Modelling in mechanics

Gold

A boat is searching for a wreck starting from point *A* and then travelling to points *B* and *C* before finding the wreck at *D*.

The displacement from *A* to *B* is $3\mathbf{i} + 4\mathbf{j}$ km

The displacement from *B* to *C* is $5\mathbf{i} + 4\mathbf{j}$ km

The displacement from *C* to *D* is $12\mathbf{i} + 5\mathbf{j}$ km

a Find the magnitude of the displacement from *A* to *D* giving your answer to one decimal place.
b Find the distance travelled by the boat from *A* to *D* giving your answer to one decimal place and explain why this is not equal to the magnitude of the displacement from *A* to *D*.

Silver

In this question, the unit vector **j** is directed due north and the unit vector **i** is directed due east.

Two particles *A* and *B* are moving relative to a fixed origin *O* in straight lines and with constant velocities.

The velocity of particle *A* is $(5\mathbf{j} + 12\mathbf{i})$ m s^{-1} and the velocity of particle *B* is $(8\mathbf{j} - 6\mathbf{i})$ m s^{-1}.

a Find the direction of motion of particle *A* as an angle to the unit vector **i** giving your answer in degrees to the nearest whole number.
b Find the speed of particle *B* giving your answer in km h^{-1} to 1 one decimal place.

Bronze

A boy walks to school in a straight line from his home at a constant speed of 6 km h^{-1}. He returns home taking the same route but walking with a constant speed of 5 km h^{-1}. If the distance he travels to school is 1.8 km and the direction towards the school is taken as positive, find his:

a velocity in m s^{-1} for the journey from school to home
b displacement in m from home to school
c total distance in m to school and back
d displacement in m when he arrives back home after going to school
e time taken walking to school and back to the nearest minute