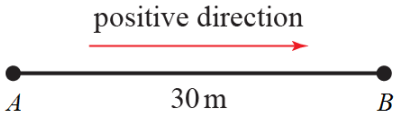
1 A person runs across a field from point A to point B with a speed of 5.3 m s^{-1} and then runs back from point B to point A with a speed of 4.8 m s^{-1}.

Figure 1



Taking the positive direction as shown in the diagram, state the person's

a velocity when travelling from A to B, **(1 mark)**

b velocity when travelling from B to A. **(1 mark)**

Another person runs 30 m from A in the exact opposite direction of B to a point C.

c State this person's displacement from A at the point C. **(1 mark)**

2 The height of a tennis ball above the ground can be modelled using the equation $h = 1.7 + 0.18x - 0.01x^2$, where h metres is the height of a tennis ball above the ground and x metres is the horizontal distance travelled.

a Find the height of the tennis ball when it is

i struck, **(2 marks)**

ii at a horizontal distance of 7 m. **(2 marks)**

To be called 'in' the tennis ball must hit the ground before it travels a horizontal distance of 25 m.

b Will the tennis ball be called 'in'? **(5 marks)**

c The tennis ball is hit with an initial speed of 2 km min^{-1}. Convert this into m s^{-1}. **(3 marks)**

3 The height of a pole vaulter above the ground can be modelled using the equation $h = \frac{1}{60}\left(125x - 12x^2\right)$, where h metres is the vertical height of the pole vaulter and x metres is the horizontal distance travelled after his feet leave the ground.

a Find the horizontal distance travelled when the pole vaulter lands. **(3 marks)**

b Given that the pole vaulter is at his greatest height halfway between leaving the ground and landing, find the greatest height of the pole vaulter. **(3 marks)**

For a jump to be successful, the pole vaulter must clear a bar of height 4.9 m.

c Calculate the range of horizontal distances from the bar that the pole vaulter can leave the ground and have a successful jump. **(7 marks)**

d State the effect in this model of

i modelling the pole vaulter as a particle, **(1 mark)**

ii making air ressistance negligible. **(1 mark)**

4 A boat travels from A to B and then from B to C. The displacement from A to B is $(-28\mathbf{i} + 80\mathbf{j})$ m. The displacement from B to C is $(130\mathbf{i} + 15\mathbf{j})$ m.

a Find the total distance the boat travelled in moving from A to C. **(4 marks)**

b Find the angle the vector $\overrightarrow{AC}$ makes with the unit vector $\mathbf{i}$. **(4 marks)**

5 An ice hockey puck is hit and initially travels with a velocity of $(14\mathbf{i} + 22\mathbf{j})$ m s^{-1}

a Find the speed of the puck. **(3 marks)**

b Find the angle of direction of motion the puck makes with the unit vector $\mathbf{j}$. **(4 marks)**

c State the effect of modelling the ice as a smooth surface. **(1 mark)**

d A hockey puck has a density of 1.4 g cm^{-3}. Convert this into kg m^{-3}. **(4 marks)**