Bearings and Moments

1 Bearings

1. A ship leaves port at O and sails 12 nautical miles at a bearing of 115°, to A. It then sails 5 nautical miles at a bearing of 242° to B, before returning directly to O.

   (a) Find the position vector of A relative to O.

   (b) Find the position vector of B relative to O.

   (c) Find the bearing taken on the last leg of the journey.

2. Two ships set sail, one from a point with position vector $-3\hat{\mathrm{i}} - 4\hat{\mathrm{j}}$, and the other from $9\hat{\mathrm{i}} - 6\hat{\mathrm{j}}$. They plan to travel in straight lines and rendezvous at the origin. Find the bearing each ship must move on, and the distance it must travel.

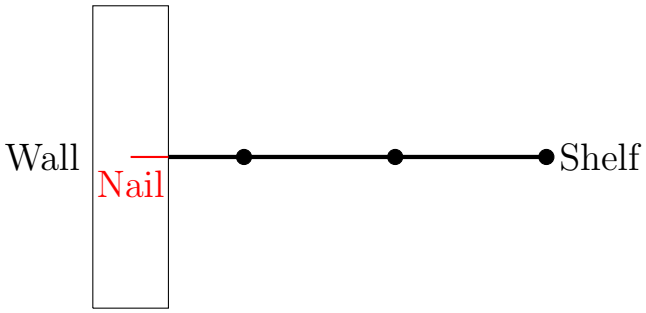
2 Moments

1. A seesaw of length 2m pivots smoothly about its midpoint. A child of mass 20kg sits on one end, and a child of mass m sits 30cm away from the opposite end. The seesaw remains balanced. Find m.

2. A light, horizontal shelf of length 5m is fastened at the left and has masses m, $2m$, and $3m$ suspended from it, at distances of 1m, 3m, and 5m respectively.

   (a) Find the moment about the fastening point.

   (b) The fastening consists of a 10cm nail extending from the shelf into the wall, shown in red below. Modelling the reaction force of the wall on this nail as acting at a single point, 5cm into the wall, find the force exerted by the wall on this nail to keep the shelf stationary.



3. A ramp of length 6m and mass 10kg rests with one end on rough ground and the other against a smooth wall. The angle formed by the ramp with the ground is 30°. A person of mass 70kg stands 5m up the ramp and the ramp is on the point of slipping against the ground. By modelling the ramp as a uniform rod and the person as a particle, find the coefficient of friction between the base of the ramp and the ground.