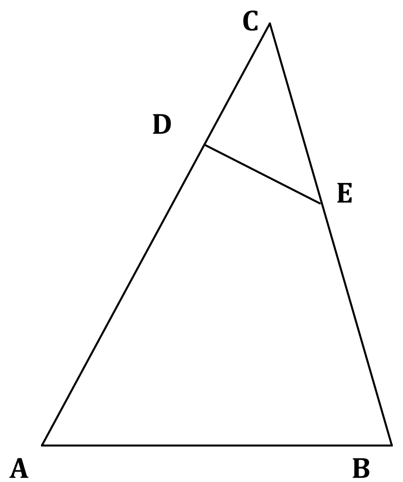
VECTORS

KCSE 1989 – 2012 Form 2 Mathematics

1. **1989 Q11 P2**

In the figure below, **AB** = **P**, **AD** = $^{3}/_{5}$ **AC** and **CE** = $^{2}/_{3}$ **CB**



Express **DE** in terms of **p** and **q**

2. **1990 Q21 P1**

In a parallelogram ABCD, **AB** = 2**a** and **AD** = **b**. M is the midpoint of AB. AC cut MD at X.

i) Express AC in terms of **a** and **b** (2 marks)

ii) Given that **AX** = m**AC** and **MX** = n**MD**, where m and n are constants, find m and n. (6 marks)

3. **1990 Q8 P2**

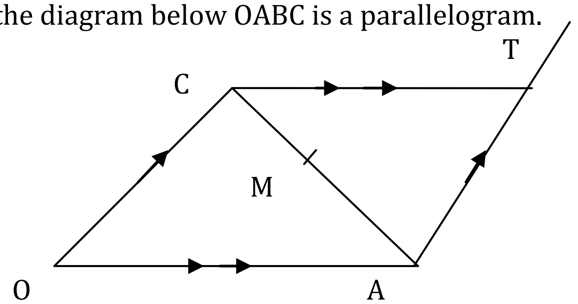
In a triangle ABC, D is the midpoint of AB and E is a point on BC such that BE = $^{2}/_{3}$ BC. If **AD** =**P** and **AC** = **Q**, express **EC** in terms of **p** and **q**. (2 marks)

4. **1990 Q10 P2**

A point T divides a line AB internally in the ratio 5 : 2. Given that A is (-4, 10) And B is (10, 3) find the coordinates of T. (4 marks)

5. **1991 Q6 P1**

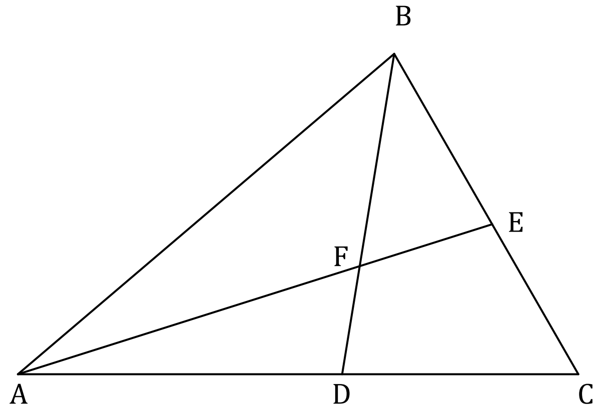
In the diagram below OABC is a parallelogram.



AB is produced to T such that BT: AB = 1:2. M is the midpoint of AC. Given that **OA = a** and **OC = c**.
Express MT in term of a and c. (3 marks)

6. **1991 Q20 P1**

In the figure below E is the midpoint of BC, AD: DC = 3:2 and F is the point of intersection of BD and DE.



i) Given that **AB = b** and **AC = c** express **AE** and **BD** in terms of b and c (3 marks)

ii) Given further that **BF** = t**BD** and **AF** = s**AE**
find the values of s and t. (5 marks)

7. **1992 Q11 P1**

Three points A, B and P are in straight line such that **AP** = t**AB**. Given that the coordinates of A, B and P are (3,4) (8,7) and (x,y) respectively, express x and y in terms of t. (3marks)

8. **1992 Q24 P1**

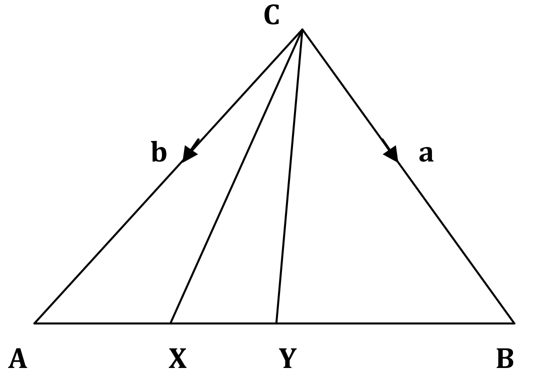
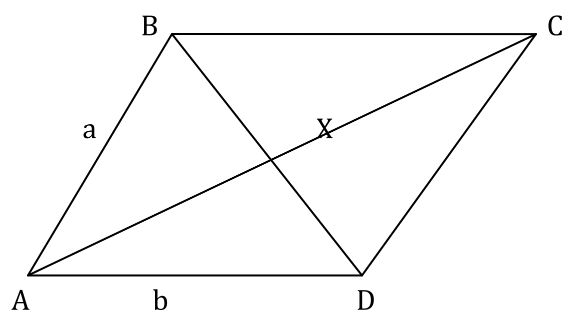
OABC is a trapezium such that the coordinates of O,A,B and C are (0,0),(2,-1), (4, 3) and (0, y).

a) Find the value of y (2 marks)
b) M is a midpoint of AB and N is a midpoint of OM. Show that A, N and C are collinear. (6 marks)

9. **1992 Q7 P2**

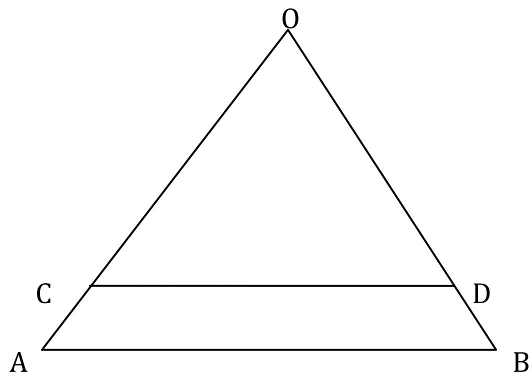
The vectors **p, q** and y are expressed in terms of the vectors t and s as follow:

p = 3**t** + 2s
q = 5**t** – s
y = h**t** + (h – k)s

	where h and k are constants. Given that y = 2**p** – 3**q**, find the values of and k. (4marks)
10	**1993 Q21 P1** OABC is a trapezium in which **OA = a**, **OC = c** and **CB = 3a**. CB is produced to such that CB : BD = 3: 1. E is a point on AB such that **AB = 2AE**. Show that O, E and d are collinear. (8 marks)
11	**1993 Q16 P1** In the figure below **CA** = b **CB** = a, **AX** = **XY** and **AY** = **YB**.  Express CX in terms of a and b (3 marks)
12	**1994 Q24 P1** In the figure below AB = a, AD = b, AX : XC = 2:3 and XB = 4:5  a) Express **i)** **AC** ii) **DC** in terms of **a** and **b** in the simplest form. (6 marks) b) If **DC** = n**a** + m**b**, find the values of n and m (2 marks)
13	**1994Q12P2** Find the position vector of point R which divides line MN internally in the ratio 2: 3. Take the position vectors of M and N to be $\mathbf{M} = \begin{pmatrix} 3 \\ 4 \\ -6 \end{pmatrix}$ and $\mathbf{N} = \begin{pmatrix} -5 \\ -1 \\ 2 \end{pmatrix}$ (3 marks)

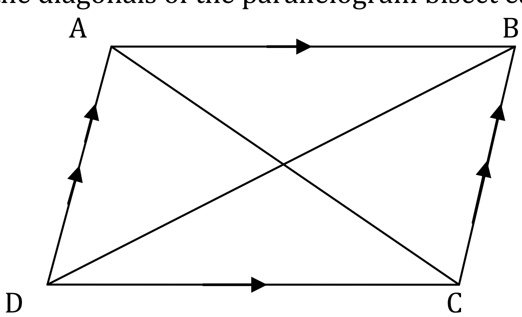
14 **1994 Q10 P2**

In the figure below OC = 3 CA and OD = 3DB. By taking OA = a, OB = b, show that CD // AB. (3 marks)



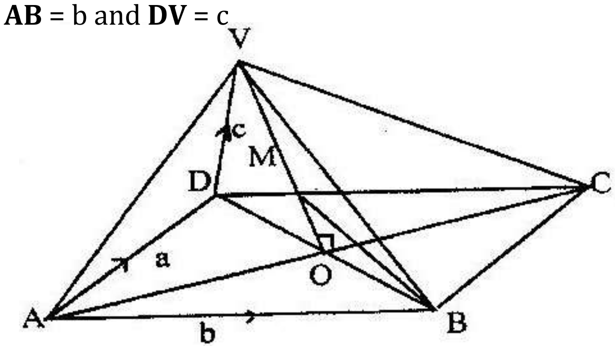
15 **1994 Q15 P2**

In the figure below ABCD is a parallelogram. AOC and BOD are diagonals of the parallelogram. Show that the diagonals of the parallelogram bisect each other. Give reasons. (3 marks)



16 **1995 Q 18 P1**

The figure below is a right pyramid with a rectangular base ABCD and VO as the height. The vectors **AD**= a,
AB = b and **DV** = c



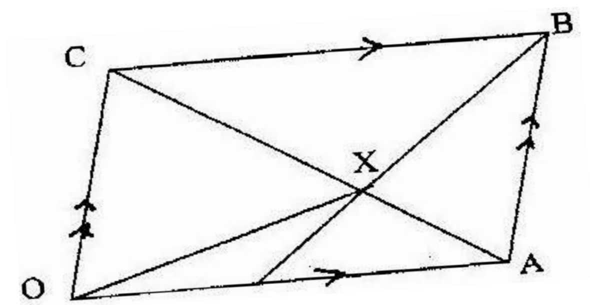
a) Express (i) **AV** in terms of **a** and **c** (1 mark)

(ii) **BV** in terms of **a**, **b** and **c** (2 marks)

(b) M is point on **OV** such that **OM: MV** = 3:4, Express **BM** in terms of **a, b** and **c** . Simplify your answer as far as possible (5 marks)

17 **1996 Q 22 P1**

a) In the diagram below OABC is a parallelogram, **OA** = a and **AB** = b. N is a point on **OA** such that **ON: NA** = 1: 2



(b) Find

(i) **AC** in terms of **a** and **b**

(ii) **BN** in terms of **a** and **b**

(c) The lines AC and BN intersect at X,

AX = h**AC** and **BX** = k**BN**

(i) By expressing **OX** in two ways, find the values of h and k

(ii) Express **OX** in terms of **a** and **b** (1 mark)

18 **1997 Q 11 P2**

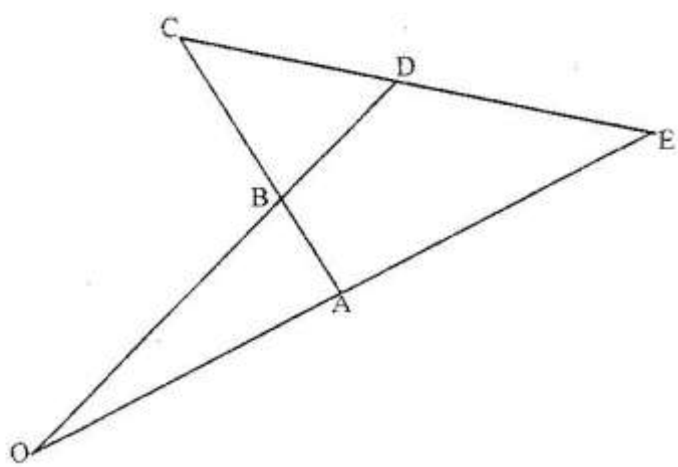
ABC is a triangle and P is on AB such that P divides AB internally in the ratio 4:3. Q is a point on AC such that PQ is parallel to BC. If AC = 14 cm

(i) State the ratio AQ:QC

(ii) Calculate the length of QC

19 **1997 Q 22 P1**

In the figure below **OA** = a, **OB** = b, **AB** = **BC** and **OB: BD** = 3:1



(a) Determine

(i) AB

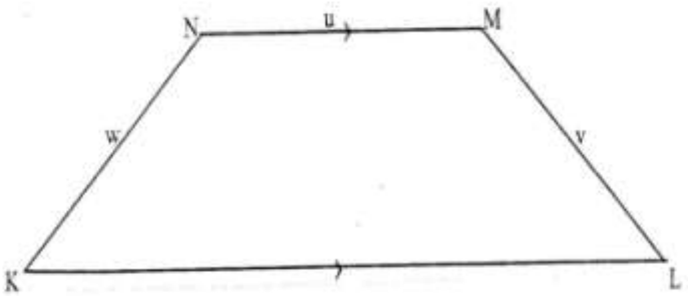
(ii) **CD**, in terms of a and b

(b) If CD : DE = 1:k and OA:AE = 1: m determine

(i) DE in terms of **a, b** and k

20 **1998 Q 9 P2**

In the figure, KLMN is a trapezium in which KL is parallel to NM and **KL** = 3 **NM**

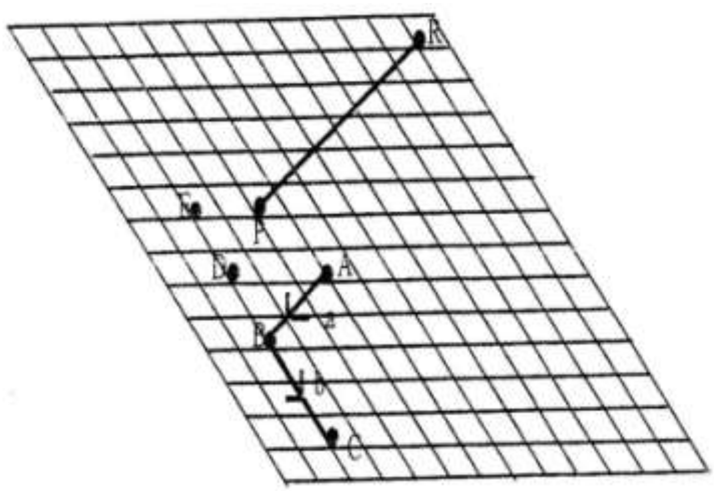


Given that **KN** = w, **NM** = u and **ML** = v. Show that 2**u** = **v**+ **w**

21 **1998 Q 22 P1**

The figure below shows a grid of equally spaced parallel lines

$\overrightarrow{AB}$ = **a** and $\overrightarrow{BC}$ = **b**



(a) Express

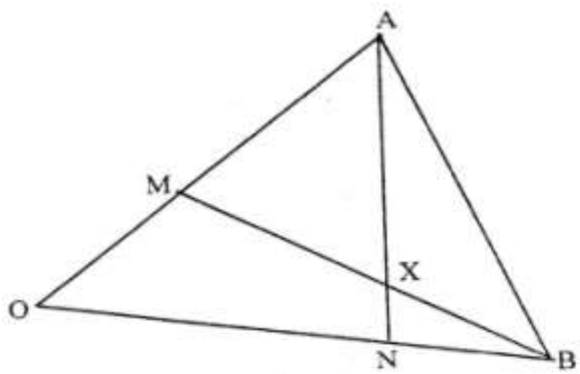
(i) **AC** in terms of a and b

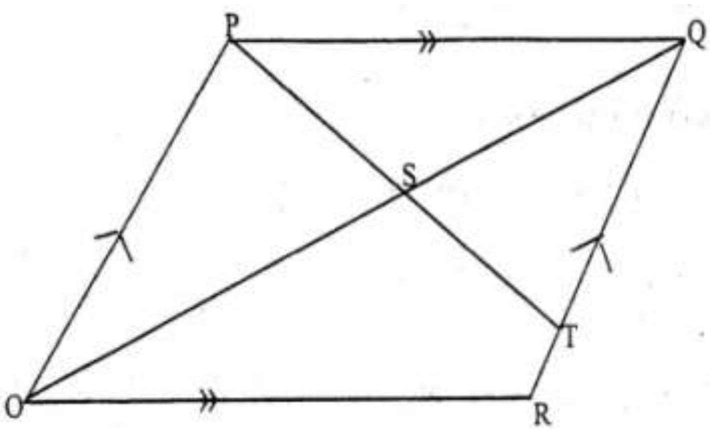
(ii) **AD** in terms of a and b.

(b) Using triangle BEP, express **BP** in terms of a and b

(c) PR produced meets BA produced at X and **PR** = $\frac{1}{9}$**b** - $\frac{8}{3}$**a**

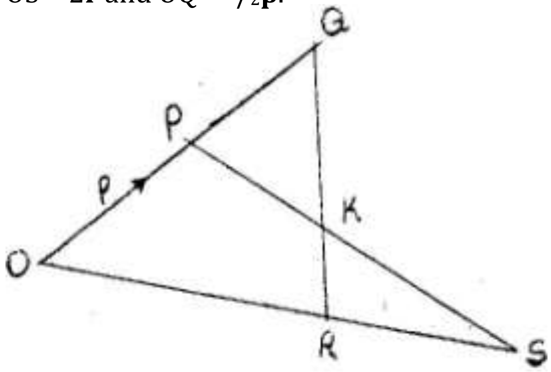
By writing **PX** as k**PR** and **BX** as h**BA** and using the triangle BPX determine the ratio PR: RX

22	**1999 Q 14 P2** The points P. Q and R lie on a straight line. The position vectors of P and R are 2i + 2j + 13k and 5i – 3j + 4k respectively. Q divides PR Internally in the ratio 2:1. Find the (a) Position vector of Q. (b) Distance of Q from the origin
23	**1999 Q 21 P1** In triangle OAB, **OA** = **a, OB** = **b** and P lies on AB such that AP: BP = 3:5 (a) Find the terms of **a** and **b** the vectors (i) **AB** (ii) **AP** (iii) **BP** (iv) **OP** (b) Point Q is on OP such AQ = $\frac{-5}{8}$ **a** +$\frac{9}{40}$ _**b.** Find the ratio OQ: QP
24	**2000 Q 21 P1** The figure below shows triangle OAB in which M divides OA in the ratio 2: 3 and N divides OB in the ratio 4:1 AN and BM intersect at X.  (a) Given that OA = **a** and OB = **b**, express in terms of a and b: (i) **AN** (ii) **BM** (b)If **AX** = s **AN** and **BX** = t**BM**, where s and t are constants, write two expressions for **OX** in terms of **a,b** s and t. Find the value of s Hence write **OX** in terms of a and b
25	**2001 Q 16 P1** The position vectors for points P and Q are 4 **i** + 3 **j** + 2**k** and 3**i** – 6**j** + 6**k** respectively. Express vector **PQ** in terms of unit vectors I, j and k. Hence find the length of **PQ**, leaving your answer in simplified form.

26	**2001 Q 19 P1** The figure below shows a parallelogram OPQR with O as the origin, **OP** = **p** and **OR = r**, Point T divides RQ in the ratio 1:4 and PT Meets OQ at S.  (a) Express in terms of p and r the vectors (i) **OQ** (ii) **OT** (b) Vector **OS** can be expressed in two ways: m**OQ** or **OT** + n **TP**, Where m and n are constants express **OS** in terms of (i) m, **p** and **r** (ii) n, **p** and **r** Hence find the: (iii) Value on m (iv) Ratio OS: SQ
27	**2002 Q 10 P2** The coordinates of points O,P,Q and R are (0,0) , (3,4) , (11,6) and (8,2) respectively. A point T is such that vectors **OT**,**QP** and **QR** satisfy the vector equation. **OT** =**QP** + ½**QR** .Find the coordinates of T.
28	**2002 Q 4 P1** The position vectors of points X and Y are x=2**i** + **j** – 3**k** and y =3i + 2j -2k respectively. Find **XY**
29	**2003 Q 6 P1** Given that x = 2**i** +**j** – 2**k**,y = - 3**i** +4**j** –**k** and z = - 5**i** +3**j** +2**k** and that p = 3**x** – **y** +2**z**. Find the magnitude of vector p to 3 significant figure (4mks)

30 **2003 Q 21 P1**

In the figure below, vector OP = **p** and OR =**r**. Vector OS = 2**r** and OQ = $^3/_2$**p**.



a) Express in terms of p and r (i) **QR** and (ii) **PS**

b) The lines QR and PS intersect at K such that **QK** = m **QR** and **PK** = n **PS**, where m and n are scalars. Find two distinct expressions for **OK** in terms of p,r,m and n. Hence find the values of m and n. (5mks)

c) State the ratio PK:KS

31 **2004 Q 4 P1**

Given that **OA** = 3**i** -2**j** + and **OB** = 4**i** + **j** – 3**k**. Find the distance between points A and B to 2 decimal places.

32 **2004 Q 21 P1**

a) If A, B and C are the points P and Q are p and q respectively is another point with position vector r = $^3/_2$**q** -$^1/_2$ **p**. Express in terms of p and q.

i) **PR**

ii) **RQ** hence show that P, Q and R are collinear.

iii) Determine the ratio PQ: QR.

33 **2005 Q 13 P1**

Point T is the midpoint of a straight line AB. Given the position vectors of A and T are i-j + k and 2i+ 1 ½ k respectively, find the position vector of B in terms of i, j and k. (3 marks)

34 **2005 Q 18 P1**

The points P, Q, R and S have position vectors 2**p**, 3**p**, **r** and 3**r** respectively, relative to an origin O. A point T divides PS internally in the ratio 1:6

(a) Find, in the simplest form, the vectors **OT** and **QT** in terms **P** and **r** (4 marks)

(b) (i) Show that the points Q, T, and R lie on a straight line (3 marks)

(ii) Determine the ratio in which T divides QR (1 mark)

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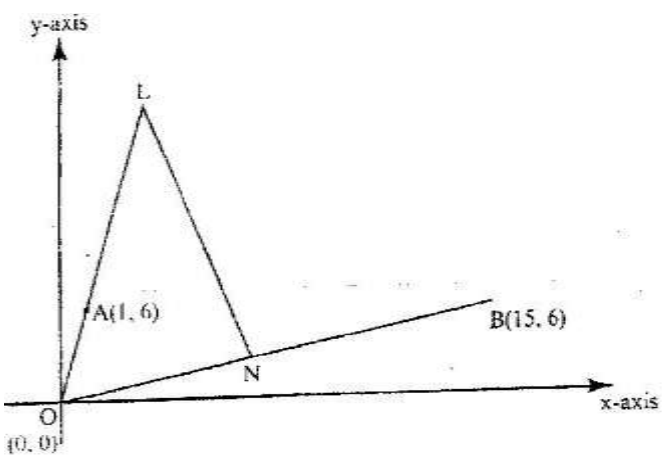
35	**2006 Q 12 P1** Two points P and Q have coordinates (-2, 3) and (1,3) respectively. A translation map point P to P' (10, 10) a) Find the coordinates of Q' the image of Q under the translation (1 mark) (ii) The position vector of **P** and **Q** in (a) above are p and q respectively given that $m\mathbf{p} - n\mathbf{q} = \begin{pmatrix}-12\\9\end{pmatrix}$ (3 marks) b) Find the value of *m* and *n*
36	**2006 Q 22 P1** In the diagram below, the coordinates of points A and B are (1,6) and (15,6) respectively). Point N is on OB such that 3 ON = 2OB. Line OA is produced to L such that OL = 3 OA  (a) Find vector LN (3 marks) (b) Given that a point M is on LN such that LM: MN = 3: 4, find the coordinates of (2 marks) (c) If line OM is produced to T such that OM: MT = 6:1 (i) Find the position vector of T (1 mark) (ii) Show that points L, T and B are collinear (4 marks)

37

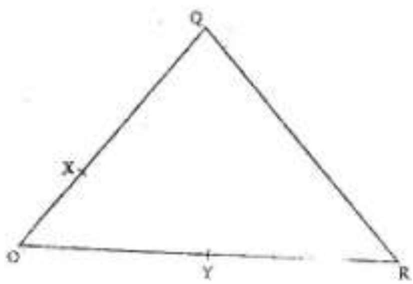
2006 Q 9 P2

Given that q $\mathbf{i} + {}^{1}/_{3}\,\mathbf{j} + {}^{2}/_{3}\,\mathbf{k}$ is a unit vector, find q (2 marks)

38

2007 Q 21 P1

In the figure below, **OQ** = q and **OR** = r. Point X divides OQ in the ratio 1: 2 and Y divides OR in the ratio 3: 4 lines XR and YQ intersect at E.



(a)Express in terms of q and r

(i) **XR** (1 mark)

(ii) **YQ** (1 mark)

(b) If **XE** = m **XR** and **YE** = n **YQ**, express **OE** in terms of: (1 mark)

(i) r, q and m

(ii) r, q and n (1 mark)

(c) Using the results in (b) above, find the values of m and n. (6 marks)

39

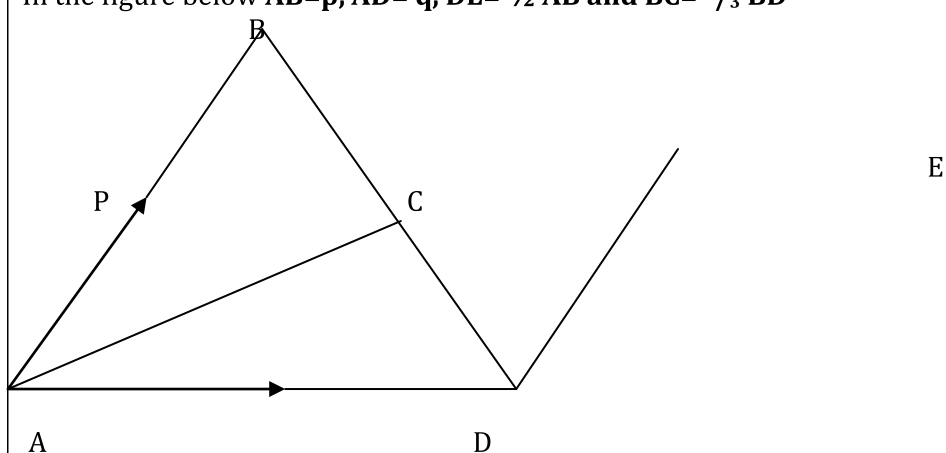
2007 Q 12 P2

Vector q has a magnitude of 7 and is parallel to vector p. Given that p= 3 **i** –**j** + 1 ½ **k**, express vector q in terms of i, j, and k. (2 marks)

40

2008 Q 19 P2

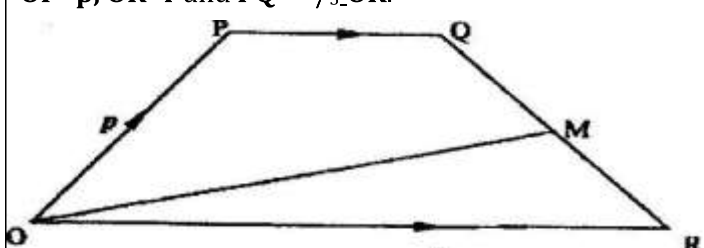
In the figure below **AB=p, AD= q, DE= ½ AB and BC= ${}^{2}/_{3}$ BD**



a) Find in terms of p arid q the vectors: (1mk)

(i) **BD**; (1mk)

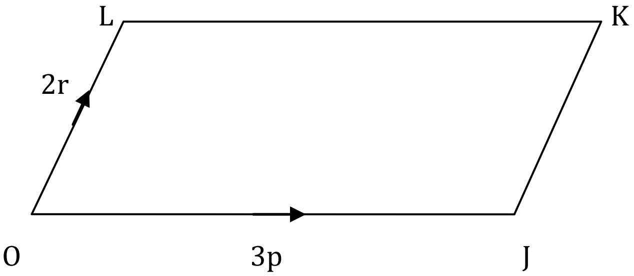
(ii) **BC**; (1mk)

	(iii) **CD**; (1mk) (iv) **AC**. (2mks) b) Given that **AC**=k**CE**, where k is a scalar, find (i) The value of k (4mks) (ii) The ratio in which C divides AE (1mk)
41	**2008 Q 4 P2** The position vectors of points A and B are $\begin{pmatrix}3\\-1\\-4\end{pmatrix}$and $\begin{pmatrix}8\\-6\\6\end{pmatrix}$ respectively. A point P divides AB in AB it he ratio 2:3. Find the position Vector of point P. (3mks)
42	**2009 Q 20 P1** The position vectors of point A and B with respect to the O,are $\begin{pmatrix}-8\\5\end{pmatrix}$ and $\begin{pmatrix}12\\-5\end{pmatrix}$ respectively Point M is the midpoint of AB and N is the midpoint of OA.
	(a) Find: i) The coordinates of N and M (3 mks) ii) The magnitude of NM (3 mks) (b) Express vector **NM** in term of **OB**. (c) Point P maps onto P by a translation $\begin{pmatrix}-5\\8\end{pmatrix}$ Given that **OP**=**OM**+2**MN**, find the coordinates of P′
43	**2009 Q 6 P2** Vector **OA** =$\begin{pmatrix}2\\1\end{pmatrix}$ and **OB**= $\begin{pmatrix}6\\-3\end{pmatrix}$ Point C is on OB such CB=2OC and point D is on AB such that AD=3DB. Express **CD** as a column vector. (3 mks)
44	**2010 Q 7 P1** In the figure below, OPQR is a trapezium in which PQ is parallel to OR and M is the mid-point of QR and **OP=p, OR=r** and **PQ** = $^1/_3$ **OR**.  Find **OM** in terms of **p** and **r.** (3 mks)

45

2010 Q 18 P2

In the figure below OJKL is a parallelogram in which
OJ = 3p and OL = 2r



a) If A is a point on LK such that LA = ½ AK and point B divide the line JK externally in the ratio 3:1, express **OB** and **AJ** in terms of **p** and **r.**

(2 marks)

b) Line OB interests AJ at X such that **OX** = m**OB** and **AX** = n**AJ.**

i) Express **OX** in terms of **p, r** and m. (1 mark)

ii) Express **OX** in terms of **p, r** and n (1 mark)

iii) Determine the value of *m* and *n* and hence the ratio in which point x divides line AJ.

(6 marks)

46

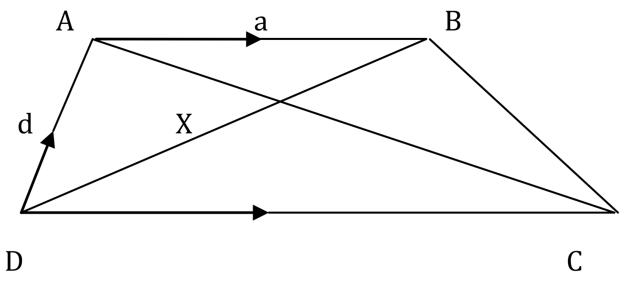
2011 Q 13 P2

Vector **OP**=6**i** + **j** and **OQ**+ -2**i** +5**j**. A point N divides **PQ** internally in the ratio 3:1. Find **PN** in terms of i and j. (3 mks)

47

2011 Q 23 P1

In the figure below,ABCD is a trapezium. AB is parallel to DC,diagonals AC and DB intersect at X and DC=2AB. **AB= a, DA=d, AX=**k **AC** and **DX**= h**DB** where h and k are constants.



a) Find in terms of a and d

i) BC (2 mks)

ii) AX (2 mks)

iii) DX (1 mks)

48

2012 Q9 P1

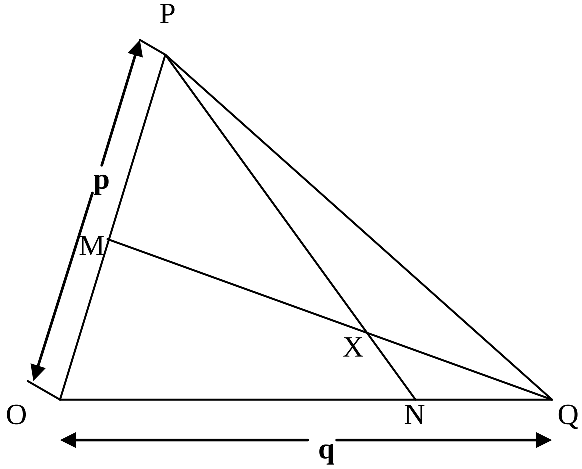
Given that **OA** = 2**i** + 3**j** and 3**i** – 2**j**

Find the magnitude of **AB** to one decimal place (3marks)

49

2012 Q19 P2

In triangle OPQ below, **OP** = **p**, **OQ**=**q**. Point M lies on **OP** such that **OM**: **MP**=2:3 and point N lies on **OQ** such that **ON**: **NQ**=5:1. Line PN intersects line MQ at X.



(a) Express in terms of **p** and **q**:

(i) **PN;** (1 mark)

ii) **QM;** (1 mark)

(b) Given that **PX**= k**PN** and **QX**=r**QM,**where k and r are scalars:

(i) Write two different expressions for OX in terms of **p**,**q**,k and r; (2 marks)

(ii) Find the values of k and r; (4 marks)

(iii) Determine the ratio in which X divides line MQ. (2 marks)