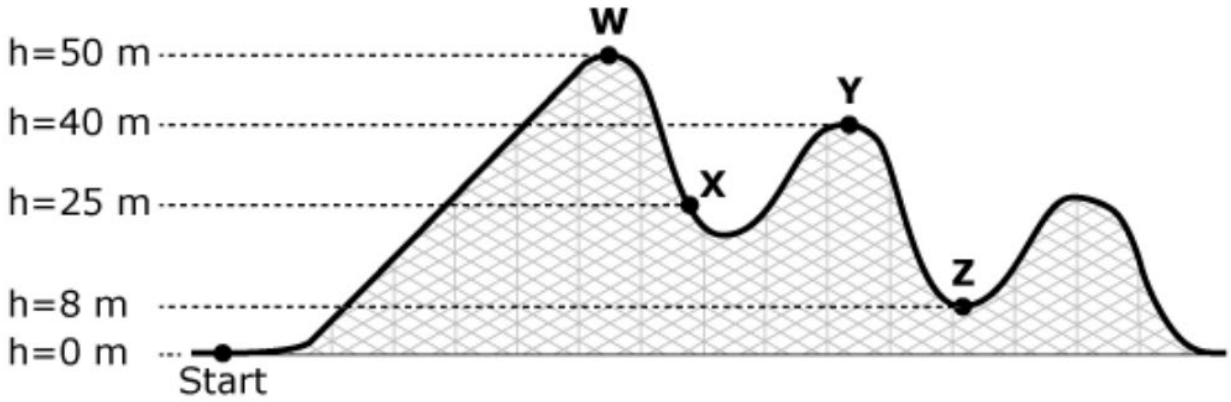
2024 MCAS Informational Webinar on Constructed-Responses

Sample Constructed-Response Item Training Pack

High School Introductory Physics
Roller Coaster

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

Scoring Guide

Score	Description
4	The response demonstrates a thorough understanding of energy conservation, including the transformation of gravitational potential energy to kinetic energy. The response correctly identifies the point where the car had the greatest gravitational potential energy and correctly calculates the car's gravitational potential energy at that point. The response correctly compares the car's kinetic energy at point Y to the car's kinetic energy at point Z and clearly explains the reasoning. The response also correctly identifies the height at which the kinetic energy of the car was equal to the gravitational potential energy of the car and clearly explains the reasoning.
3	The response demonstrates a general understanding of energy conservation, including the transformation of gravitational potential energy to kinetic energy.
2	The response demonstrates a limited understanding of energy conservation, including the transformation of gravitational potential energy to kinetic energy.
1	The response demonstrates a minimal understanding of energy conservation, including the transformation of gravitational potential energy to kinetic energy.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

Scoring Notes

Part A

Point W

Part B

PE = mgh = (4500 kg)(10 m/s^2)(50 m) = 2,250,000 J OR 2,205,000 J if 9.8 m/s^2 is used.

Note: Only accept correct calculations based on an incorrect ID in Part A for scoring going from 0 to 1.

Part C

At point Y, the kinetic energy is less than the kinetic energy at point Z because point Y is at a greater height than point Z. OR because the GPE at point Y is greater than the GPE at point Z, so the KE at point Y must be less than the KE at point Z.

Part D

At point X OR h = 25 m because (any one of the following):

- it is where the car is at half of its original height.
- half of the GPE at point W has been converted to KE.
- it is in the middle of/between the lowest and highest points [0 m and 50 m].

Each part is worth 1 point.

To receive a score of 4, all calculations and units must be included and be correct.

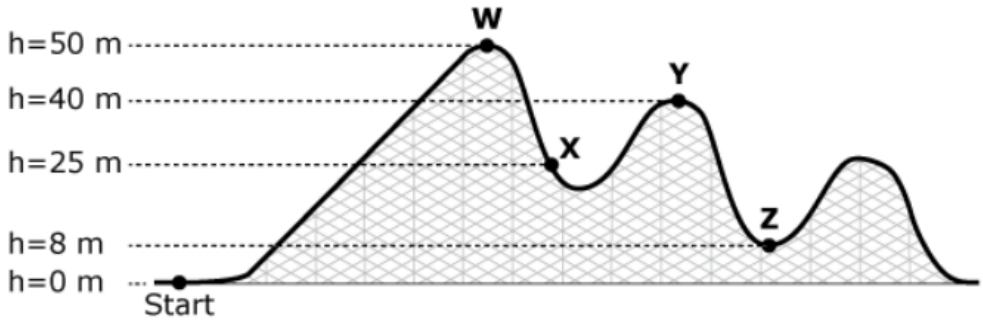
Anchor Set of Student Responses (with scores)

Roller Coaster

Anchor Score 4

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U | 1377

The car and its passengers had the most gravitational potential energy at Point W, the highest point above the ground (50m)

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$$U_g = mgh$$
$$\square = 4500 \cdot 10 \cdot 50$$
$$\square = 2{,}250{,}000 \text{ J}$$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1156

The car and its passengers have more kinetic energy at point Z than point Y, because energy has to be conserved. There is more potential energy at point Y than point Z because point Y is higher off the ground, but the total mechanical energy at both points must be the same, meaning there is more kinetic energy at point Z and less at point Y.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

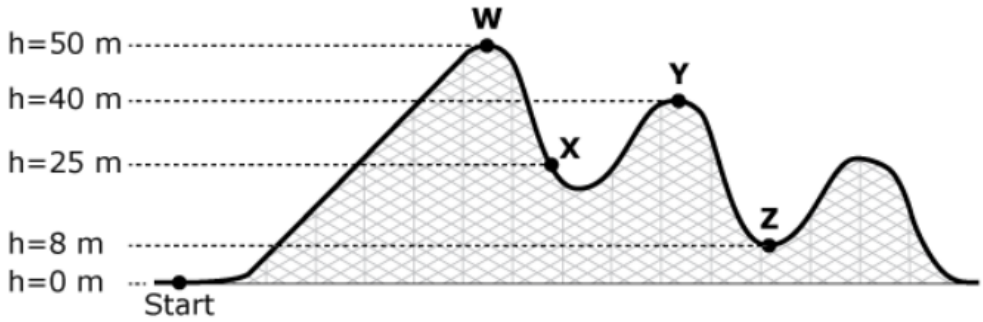
1181

The kinetic and potential energy for the car and its passengers are equal at 25m (point X), because the car has moved downward halfway from its original point, meaning its potential energyis also half as much. The other half has been converted into kinetic energy, meaning the kinetic and potential energy is the same.

Anchor Score 3

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1414

The passangers had the most potential energy on point W because its the highest point.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$PE = mgh$

$PE = 4500 \cdot 10 \cdot 50$

$PE = 2{,}250{,}000$ J

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1350

Point Y has less kinetic energy than pont Z because it it is at a higher point. In other words, Point Z has greater KE because it is at a lower point.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

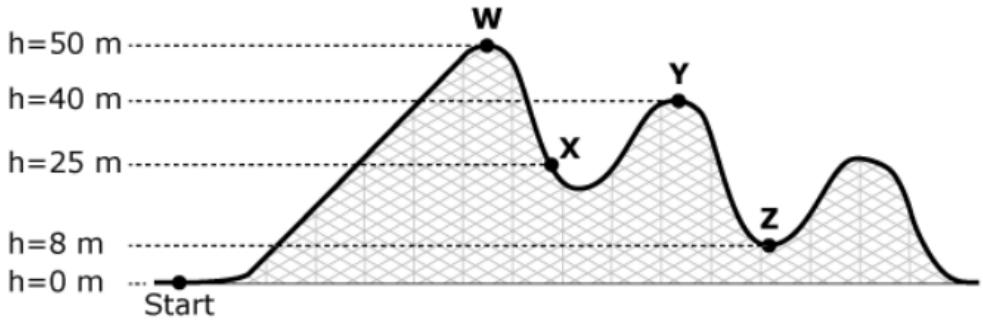
1402

The highest and lowest heights would be equal because PE is converted to KE has it moves downward.

Anchor Score 2

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1499

W

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$\Delta PE = myh$

$\Delta PE = 4500(10)(50)$

$\Delta PE = 2250000$ J

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1365

y
KE=1/2mv^2
KE=1/2 4500 10^2
KE=225000
z
KE=1/2mv^2
KE=1/2 4500 10^2
KE=225000

The amount of kinetic energy is the same at point Y and point Z

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

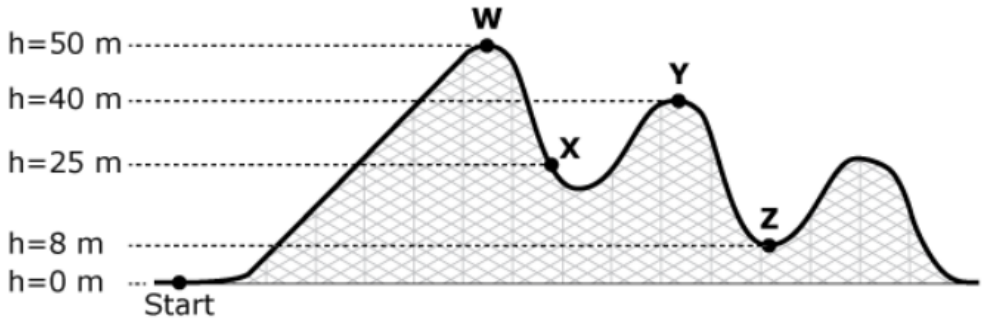
1445

W the kinetic energy and potential energy are the same.

Anchor Score 1

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1420

The roller coaster track had the most gravitational potential energy at point W.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$4500\,\text{kg} \div 50 = 90\,\text{m}$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1417

There was more kinetic energy at point Y because it's 40 m and point Z only has 8 m

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

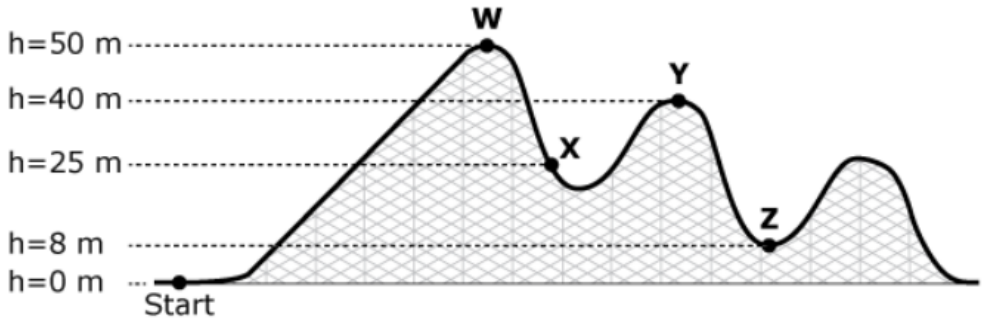
1421

Point Y is closer to point W which has the most gravitational potential energy.

Anchor Score 0

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1385

the point where the car and the passengers had the greatest amount of gravitational potential energy is at point Y.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

the calculation would be 5x8 which would equal 40 m

Symbols
Relations
Geometry
Groups

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1421

the amount of kinetic energy is 5m because when you divid 40 and 8 it equals 5m

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

1372

The height that is equal to gravitational potential energy is at point W because 4500/50 would be the height whitch would be 90m

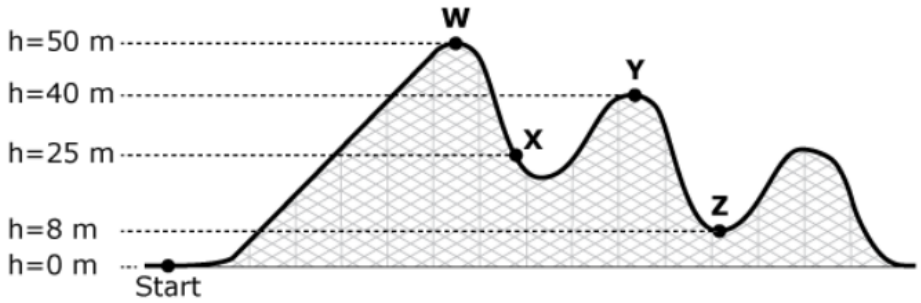
Set of Student Responses without Scores (for educator practice)

Roller Coster

Response A

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1499

Y

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$4{,}500\ \text{kg} \times 40\ \text{m} = 180{,}000\ \frac{m}{\text{kg}}$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1210

Point Y: KE = 1/2mv^2 = 1/2(4,500 kg)(40m)^2 = 1/2(4,500 kg)(1600 m) = 1/2 (7,200,000 m/kg) = 8,640,000 m/kg
Point Z:KE = 1/2mv^2 = 1/2(4,500 kg)(8m)^2 = 1/2(4,500 kg)(64m) = 1/2 (288,000 m/kg) = 345,600 m/kg
Point Y has a higher kinetic energy becuase it is at a higher height than point Z.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

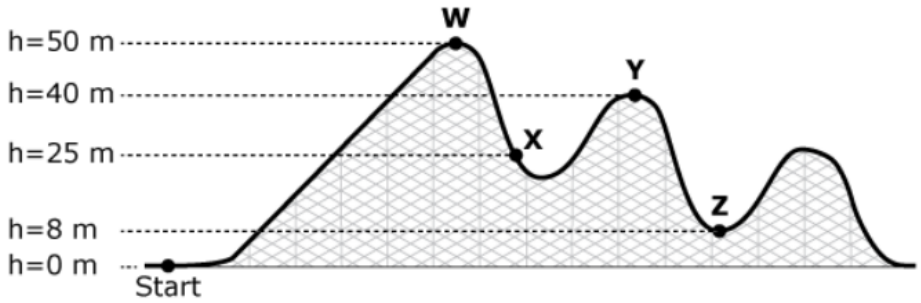
1356

Height W because it's the highest height and the highest height has the highest gravitational potential energy so they are equal to each other.

Response B

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

1348

at point "W" the passengers had the greatest amount of gravitational potential energy because that where the rollercoaster car is at it's highest point.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$$PE = \text{mg}\,\Delta h$$

$$m = 4500\,\text{kg} \qquad g = 10 \cdot \frac{m}{s} \qquad \Delta h = 50m$$

$$PE = (4{,}500)\ (10)\ (50) = PE = 2{,}250{,}000J$$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1280

The kinetic energy at point "Y" is less than the kinetic energy at point "Z" because point "Z" is at a lower point than point "Y" and the rollercoaster car traveled from point "Y" to "Z" point "y" has decreased in speed.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

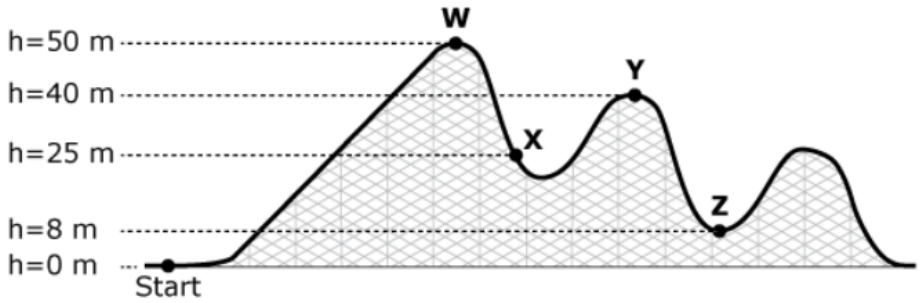
1274

the height of point "Z" and its KE are equal to the PE of point "W" because point "W" is the highest meaning it has the most PE and point "Z" is the lowest, having the most KE. The PE is high so the KE has to be high as well.

Response C

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

1351

The car and its passengers had the greatest amount of gravitational energy on the roller coaster track at point W. It was highest line on the track.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$50m \times 4500 = 225000m$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1404

Point Y = 40 m Point Z = 8 m.
Point Y's acceleration is higher height point Z's acceleration.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

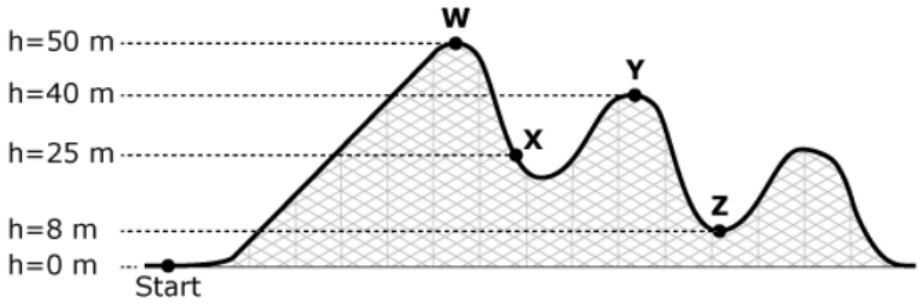
1469

The highest height is point W.

Response D

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

1450

Y is the point with the greatest potential energy.

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$4500\,\text{kg} \times 10\ \frac{m}{s^2} \times 40\ \text{m} = 1{,}800{,}000\ \text{FN}$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1276

The amount of kinetic energy at point Y is much lower because its at a high point on the roller coaster where it's mostly potential energy. For point Z the kinetic energy is much higher as it just dropped from a high point.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

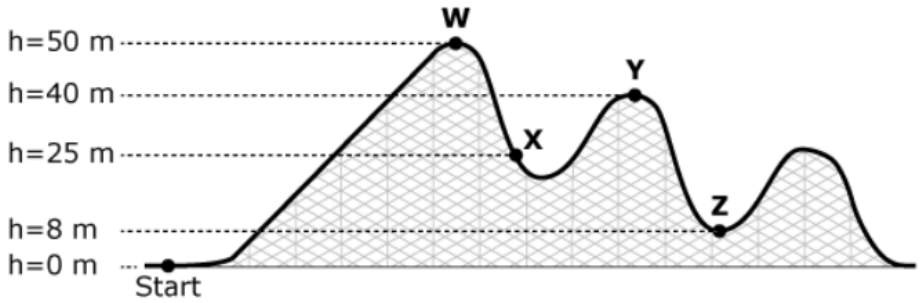
1375

At 25 m is where both potential energy and kinetic energy will be the same because it is halfway down from the highest point.

Response E

This question has four parts.

A diagram of a roller coaster track at an amusement park is shown. The location where passengers get into a car to ride along the track is labeled “Start.” Four additional points along the track are labeled W, X, Y, and Z.



For one ride, a car and its passengers had a total mass of 4500 kg. The car was pulled with a motor from the starting point to point W. The car was held at rest at point W until it was released. The car then moved along the track to point Z with negligible friction.

Part A

Identify the point on the roller coaster track where the car and its passengers had the greatest amount of gravitational potential energy.

B I U 1424

The car had the greatest amount of gravitational potential energy at point W

Part B

Calculate the amount of gravitational potential energy the car and its passengers had at the point you identified in Part A. Show your calculations and include units in your answer.

$\Delta PE = ? \quad m = 4500\ \text{kg} \quad g = 10 \cdot \frac{m}{s^2}$

$\Delta h = 50\ \text{m} \quad \Delta PE = \text{mg}\,\Delta h$

$\Delta PE = 4500\,\text{kg} \cdot 10 \cdot \frac{m}{s^2} \cdot 50m$

$\Delta PE = 2250000J$

Symbols

Part C

Compare the amount of kinetic energy of the car and its passengers at point Y to the amount of kinetic energy of the car and its passengers at point Z. Explain your reasoning.

1376

The car's kinetic energy at point Y is smaller than the car's kinetic energy at point Z because point Y has a bigger height.

Part D

Identify the height at which the kinetic energy of the car and its passengers was equal to the gravitational potential energy of the car and its passengers. Explain your reasoning.

1378

The car had half kinetic energy and half gravitational potential energy at point X because it's half of point W's height.

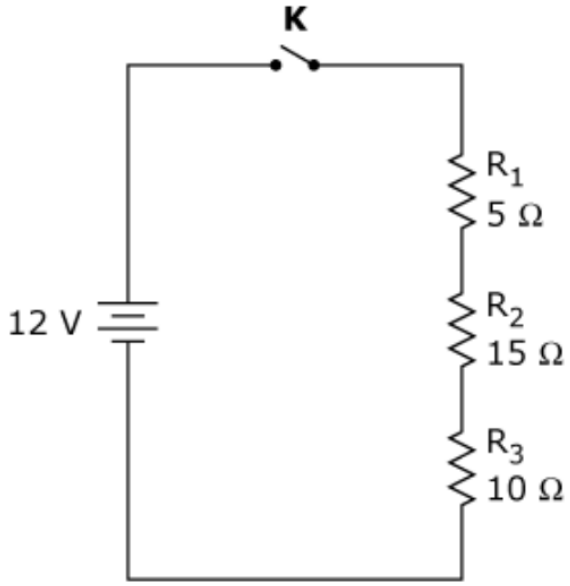
2024 MCAS Informational Webinar on Constructed-Responses

Sample Constructed-Response Item Training Pack

High School Introductory Physics Series Circuit

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K and explain its main function.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

Scoring Guide

Score	Description
4	The response demonstrates a thorough understanding of series circuits and Ohm's law. The response correctly identifies and clearly explains the main function of component K. The response correctly calculates the total resistance of the circuit, clearly explains whether the amount of current through R_1 and R_2 is the same, and also correctly calculates the voltage drop across the R_1.
3	The response demonstrates a general understanding of series circuits and Ohm's law.
2	The response demonstrates a limited understanding of series circuits and Ohm's law.
1	The response demonstrates a minimal understanding of series circuits and Ohm's law.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.
Blank	No response.

Scoring Notes

Part A

Component K is a switch and is used to (any one of the following):

- turn the circuit on/off.
- allow/prevent current from flowing in the circuit.
- open/close the circuit.

Part B

Total resistance = 5 Ω + 15 Ω + 10 Ω = 30 Ω

Part C

The current flowing through R_1 is the same as the current flowing through R_2 because (any one of the following):

- the resistors are connected in series.
- there is only one pathway for the current.
- the resistors are connected on the same branch
- Circuit current: I = V/R = 12 V / 30 Ω = 0.4 A

Part D

Voltage drop across R_1 = IR = (0.4 A)(5 Ω) = 2 V
OR There is 1/6 of the total resistance, so it's 1/6 the total voltage = 2 V

Each part is worth 1 point.

To receive a score of 4, all calculations and units must be included and be correct.

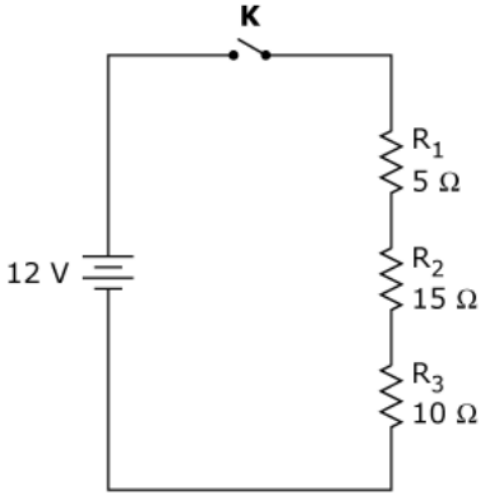
Anchor Set of Student Responses (with scores)

Series Circuit

Anchor Score 4

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1313

Component K is a switch. It's main function is to open and close the circuit, in other words turn on and turn off the current. Because the current stops flowing when the circuit is open.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$R_{total} = R_1 + R_2 + R_3 = 5\Omega + 15\Omega + 10\Omega = 30\Omega$

Symbols
Relations
Geometry
Groups

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1405

Yes it is. Because in a series circuit, the amount of current flowing is the same at any point.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

$$I = \frac{V}{R} = \frac{12V}{30\Omega} = 0.4A$$

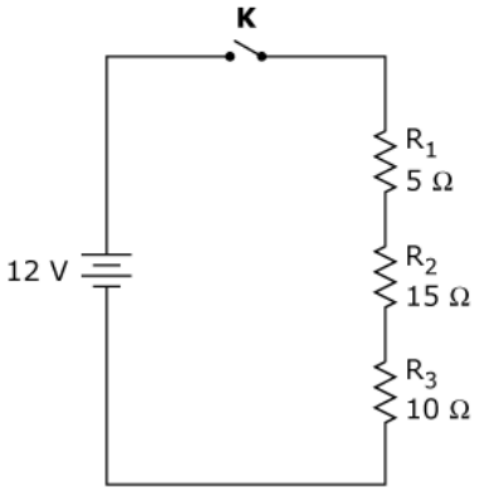
$$V = IR = 0.4A \times 5\Omega = 2V$$

Symbols

Anchor Score 3

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1341

Component K is a switch. A switch can turn a circuit on and off, which means that it can control when there is and isn't current flowing through the circuit.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

You calculate total resistance by adding up all 3 resistors: $r_1 + r_2 + r_3$.

$5\Omega + 15\Omega + 10\Omega = 30\Omega$

There is a total of 30Ω of resistance.

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1206

The ammount of current flowing through R1 is not the same as the current flowing through R2. All the voltage goes through R1 which is the first resistor, but not all of it comes out because it is being held back by the resistor. What is left, then goes through R2. This is called voltage drop.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

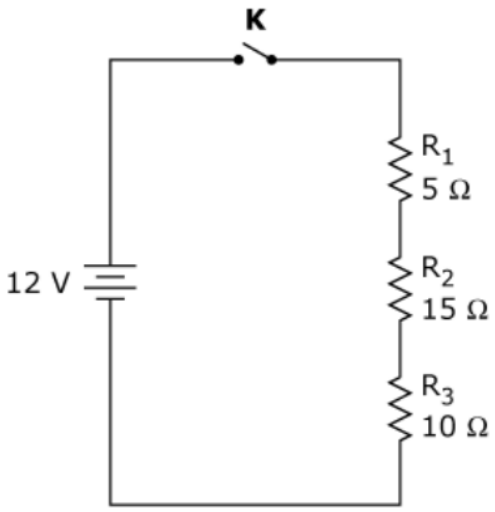
To calculate the voltage drop across R_1, you first have to find what percentage of the total resistance R_1 is. $\frac{R_1}{R_T} = \frac{5\Omega}{30\Omega} = \frac{1}{6}$. You then have to multiple $\frac{1}{6}$ times the voltage of the battery which is 12V. $12V\left(\frac{1}{6}\right) = voltage$ drop. The voltage drop across R_1 is 2V.

Symbols

Anchor Score 2

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1415

Component K is an open switch. Its main function is to close the circuit or open it.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

The total resistance is 30Ω. There is 3 different resistances and I added all of them together.

$$5\Omega + 15\Omega + 10\Omega = 30\Omega$$

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1261

The amount of current flowing through R1 is not the same as the amount of current flowing through R2. It is not the same because R2 has a greater resistance than R1. When you divide their voltage by their resistance it will be different.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

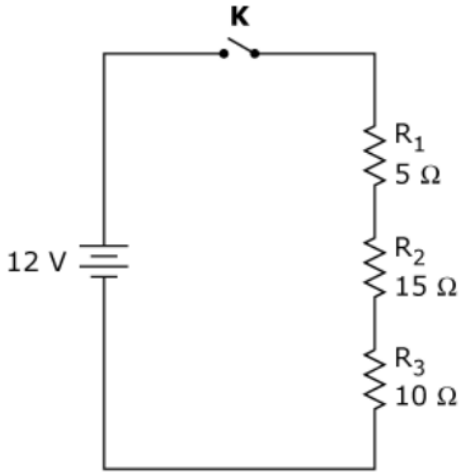
The voltage drop is 12V because that's the voltage for each current even if they're added together or not.

Symbols

Anchor Score 1

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1439

component K is a resistor. The current stops flowing after K.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

R1 R2 R3

$5 + 15 + 10 = 30\Omega$

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1387

No, R2 has more current flowing through it because it has its own current of 15 ohms and R1's current of 5 ohms.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

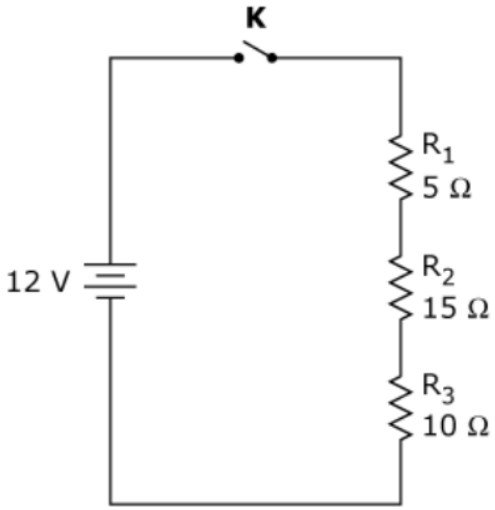
$$V = IR$$
$$V = 30\,(5)$$
$$V = 150\Omega$$

Symbols

Anchor Score 0

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1460

Component K represents a short circuit.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$\frac{R_1+R_2+R_3}{3} = R\ \text{Total}$

$\frac{5+15+10}{3} = 10\Omega$

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1291

R1=V=IR 4/5=I5/5 R1=I=0.8A
R2 = I=IV 4/15=I15/15 R2=I=0.26A
No, the current flowing through R1 is not the same amount of current flowing through R2 because they have different resistances.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

In series, the voltage is split amongst the resistors equally.

3 resistors, total 12 voltage

$$12 \div 3 = 4V$$

Symbols

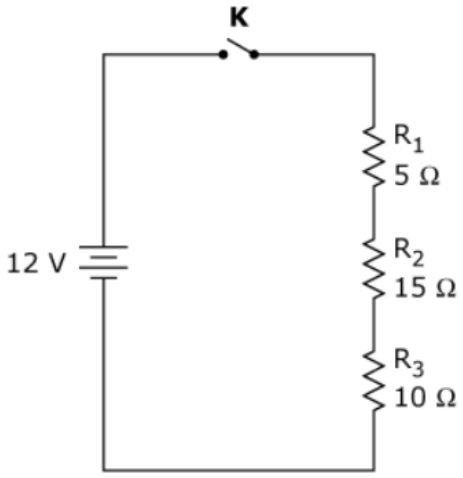
Set of Student Responses without Scores (for educator practice)

Series Circuit

Response A

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

1379

The componet K is a switch. The switch's main function is to turn and off the circuit. It alows current to flow through.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

The total amount of resistance of the circuit is 30 ohms.

$R_1 + R_2 + R_3 = \square\ total$ resistance

$5 + 15 + 10 = 30$

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1232

The current flowing R1 is not the same amount of current flowing through R2. At first the current flows through the circuit. When it gets to R1 it powers it. Making the amount of current go down. Now when R2 gets the current it s not the same as it first was with R1.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

The voltage drop across R1 is 9.6 V.

$$12 \div 3 = 4$$

$$12 \div 5 = 2.4$$

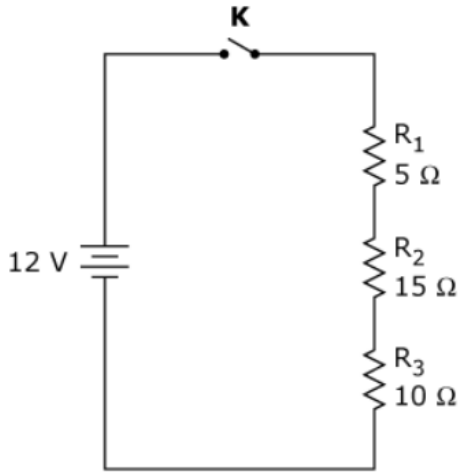
$$2.4 \times 4 = 9.6$$

Symbols

Response B

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

1430

Component K is a switch and it is used to open and close the circuit.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$R_{TOTAL} = R_1 + R_2 + R_3$

$R_{TOTAL} = 5\Omega + 15\Omega + 10\Omega$

$R_{TOTAL} = 30\Omega$ The total resistance of the circuit is 30Ω.

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1243

Yes, the amount of curren flowing through R1 is the same as the amount of current flowing through R2. This is because this circuit is a series circuit, and in a series circuit the current of the circuit will be the same at any point throughout the circuit.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

$I = \frac{V}{R}$ I = $\frac{12V}{30\Omega}$ I = 0.4 A

$V = IR$ V = $0.4A \cdot 5\Omega$

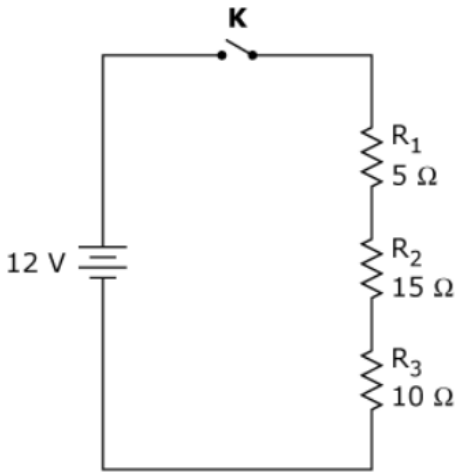
$V = 2V$ The voltage drop across R_1 is 2 volts.

Symbols

Response C

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

B I U 1446

Component K's main function is to let exess energy out

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$5 + 15 + 10 = 30$

$\frac{30}{3} = 10$

R = 10

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1447

no because they have different ammounts of resistance

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

$$V = IR$$

$$V = 12\,(5)$$

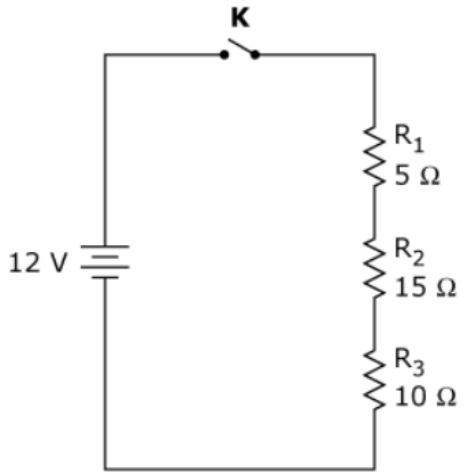
V = 60

Symbols

Response D

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

1489

K is motor.

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$R_1 = 5 + R_2 = 15 + R_3 = 10 = 30\Omega$

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1462

No because one is more than the other.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

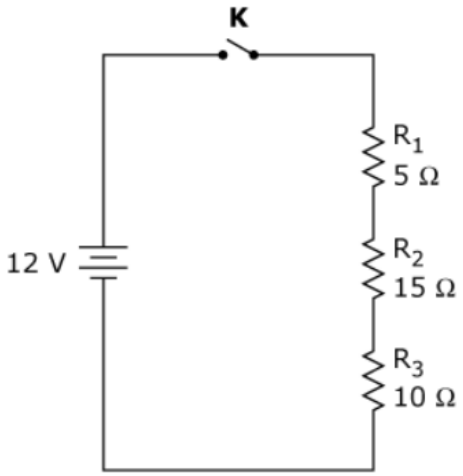
voltage drop $\frac{12}{5} = 2.4\ \text{V}$

Symbols

Response E

This question has four parts.

The diagram shows a circuit with a 12 V battery, three resistors, and component K.



Part A

Identify component K **and** explain its main function.

1288

Component K is a switch, its main function is to turn the circuit on and off. By bieng closed, the circuit is on. By bieng open the circuit is off. (Refering to the switch the one that is being closed and open).

Part B

Component K is replaced with a piece of wire.

Calculate the total resistance of the circuit. Show your calculations and include units in your answer.

$R_1 + R_2 + R_3 = R_T$

$5\Omega + 15\Omega + 10\Omega = R_T = 30\Omega$

Because this is a series circuit you can add up all of the resistors to get the total resistance.

Symbols

Part C

Is the amount of current flowing through R_1 the same as the amount of current flowing through R_2? Explain your reasoning.

1291

No, the amount of current would not be the same because current is voltage divided by the resistance. In resistor #1 the current flowing through it would be 2.4 amps, but in resistor #2 there would be .8 amps.

Part D

Calculate the voltage drop across R_1. Show your calculations and include units in your answer.

$V = IR$

Total current = 0.4 amps

Resistance = 5Ω

$.4A \times 5\Omega = 2$ volts

2 volts is the voltage drop

Symbols