

1 a)  $-\mathbf{p}$       b)  $2\mathbf{q}$       c)  $\frac{1}{2}\mathbf{p}$       d)  $\mathbf{p}$       e)  $-\mathbf{q}$       f)  $\mathbf{p} + \mathbf{q}$   
 g)  $\frac{1}{2}\mathbf{p} + 2\mathbf{q}$       h)  $\mathbf{p} - \mathbf{q}$       i)  $2\mathbf{q} - \mathbf{p}$       j)  $-\mathbf{p} - 2\mathbf{q}$       k)  $\frac{1}{2}\mathbf{p} - \mathbf{q}$       l)  $-\frac{1}{2}\mathbf{p} - 2\mathbf{q}$

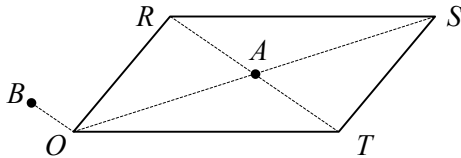
2 a)  $\mathbf{u} + \mathbf{v}$       b)  $\mathbf{w} - \mathbf{u}$       c)  $\mathbf{u} + \mathbf{v} - \mathbf{w}$

3 a)  $\mathbf{q}$       b)  $\mathbf{p} + \mathbf{r}$       c)  $\mathbf{r} - \mathbf{q}$       d)  $\mathbf{p} + \mathbf{q} + \mathbf{r}$       e)  $-\mathbf{q} - \mathbf{r}$       f)  $\mathbf{q} + \mathbf{r} - \mathbf{p}$

4 a i)  $=(\mathbf{a} + 2\mathbf{b}) + (\mathbf{a} - 2\mathbf{b})$   
 $= 2\mathbf{a}$   
 ii)  $=(\mathbf{a} + 2\mathbf{b}) - (\mathbf{a} - 2\mathbf{b})$   
 $= 4\mathbf{b}$

b  $\overrightarrow{OA} = \frac{1}{2}\overrightarrow{OS}$ ,  $\overrightarrow{OB} = \frac{1}{4}\overrightarrow{TR}$

$\therefore$



5 a i)  $= \frac{1}{2}\mathbf{a}$   
 ii)  $= \mathbf{b} - \mathbf{a}$   
 iii)  $= \frac{1}{2}(\mathbf{b} - \mathbf{a})$   
 iv)  $= \mathbf{a} + \frac{1}{2}(\mathbf{b} - \mathbf{a}) = \frac{1}{2}(\mathbf{a} + \mathbf{b})$   
 v)  $= \frac{1}{2}(\mathbf{a} + \mathbf{b}) - \frac{1}{2}\mathbf{a} = \frac{1}{2}\mathbf{b}$

b they are parallel (and the magnitude of  $\overrightarrow{CD}$  is half that of  $\overrightarrow{OB}$ )

6 a parallel,  $3\mathbf{p} = \frac{3}{2}(2\mathbf{p})$   
 b not parallel  
 c parallel,  $(\mathbf{p} - \frac{1}{3}\mathbf{q}) = \frac{1}{3}(3\mathbf{p} - \mathbf{q})$   
 d parallel,  $(4\mathbf{q} - 2\mathbf{p}) = -2(\mathbf{p} - 2\mathbf{q})$   
 e parallel,  $(6\mathbf{p} + 8\mathbf{q}) = 8(\frac{3}{4}\mathbf{p} + \mathbf{q})$   
 f not parallel

7 a  $=(2\mathbf{m} + 3\mathbf{n}) - (4\mathbf{m} + 2\mathbf{n})$   
 $= \mathbf{n} - 2\mathbf{m}$   
 b  $\overrightarrow{OM} = \frac{1}{2}\overrightarrow{OC} = \mathbf{m} + \frac{3}{2}\mathbf{n}$   
 $\overrightarrow{AM} = (\mathbf{m} + \frac{3}{2}\mathbf{n}) - 4\mathbf{m} = \frac{3}{2}\mathbf{n} - 3\mathbf{m}$   
 $\therefore \overrightarrow{AM} = \frac{3}{2}\overrightarrow{BC}$   
 $\therefore AM$  is parallel to  $BC$

$$8 \quad \text{a} \quad \overrightarrow{OM} = \frac{1}{2} \overrightarrow{OA} = 3\mathbf{u} - 2\mathbf{v}$$

$$\overrightarrow{AB} = (3\mathbf{u} - \mathbf{v}) - (6\mathbf{u} - 4\mathbf{v}) = 3\mathbf{v} - 3\mathbf{u}$$

$$\overrightarrow{ON} = \overrightarrow{OA} + \frac{1}{3} \overrightarrow{AB} = (6\mathbf{u} - 4\mathbf{v}) + \frac{1}{3}(3\mathbf{v} - 3\mathbf{u}) = 5\mathbf{u} - 3\mathbf{v}$$

$$\text{b} \quad \overrightarrow{CM} = (3\mathbf{u} - 2\mathbf{v}) - (\mathbf{v} - 3\mathbf{u}) = 6\mathbf{u} - 3\mathbf{v}$$

$$\overrightarrow{CN} = (5\mathbf{u} - 3\mathbf{v}) - (\mathbf{v} - 3\mathbf{u}) = 8\mathbf{u} - 4\mathbf{v}$$

$$\therefore \overrightarrow{CN} = \frac{4}{3} \overrightarrow{CM}$$

$\therefore \overrightarrow{CN}$  and  $\overrightarrow{CM}$  are parallel

common point  $C \therefore C, M$  and  $N$  are collinear

$$9 \quad \text{a} \quad a = 5, b = 3$$

$$\text{b} \quad 2 + b = 0 \text{ and } a - 4 = 0$$

$$\therefore a = 4, b = -2$$

$$\text{c} \quad -1 = b \text{ and } 4a = -2$$

$$\therefore a = -\frac{1}{2}, b = -1$$

$$\text{d} \quad 2a + 6 = 0 \text{ and } b - a = 0$$

$$\therefore a = -3, b = -3$$

$$10 \quad \text{a} \quad \overrightarrow{OC} = \frac{1}{2} \mathbf{a}$$

$$\overrightarrow{CB} = \mathbf{b} - \frac{1}{2} \mathbf{a}$$

$$\overrightarrow{OD} = \frac{1}{2} \mathbf{a} + \frac{1}{2} (\mathbf{b} - \frac{1}{2} \mathbf{a}) = \frac{1}{4} \mathbf{a} + \frac{1}{2} \mathbf{b}$$

$$\text{b} \quad \overrightarrow{AB} = \mathbf{b} - \mathbf{a}$$

$$\overrightarrow{OE} = \overrightarrow{OA} + k \overrightarrow{AB}$$

$$\therefore \overrightarrow{OE} = \mathbf{a} + k(\mathbf{b} - \mathbf{a})$$

$$\text{c} \quad \overrightarrow{OE} = l \overrightarrow{OD}$$

$$\therefore \mathbf{a} + k(\mathbf{b} - \mathbf{a}) = l(\frac{1}{4} \mathbf{a} + \frac{1}{2} \mathbf{b})$$

$$\therefore 1 - k = \frac{1}{4} l$$

$$\text{and } k = \frac{1}{2} l$$

$$\text{adding } 1 = \frac{3}{4} l$$

$$l = \frac{4}{3}$$

$$\therefore \overrightarrow{OE} = \frac{4}{3} (\frac{1}{4} \mathbf{a} + \frac{1}{2} \mathbf{b}) = \frac{1}{3} \mathbf{a} + \frac{2}{3} \mathbf{b}$$

$$\text{d} \quad k = \frac{1}{2} l = \frac{2}{3}$$

$$\therefore \overrightarrow{AE} = \frac{2}{3} \overrightarrow{AB}$$

$$\therefore AE : EB = 2 : 1$$