2.3) Conservation of mechanical energy and the work-energy principle

Worked example	Your turn
A smooth plane is inclined at $60°$ to the horizontal. A particle of mass $1\ kg$ slides down a line of greatest slope of the plane. The particle starts from rest at point A and passes point B with a speed of $12\ ms^{-1}$. Find the distance AB.	A smooth plane is inclined at $30°$ to the horizontal. A particle of mass $0.5\ kg$ slides down a line of greatest slope of the plane. The particle starts from rest at point A and passes point B with a speed of $6\ ms^{-1}$. Find the distance AB. $3.67\ m$ (3 sf)

Worked example	Your turn
A particle of mass 4 kg is projected with speed 16 ms^{-1} up the line of greatest slope of a rough plane inclined at 30° to the horizontal. The coefficient of friction between the particle and the plane is 0.8. Calculate the distance the particle travels up the plane before coming to instantaneous rest.	A particle of mass 2 kg is projected with speed 8 ms^{-1} up the line of greatest slope of a rough plane inclined at 45° to the horizontal. The coefficient of friction between the particle and the plane is 0.4. Calculate the distance the particle travels up the plane before coming to instantaneous rest. 3.30 m (3 sf)

Worked example	Your turn
A skier is moving downhill and passes point A on a ski run at 12 ms^{-1}. After descending 100 m vertically the run begins to ascend. When the skier has ascended 50 m to the point B her speed is 8 ms^{-1}. The skier and her skis have a combined mass of 55 kg. The total distance she travels from A to B is 2800 m. The non-gravitational resistances to motion are constant and have a total magnitude of 24 N. Calculate the work done by the skier.	A skier is moving downhill and passes point A on a ski run at 6 ms^{-1}. After descending 50 m vertically the run begins to ascend. When the skier has ascended 25 m to the point B her speed is 4 ms^{-1}. The skier and her skis have a combined mass of 55 kg. The total distance she travels from A to B is 1400 m. The non-gravitational resistances to motion are constant and have a total magnitude of 12 N. Calculate the work done by the skier. $2780\ J$ (3 sf)

Worked example	Your turn
Two particles, A and B, of mass m and $4m$ respectively, are attached to the ends of a light inextensible string. The particle A lies on a rough plane inclined at an angle α to the horizontal, where $\tan\alpha = \frac{5}{12}$. The string passes over a small light smooth pulley P fixed at the top of the plane. The particle B hangs freely below P. The particles are released from rest with the string taut and the section of the strig from A to P parallel to a line of greatest slope of the plane. The coefficient of friction between A and the plane is $\frac{3}{8}$. When each particle has moved a distance h, B has not reached the ground and A has not reached P. a) Find an expression for the potential energy lost by the system when each particle has moved a distance h b) When each particle has moved a distance h, they are moving with speed v. Using the work-energy principle, find an expression for v^2 in the form kgh where k is a number.	Two particles, A and B, of mass m and $2m$ respectively, are attached to the ends of a light inextensible string. The particle A lies on a rough plane inclined at an angle α to the horizontal, where $\tan\alpha = \frac{3}{4}$. The string passes over a small light smooth pulley P fixed at the top of the plane. The particle B hangs freely below P. The particles are released from rest with the string taut and the section of the strig from A to P parallel to a line of greatest slope of the plane. The coefficient of friction between A and the plane is $\frac{5}{8}$. When each particle has moved a distance h, B has not reached the ground and A has not reached P. a) Find an expression for the potential energy lost by the system when each particle has moved a distance h b) When each particle has moved a distance h, they are moving with speed v. Using the work-energy principle, find an expression for v^2 in the form kgh where k is a number. a) $\frac{7mgh}{5}$ b) $v^2 = \frac{3}{5}gh$