

V - axe - • x(1-2, 2-1, 1 (•) - ex (-1,1,2)

- (262)-(-01, -I (-1)- 261-24}-2+1)

I(0,%,-1) 0,,,, -2 V' -2 171 -(+1,'+*,-241)

-1 I 2 -<

>T ~(5,5,0)

462,1,-,)