2023 MCAS Sample Student Work and Scoring Guide

High School Introductory Physics
Question 42: Constructed-Response

Reporting Category: Motion, Forces, and Interactions
Practice Category: None
Standard: HS.PHY.2.5 - Provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
Item Description: Explain why a light bulb turns on in a given setup, describe two changes to the setup that would increase the brightness of the bulb, and describe how the relationship between electricity and motion in the setup is different than in an electric motor.

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Scoring Guide

Select a score point in the table below to view the sample student response.

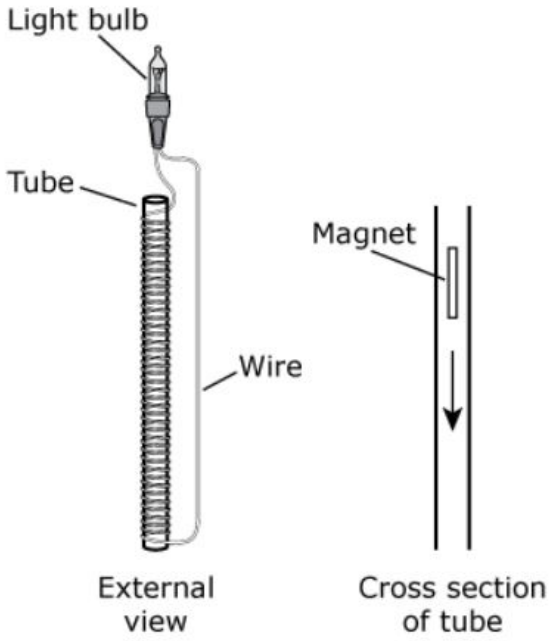
Score*	Description
4A	The response demonstrates a thorough understanding of how an electric current can produce a magnetic field. The response clearly explains why the light bulb turns on when the magnet is falling through the tube. The response clearly describes two changes to the investigation that would increase the brightness of the light bulb. The response also clearly describes how the relationship between electricity and motion in one investigation is different from the relationship between electricity and motion in another investigation.
4B	
3	The response demonstrates a general understanding of how an electric current can produce a magnetic field.
2	The response demonstrates a limited understanding of how an electric current can produce a magnetic field.
1	The response demonstrates a minimal understanding of how an electric current can produce a magnetic field.
0	The response is incorrect or contains some correct work that is irrelevant to the skill or concept being measured.

*Letters are used to distinguish between sample student responses that earned the same score (e.g., 4A and 4B).

Score Point 4A

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1330

The light bulb turns on when the magnet is falling through the tube because the magnet has a magnetic field around it that creates current in the wire to the light bulb.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1279

One change would be to increase the speed of the falling magnet to create a larger current for the light bulb. Another change would be to wrap the coil around the tube more times to exert a larger current from the magnet.

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1323

In this investigation, the motion of the magnet generates electricity by adding current to the wire. In an electric motor, electricity is used to create motion, to move objects.

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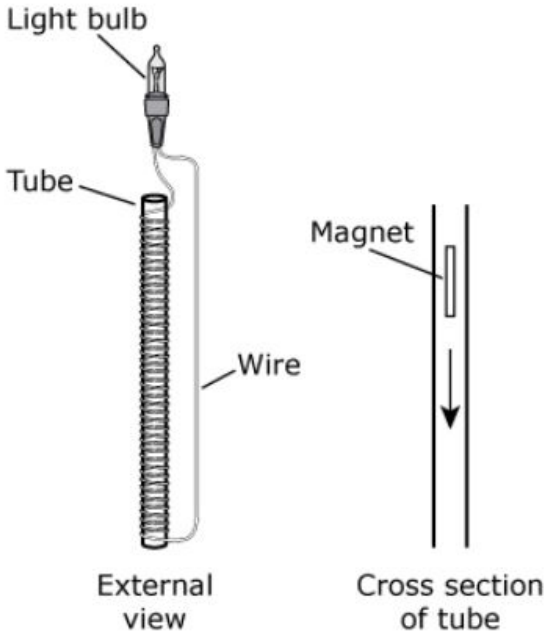
Score Point 4B

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1343

When the magnet is falling through the tube it moves the electrons in the coil. The electrons move because of the magnet's magnetic field, creating current.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1438

1. use a more powerfull magnet
2. coil the wire closer together

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1285

The relationship between electricity and motion is opposite in an electric motor than in this investigation. The motion in this investigation creates current, while in an electric motor, the current creates motion.

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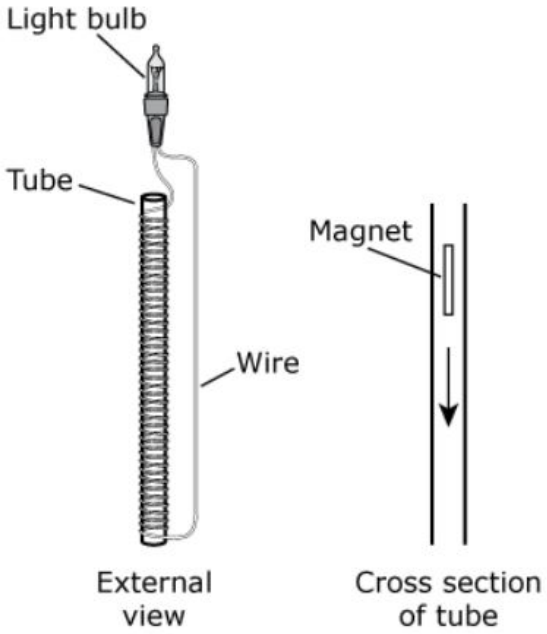
Score Point 3

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1405

The magnetic force in the coil as the magnet falls generates electricity to light up the bulb.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1386

One change that would increase the brightness of the bulb is more loops in the coil. another is a stronger magnet.

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1360

The relationship between the two is that in the investigation the electric flow is very brief. While in a generator the charge is continuos.

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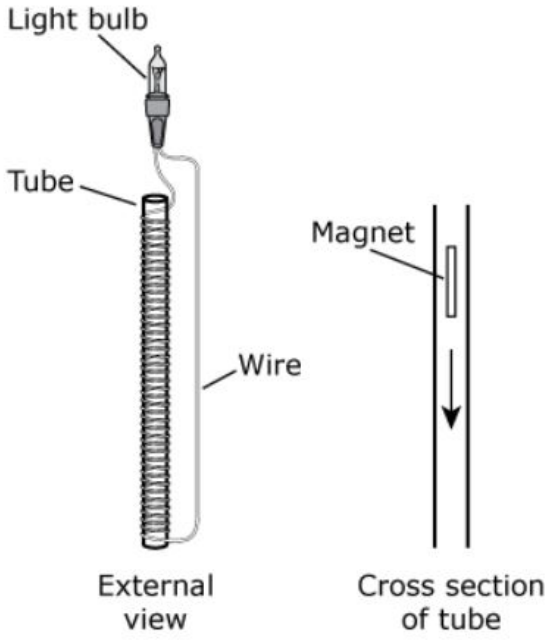
Score Point 2

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1381

The light bulb turns on as the magnet is falling because the magnet's movement creates an electric current in the wire.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1356

To increase the brightness of the light bulb, the plastic tube could be taken out or the magnet could be moved up and down instead of just down.

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1350

In this investigation, the motion of the magnet creates the electric current in the wire. In an electric motor, electricity is used to create motion.

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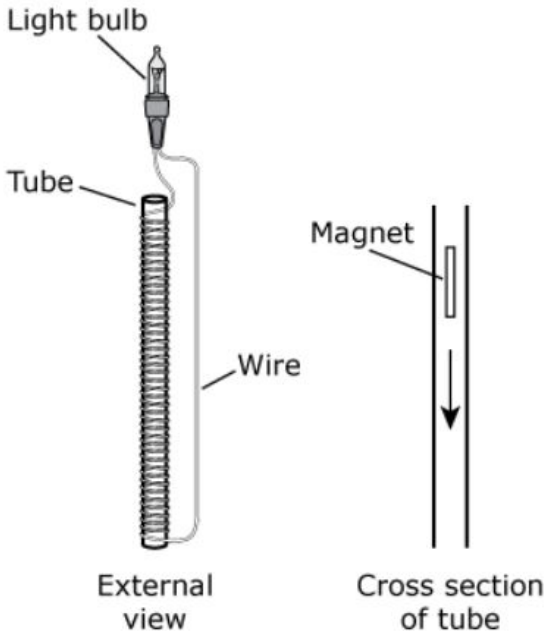
Score Point 1

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1297

The lightbulb turns on when the magnet is dropped down the tube because it is connected to copper wire. The copper wire is attracted to the magnet so therefore the attraction causes the light to turn on.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1147

One change that would increase the brightness is if there was a stronger magnet. The stronger the magnet, the greater the attraction to the wire used to turn the lightbulb on. A second change that would increase the brightness is if there was only one lightbulb. This would make it brighter because the light wouldn't have to be split between two bulbs.

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1305

In an electric motor the relationship between electricity and motion differ from this experiement because it is a larger object. The motor needs more electricity to run than just two light bulbs.

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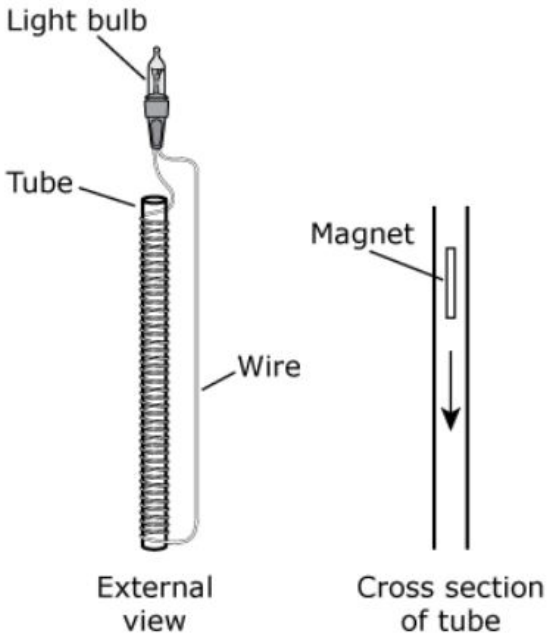
Score Point 0

This question has three parts.

In an investigation, a hollow plastic tube is wrapped in copper wire and a light bulb is connected to both ends of the wire. A magnet is then dropped inside the tube. The diagram shows two views of this setup.



When the magnet is falling through the tube, the light bulb turns on.

Part A

Explain why the light bulb turns on when the magnet is falling through the tube.

B I U 1296

The light bulb turns on when the magnet is dropped through the tube because the force of the magnet goes through the copper which is connected with wire to the light bulb, then it turns on the light bulb.

Part B

Describe **two** changes to the investigation that would increase the brightness of the light bulb.

1370

Two changes that would increase the brightness of the bulb would be using steal instade of copper and using a higher voltage bulb.

Part C

Describe how the relationship between electricity and motion in this investigation is different from the relationship between electricity and motion in an electric motor.

1278

The difference between electricity and motion in this investigation then an electric motor would be the electirc motor would have more power then this investigation because the electric motor would just give of more power.

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