1. In the diagram \( \overrightarrow{OA} = 2a, \overrightarrow{OB} = 3a - 2b \) and \( \overrightarrow{OC} = 5a - 6b \). Express in terms of \( a \) and \( b \), as simple as possible
   a. \( \overrightarrow{AB} \)
   b. \( \overrightarrow{BC} \)
   c. What do your answers to part (a) tell you about the points A, B and C? Give a reason for your answer.

2. OABC is a parallelogram.
   D is the midpoint of CB.
   H is the midpoint of OD.
   \( \overrightarrow{OE} = \frac{2}{3} \overrightarrow{OC} \)
   Vector \( \overrightarrow{OA} = a \) and vector \( \overrightarrow{OC} = c \).

   (a) Express, in terms of \( a \) and \( c \),
      (i) \( \overrightarrow{OD} \)
      (ii) \( \overrightarrow{AE} \)
      (iii) \( \overrightarrow{HE} \)  
      (5 marks)

   (b) Show that \( \overrightarrow{AE} + 4\overrightarrow{HE} \) and explain what this proves about the points A, H and E.  
      (2 marks)
3. \( WXYV \) is a parallelogram in which \( \overrightarrow{VY} = a \), \( \overrightarrow{VW} = b \) and \( WS : WY = 1 : 2 \)

Write in terms of \( a \) and \( b \) an expression for

(a) \( \overrightarrow{YY} \)

(b) \( \overrightarrow{WS} \)

(c) \( \overrightarrow{SX} \)

(d) \( R \) is the midpoint of \( \overrightarrow{WY} \). Prove that \( R, S \) and \( X \) are collinear

4. The diagram below, not drawn to scale shows triangle \( JKL \).

\[ M \text{ and } N \text{ are points on } JK \text{ and } JL \text{ respectively, such that } JM = \frac{1}{3} JK \text{ and } JN = \frac{1}{3} JL \]

(i) Copy and complete the diagram showing the points \( M \) and \( N \)

(ii) Given that \( JM = u \) and \( JN = v \), write in terms of \( u \) and \( v \), an expression for

a. \( \overrightarrow{JK} \)

b. \( \overrightarrow{MN} \)

c. \( \overrightarrow{KL} \)

(iii) Using your findings in b(ii), deduce TWO geometrical relationships between \( KL \) and \( MN \)

This paper becomes due on Thursday November 17, 2011

You are strongly advised to do this paper