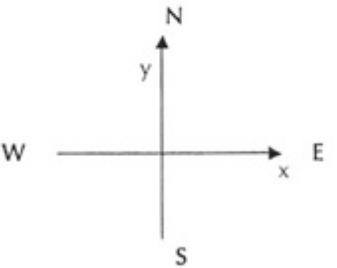
QUESTION 1 [Marks 24]

A car travels at a constant velocity of 60 km.hr^{-1} for 3 hours in a direction 60° to the south of east. The car stops for 2 hours, then it travels for $1\frac{1}{2}$ hours in a direction due north at a constant velocity of 90 km.hr^{-1}.

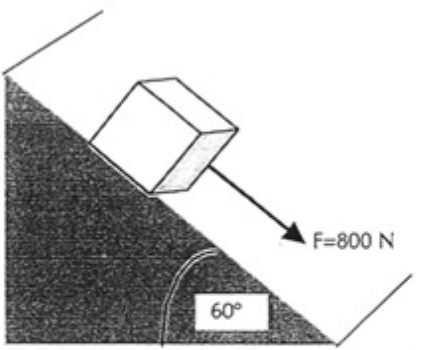
(a) (i) Determine the x and y components of the final displacement vector $\mathbf{r}_{total}$ of the car from its initial position.

(ii) Determine the magnitude and direction of the final displacement vector $\mathbf{r}_{total}$ of the car from its initial position.

(iii) Determine the magnitude and direction of the average velocity $\bar{\mathbf{v}}$ of the car over the full $6\frac{1}{2}$ hour period.



(b) A mass of 150 kg is pulled from rest down a rough plane inclined at 60° to the horizontal by a force F=800 N parallel to the plane, as shown.
The coefficient of kinetic friction between the rough plane and the mass is $\mu_k = 0.2$.



(i) Draw a sketch and mark on it all the forces acting on the mass.

(ii) Determine the friction force acting on the mass.

(iii) Determine the acceleration of the mass.

(iv) Determine the work done by the friction force on the block when the block has slipped a distance of 4 m along the plane.

(v) Determine the total work done on the block when the block has slipped a distance of 4 m along the plane.