This examination consists of **two questions**. You should attempt both of them.

For maximum credit, **you must explain your answers clearly**.

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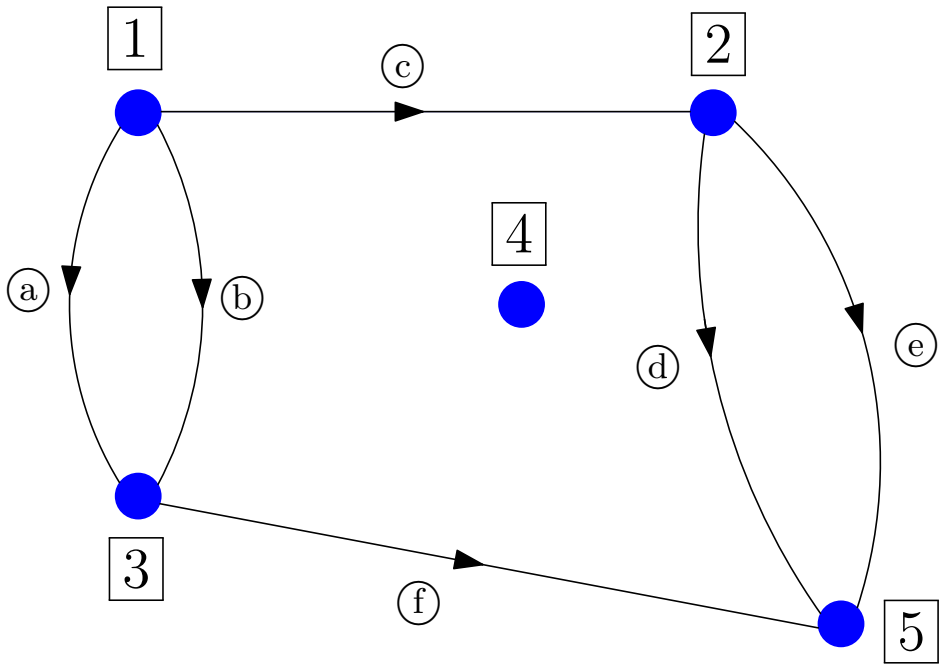
**1.** Consider the graph shown in the figure where large blue dots indicate nodes and all lines with arrows are edges:




(a) Write down the incidence matrix **A** for this graph (you must use the numerical and alphabetical ordering of nodes and edges on the figure, and the edge directions indicated).

(b) Find a basis for the right null space of **A**.

(c) Find a basis for the row space of **A**.

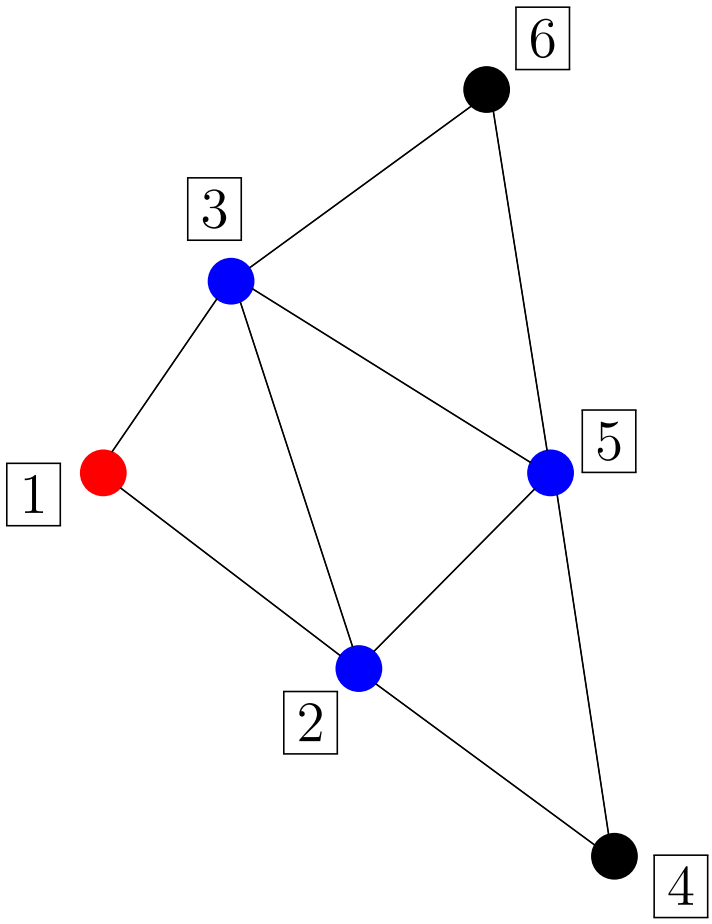
(d) Find a basis for the column space of **A**.

(e) Write down as many linearly independent vectors as you can that are orthogonal to all elements of the column space of **A** (note: two vectors $\mathbf{x}_1$ and $\mathbf{x}_2$ are said to be orthogonal if $\mathbf{x}_1^T\mathbf{x}_2 = 0$).

**(12 marks)**

**2.** The figure below shows an electric circuit in which node $\boxed{1}$ is set to unit voltage and nodes $\boxed{4}$ and $\boxed{6}$ are set to zero voltage ("grounded"). Kirchhoff's current law holds at all other nodes.

All edges have **unit conductance**.




Find the divergence of the currents at node $\boxed{6}$.

**(8 marks)**

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**THE END**

(If you have extra time, use it to ensure you have explained all your answers clearly and fully).