8.1) Vectors in kinematics

Worked example	Your turn
A particle starts from the position vector $(7\boldsymbol{i} - 2\boldsymbol{j})$ m and moves with constant velocity $(-3\boldsymbol{i} + \boldsymbol{j})$ ms^{-1}. (a) Find the position vector of the particle 2 seconds later. (b) Find the time at which the particle is due north of the origin.	A particle starts from the position vector $(3\boldsymbol{i} + 7\boldsymbol{j})$ m and moves with constant velocity $(2\boldsymbol{i} - \boldsymbol{j})$ ms^{-1}. (a) Find the position vector of the particle 4 seconds later. (b) Find the time at which the particle is due east of the origin. a) $(11\boldsymbol{i} + 3\boldsymbol{j})\ ms^{-1}$ b) 7 s

Worked example	Your turn
A particle P has velocity $(-\boldsymbol{i} + 5\boldsymbol{j})$ ms^{-1}. The particle moves with constant acceleration $\boldsymbol{a} = (4\boldsymbol{i} + 7\boldsymbol{j})$ ms^{-2}. Find: (a) the speed of the particle at time $t = 6$ seconds. (b) the bearing on which it is travelling at time $t = 6$ seconds.	A particle P has velocity $(-3\boldsymbol{i} + \boldsymbol{j})$ ms^{-1}. The particle moves with constant acceleration $\boldsymbol{a} = (2\boldsymbol{i} + 3\boldsymbol{j})$ ms^{-2}. Find: (a) the speed of the particle at time $t = 3$ seconds. (b) the bearing on which it is travelling at time $t = 3$ seconds. a) $10.4\ ms^{-1}$ (3 sf) b) $017°$

Worked example	Your turn
An ice skater is skating on a large flat ice rink. At time $t = 0$ the skater is at a fixed point O and is travelling with velocity $(-4\boldsymbol{i} - 9\boldsymbol{j})\ ms^{-1}$. At time $t = 5$ s the skater is travelling with velocity $(-34\boldsymbol{i} + 29\boldsymbol{j})\ ms^{-1}$. Relative to O, the skater has position vector $\boldsymbol{s}$ at time t seconds. Modelling the ice skater as a particle with constant acceleration, find: (a) The acceleration of the ice skater (b) An expression for $\boldsymbol{s}$ in terms of t (c) The time at which the skater is directly south-west of O. A second skater travels so that she has position vector $\boldsymbol{r} = (-132\boldsymbol{i} + (6 - 22t)\boldsymbol{j})$ m relative to O at time t. (d) Show that the two skaters will meet.	An ice skater is skating on a large flat ice rink. At time $t = 0$ the skater is at a fixed point O and is travelling with velocity $(2.4\boldsymbol{i} - 0.6\boldsymbol{j})\ ms^{-1}$. At time $t = 20$ s the skater is travelling with velocity $(-5.6\boldsymbol{i} + 3.4\boldsymbol{j})\ ms^{-1}$. Relative to O, the skater has position vector $\boldsymbol{s}$ at time t seconds. Modelling the ice skater as a particle with constant acceleration, find: (a) The acceleration of the ice skater (b) An expression for $\boldsymbol{s}$ in terms of t (c) The time at which the skater is directly north-east of O. A second skater travels so that she has position vector $\boldsymbol{r} = (1.1t - 6)\boldsymbol{j}$ m relative to O at time t. (d) Show that the two skaters will meet. a) $(-0.4\boldsymbol{i} + 0.2\boldsymbol{j})\ ms^{-2}$ b) $\left((2.4t - 0.2t^2)\boldsymbol{i} + (-0.6t + 0.1t^2)\boldsymbol{j}\right)\ m$ c) $t = 10$ s d) Shown: Meet when $t = 12$ s

Worked example	Your turn
A ship S is moving with constant velocity $(2\boldsymbol{i} + 4\boldsymbol{j})\ kmh^{-1}$. At time $t = 0$, the position vector of S is $(-3\boldsymbol{i} + 5\boldsymbol{j})\ km$. A ship T is moving with constant velocity $(6\boldsymbol{i} + n\boldsymbol{j})\ kmh^{-1}$ At time $t = 0$, the position vector of T is $(-15\boldsymbol{i} + 2\boldsymbol{j})\ km$. The two ships meet at point P. Find the value of n and the distance OP	A ship S is moving with constant velocity $(3\boldsymbol{i} + 3\boldsymbol{j})\ kmh^{-1}$. At time $t = 0$, the position vector of S is $(-4\boldsymbol{i} + 2\boldsymbol{j})\ km$. A ship T is moving with constant velocity $(-2\boldsymbol{i} +$ $n = 3.5, OP = 8.25\ km$ (3 sf)