Q2- A bobsled run leads down a hill as sketched in the figure above. Between points A and D, friction is negligible. Between points D and E at the end of the run, the coefficient of kinetic friction is **μ = 0.5**. The mass of the bobsled with drivers is **250 kg** and it starts from rest at point A.

a) Find the speed of the bobsled at point B.

The speed of the bobsled can easily be calculated using law of conservation of mechanical energy, as there is no non-conservative force is acting up to point D.

If the speed at B is v then

Gain in kinetic energy = loss in potential energy

Or $\frac{1}{2} mv^2 = mgh_1$

Or $v^2 = 2gh_1 = 2*9.8*50 = 980$

Gives $v = 31.305$ m/s

Answer: v = 31.305 m/s

b) Find the work done by gravity on the sled between points A and C.

Between points A and C the sled is coming down by 50 – 30 = 20 m
Hence the net displacement in the direction of gravitational force is 20 m and hence the work done by the gravity on the sled is

$W = mg*(h_1 - h_2) = 250*9.8*20 = 49000$ J

Answer: W = 49000 J

c) Find the distance **x** beyond point D at which the bobsled will come to a halt.

Till point D there is no friction and hence the mechanical energy of the sled is conserved and after that the same energy is utilized to work against friction in moving the sled. When the work done is equal to the initial energy of the sled, the kinetic energy and hence the velocity will become zero and the sled comes to rest.
The magnitude of the frictional force is $\mu N = \mu mg$
Work done against the friction = $\mu mg*x$
This work done is equal to the loss of kinetic energy which is equal to initial potential energy at A = mgh_1
Hence $\mu mgx = mgh_1$
or $x = h_1/\mu = 50/0.5 = 100$ m

Answer: x = 100 m