NAME: _____ CLASS: _____ DATE:_____

Answer each of the following items. write final answers in 3 significant figures, if necessary.

1. $A$, $B$ and $C$ are points with position vectors $\binom{3}{6}$, $\binom{-13}{4}$ and $\binom{6}{-8}$ respectively, relative to an origin $O$. Write down the

    **(a)** magnitude of $\overrightarrow{OB}$.         [1]

    **(b)** unit vector of $\overrightarrow{OA}$.         [2]

    **(c)** vector $\overrightarrow{AC}$ in $x\mathbf{i} + y\mathbf{j}$ form.         [2]

    **(d)** vector $\mathbf{e}$ which has a magnitude of 30 units in the direction of $\overrightarrow{OC}$         [3]

2. The four points $O$, $A$, $B$ and $D$ are such that $\overrightarrow{OA} = \binom{8}{4}$, $\overrightarrow{OB} = \binom{12}{6}$ and $\overrightarrow{OD} = \binom{d}{3d}$.

    **(a)** Show that $O$, $A$ and $B$ lie on the same straight line.         [2]

    **(b)** Find the value of $d$ given that $\left| \overrightarrow{AD} \right| = \left| \overrightarrow{BD} \right|$.         [3]
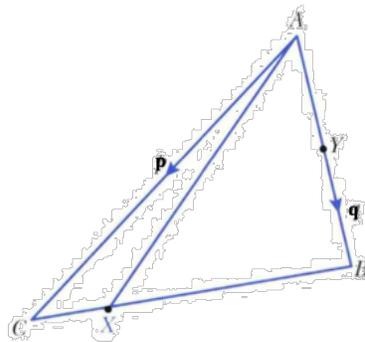
3. In the diagram, $\overrightarrow{AC} = \mathbf{p}$ and $\overrightarrow{AB} = \mathbf{q}$.
   $Y$ is the midpoint of $AB$.
   The point $X$ divides the line $CB$ in the ratio of 1:4.

    **(a)** Express the following in terms of $\mathbf{p}$ and/or $\mathbf{q}$.         [5]
        (i) $\overrightarrow{CB}$
        (ii) $\overrightarrow{CX}$
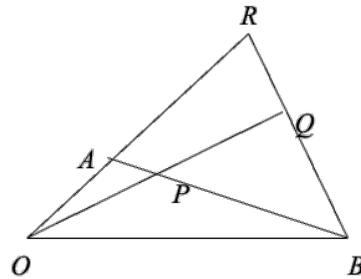        (iii) $\overrightarrow{AX}$



    **(b)** Show that $\overrightarrow{YX} = \frac{4}{5}\mathbf{p} - \frac{3}{10}\mathbf{q}$.         [3]

4. Given that $\mathbf{a} = 2\mathbf{i} + \lambda\mathbf{j}$ and $\mathbf{b} = \mu\mathbf{i} - 5\mathbf{j}$, find the values of $\lambda$ and $\mu$ such that
   $2\mathbf{a} - \mathbf{b} = -3\mathbf{i} + 8\mathbf{j}$. [4]

5. In the figure shown, the position vectors of $A$ and $B$ with respect to $O$ are $\mathbf{a}$ and $\mathbf{b}$
   respectively. The points $P$ and $Q$ are such that $\overrightarrow{AB} = 5\overrightarrow{AP}$ and $\overrightarrow{OQ} = 2\overrightarrow{OP}$



   (a) Express $\overrightarrow{AB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [1]
   (b) Express $\overrightarrow{OP}$ and $\overrightarrow{BQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [4]
   (c) Given that $\overrightarrow{OR} = \lambda\mathbf{a}$ and $\overrightarrow{BR} = \mu\overrightarrow{BQ}$, express $\overrightarrow{BR}$ in terms of
       i.   $\lambda$, $\mathbf{a}$ and $\mathbf{b}$ [2]
       ii.  $\mu$, $\mathbf{a}$ and $\mathbf{b}$ [2]
       Hence, evaluate $\lambda$ and $\mu$. [3]

6. The position vectors of three points $P,\ Q$ and $R$ relative to an origin $O$ are $2\mathbf{b} - \mathbf{a},\ 3\mathbf{a} - \mathbf{b}$
   and $5\mathbf{a} + k\mathbf{b}$ respectively.

   (a) Express $\overrightarrow{PQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. [2]

   (b) Express $\overrightarrow{QR}$ in terms of $k$, $\mathbf{a}$ and $\mathbf{b}$. [2]

   (c) If $\overrightarrow{PQ} = h\overrightarrow{QR}$, find the value of $k$ and state the ratio $PQ:QR$. [4]

   (d) Describe points $P,\ Q$ and $R$. [1]

   (e) Find the position vector of $S$ such that $\overrightarrow{PS} = 3\overrightarrow{QS}$. [3]