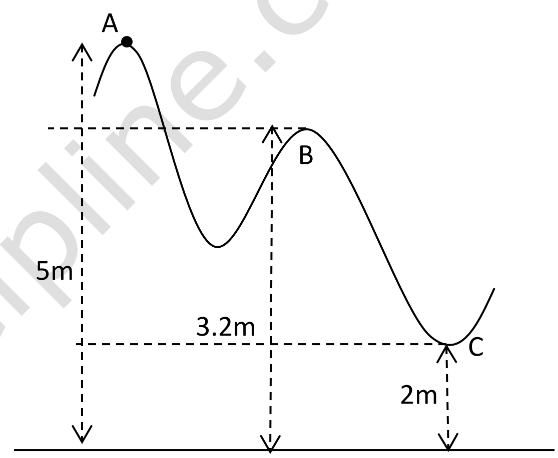
Q- A particle of mass m=5.00kg is released from point A and slides on the frictionless track. Determine

(a) the particle's speed at points B and C. and

(b) the net work done by the gravitational force as the particle moves from A to C.

(a)

As there is no friction, according to law of conservation of energy the total energy of the particle during motion remains conserved. Hence the loss in potential energy will be equal to the gain in kinetic energy and loss in kinetic energy will be equal to gain in potential energy.



For velocity at point B

At point A velocity of the particle is zero

Let the velocity of the particle at point B is v_B then its kinetic energy will be given by

$KE = (½) mv_B^2$

Hence as the particle comes from A to B gain in kinetic energy will be

$(½) mv_B^2 - 0 = (½) mv_B^2$

Vertical height of the particle at A is h_A and that at B is h_B

Hence loss in height from A to B is $h_A - h_B$

And hence loss in potential energy from A to B is

$mg (h_A - h_B)$

According to law of conservation of energy we get

Gain in kinetic energy = loss in potential energy

Or $(½) mv_B^2 = mg (h_A - h_B)$

Or $v_B^2 = 2g (h_A - h_B)$

Substituting values, we have

$v_B^2 = 2*9.8*(5.00 - 3.20) = 35.28$

Gives $v_B = \sqrt{35.28} = 5.94$ m/s

Now for velocity at point C

At point A velocity of the particle is zero

Let the velocity of the particle at point C is v_C then its kinetic energy will be given by

$KE = (½) mv_C^2$

Hence as the particle comes from A to C gain in kinetic energy will be

$(½) mv_C^2 - 0 = (½) mv_C^2$

Vertical height of the particle at A is h_A and that at C is h_C

Hence loss in height from A to B is $h_A - h_C$

And hence loss in potential energy from A to C is

$mg (h_A - h_C)$

According to law of conservation of energy we get

Gain in kinetic energy = loss in potential energy

or $(½) mv_C^2 = mg (h_A - h_C)$

or $v_C^2 = 2g (h_A - h_C)$

Substituting values, we have

$V_C^2 = 2*9.8*(5.00 - 2.00) = 58.8$

Gives $v_C = \sqrt{58.8} = 7.67$ m/s

(b)

The net work done by the gravity is equal to the net loss in potential energy of the particle. As the total loss in height is $h_A - h_C$, the net loss in potential energy will be $mg*(h_A - h_C)$ and hence

The work done by gravity is

$W = mg*(h_A - h_C) = 5.00*9.8*(5.00-2.00) = 5.00*9.8*3.00 = 147.00$ J.