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Phy-150 Project 3

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Part 1

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Part 2

PE = mgh (g = gravity, h = height m = mass)

Total energy = potential energy + kinetic energy

Mgh (total energy)= mgh(PE) + ½ mv^2 to get velocity (normally is d/t)

KE = 1/2 mv^2 (m = mass and v = velocity)

Kinetic Energy = Total Energy – Potential energy

Momentum = velocity \* mass

Momentum before collision = mvi + m(0)

Momentum after collision = 2Mvf

Cart mass = 550 kg

Gravity = 9.8m/s^2

W = F \* D

275kg is half of 550kg so I just went with it on most of the equations so I didn’t have to do extra work.

1.

550kg \* 9.8m/s \* 75m

404,250J

PE at start = 404,250J

KE at start = 0J

404,250J = 404,250J \* ½ 550kg \* v^2

Subtract potential energy of 404,250 from total energy of 404,250

0 = ½ 550kg \* v^2

0 = 275kg \* v^2

Divide both sides by 275kg

sqrt both sides

V = 0m/s

V\*M = momentum

0m/s\*550kg = 0m/s

Momentum = 0kg m/s

Height = 75m

2.

550kg \* 9.8m/s \* 40m = 215,600J

PE = 215600J

404,250J – 215,600J = 188,650J

KE = 188,650J

404,250J = 215,600J \*275 \* v^2

404,250J – 215,600J

188,650J = 275kg\*v^2

188,650J / 275kg

754.6m/s sqrt

V = 27.47m/s

27.47m/s \* 550kg = 15108.49m/s

Height = 40m

3.

550kg \* 9.8m/s \* 60m

PE = 323,400J

404,250J – 323,400J

KE = 80,850J

404,250J = 323,400J \*275kg \*v^2

Subtract 323,400J from 404250J

80850J = 275kg v^2

Divide 275kg from both sides

294m/s sqrt

V = 17.15m/s

17.15m/s \* 550kg

Momentum = 9,432.5 m/s

4.

550kg \* 9.8m/s \* 30m

PE = 161700J

404250J – 161700J = 242500J

KE = 242500J

404250J = 161700J \*275kg \*v^2

Subtract 161700J from both sides

242500J = 275kg \*v^2

242500J / 275kg

882m/s sqrt

V = 29.7m/s

29.7 \* 550 = 16334.17

Momentum = 16334 m/s

5.

60m \* 9.8m/s \* 550kg = 323400J

PE = 323400J

404250J – 323400J

KE = 80850J

404,250J = 323,400J \*275kg \*v^2

Subtract 323,400J from 404250J

80850J = 275kg v^2

Divide 275kg from both sides

294m/s sqrt

V = 17.15m/s

17.15m/s \* 550kg

Momentum = 9,432. m/s

6.

550kg \* 9.8m/s \* 0m

PE = 0J

KE = 404250J – 0 = 404250J

404250J = 0J \*275kg \*v^2

404250J = 275kg \*v^2

1470m/s sqrt

V = 38.34m/s

38.34m/s \* 550kg

Momentum = 808500 m/s

FV = 38.34m/s

Part 3

As the cart move along the track the energy is changed from potential energy as the cart goes down peaking as it gets to the bottom into kinetic energy and back into potential energy as it goes back up to the top. The energy remains constant along the roller coaster due to the law of conservation of energy.

Part 4A picture containing handwriting, text, drawing, font

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Initial velocity should be equal to final velocity from part 1 which was 38.34m/s. The only unknown in this part is the final velocity after the crash which can be gotten through mvi + m(0) = 2Mvf

550kg(38.34)m/s + 550kg(0) = 2(550kg)(vf)

21,087m/s / 1100kg(vf)

Vf = 19.17 m/s

Final velocity before crash was 38.34 m/s and after the crash was 19.17 m/s formula is KE = ½ mass \* velocity^2

½ (550) (38.34)^2 = 404,437.79J KE before collision

½ (550) (19.17)^2 = 101,059.45J KE after collision

Part 5

The kinetic energy of cart 1 was 404,437.79J before the collision as it has just converted all of its potential energy into kinetic energy going down just before the crash. Cart 2 had 0 kinetic energy as it was simply sitting on the tracks. Since cart 2 was not moving when the mass and velocity were added together I only added the mass from cart 2 with no velocity. After the collision I would believe the total energy would remain the same but some would be converted into thermal energy and some to sound as well as the carts grind on the tracks while cart A struggles to push cart B along with it. The principle of the conservation of energy is still applied here though, some of the energy is applied to the surrounding environment with thermal energy being applied to the tracks and the other cart and sounds being made as the carts screech across the tracks.

Part 6

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The carts have to come to a stop in 20 meters with an initial kinetic energy of 404,437.79J the work is the kinetic energy so we have the equation 404437.79J = F \* 20. Divide 404437.79 by 20 to get the force exerted by friction at 20221.89N

F = 20221.89N

Part 7

The kinetic energy of the carts when they are brought to a stop is 0. Before it was about 404,437.79J.

The total energy of the system is reduced to 0 but the energy is not destroyed it is simply converted into different types of energy such as heat, noise, friction, and work. The energy is still there it is just broken into smaller different types of energy so the law of conservation of energy would still apply as the energy was not destroyed it was simply converted to other types and spread around the system.