ACT SCIENCE PRACTICE PAPER

QUESTION 1

Magnets and electric charges show certain similarities. For example, both magnets and electric charges can exert a force on their surroundings. This force, when produced by a magnet, is called a magnetic field. When it is produced by an electric charge, the force is called an electric field. It has been observed that the strength of both magnetic fields and electric fields is inversely proportional to the square of the distance between a magnet or an electric charge and the objects that they affect.

Below, three scientists debate the relationship between electricity and magnetism.

Scientist 1:

Electricity and magnetism are two different phenomena. Materials such as iron, cobalt, and nickel contain magnetic domains: tiny regions of magnetism, each with two poles. Normally, the domains have a random orientation and are not aligned, so the magnetism of some domains cancels out that of other domains; however, in magnets, domains line up in the same direction, creating the two poles of the magnet and causing magnetic behavior.

In contrast, electricity is a moving electric charge which is caused by the flow of electrons through a material. Electrons flow through a material from a region of higher potential (more negative charge) to a region of lower potential (more positive charge). We can measure this flow of electrons as current, which refers to the amount of charge transferred over a period of time.

Scientist 2:

Electricity and magnetism are similar phenomena; however, one cannot be reduced to the other. Electricity involves two types of charges: positive and negative charge. Though electricity can occur in a moving form (in the form of current, or an electric charge moving through a wire), it can also occur in a static form. Static electricity involves no moving charge. Instead, objects can have a net excess of positive charge or a net excess of negative charge—

because of having lost or gained electrons, respectively. When two static positive electric charges or two static negative electric charges are brought close together, they repel each other. However, when a positive and a negative static charge are brought together, they attract each other.

Similarly, all magnets have two poles. Magnetic poles that are alike repel each other, while dissimilar magnetic poles attract each other. Magnets and static electric charges are alike in that they both show attraction and repulsion in similar circumstances. However, while isolated static electric charges occur in nature, there are no single, isolated magnetic poles. All magnets have two poles, which cannot be dissociated from each other.

Scientist 3:

Electricity and magnetism are two aspects of the same phenomenon. A moving flow of electrons creates a magnetic field around it. Thus, wherever an electric current exists, a magnetic field will also exist. The magnetic field created by an electric current is perpendicular to the electric current's direction of flow.

Additionally, a magnetic field can induce an electric current. This can happen when a wire is moved across a magnetic field, or when a magnetic field is moved near a conductive wire. Because magnetic fields can produce electric fields and electric fields can produce magnetic fields, we can understand electricity and magnetism as parts of one phenomenon: electromagnetism.

1. In an experiment, an iron bar that showed no magnetism was heated and allowed to cool while aligned North-South with the Earth's magnetic field. After it cooled, the iron bar was found to be magnetic. Scientist 1 would most likely explain this result by saying which of the following?

select

Interference occurred between the electric field of the bar and the magnetic field of the Earth, causing the bar to become magnetic.

select

The experiment caused the two magnetic poles of the bar to move so that they were aligned with the Earth's magnetic field.

select

The experiment allowed the magnetic domains of the bar to line up, causing the bar to become magnetic.

select

The experiment caused the magnetic domains of the bar to move out of alignment with each other.

select

The experiment induced an electric current in the bar, causing the bar to become magnetic.

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2. In a compass, a needle spins to align North-South, following the Earth's magnetic field. Suppose that a compass is placed near wire through which an electric current flows, and it is observed that the needle of the compass no longer aligns to North-South. How would this affect the arguments of Scientist 2 and Scientist 3?

select

It would weaken Scientist 2's argument, and it would weaken Scientist 3's argument.

select

It would strengthen Scientist 2's argument, and it would weaken Scientist 3's argument.

select

It would strengthen Scientist 2's argument, and it would strengthen Scientist 3's argument.

select

It would have no effect on Scientist 2's argument, and it would strengthen Scientist 3's argument.

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3. Given that all of the following are true, which of the following, if found, provides the strongest evidence *against* Scientist 1's hypothesis?

select

The magnetic domains of a material are partially created by the spin and electric charge of the electrons within the material.

select

A magnetic field affects the position of iron filings. However, an electric field has no effect on the position of iron filings.

select

When one pole of a magnet is placed near a wire carrying a current, the magnet is attracted to the wire. When the other pole of the magnet is placed in the same position, the magnet is repelled.

select

Running an electric current through a magnet does not cause a change in the strength of the magnetic field around the magnet.

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4. According to Scientist 2, which of the following would be an example of a static electric charge?

select

A wire that carries charge from the negative to the positive terminal of a battery

select

A bar magnet placed in an electric field

select

A conductive material, such as copper, that is placed in an magnetic field

select

A ring of a conductive material, such copper, that has not lost or gained electrons

select

A balloon that has been rubbed against hair so that it has picked up excess electrons

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5. When two wires carrying electric currents are placed near each other, it is found that each of the wires exerts a slight attraction on the other. Scientist 3 would most likely explain this by saying which of the following?

select

Each of the two wires produces a magnetic field parallel to it, and the magnetic fields attract each other.

select

Each of the two wires produces a magnetic field perpendicular to it, and the magnetic fields exert an attraction on each other.

select

Each of the two wires produces an electric field perpendicular to it, and the electric fields repel each other.

select

Static charges on each of the two wires become attracted to each other when the wires are placed close together.

QUESTION 6:

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6. When a wire coil is rotated between the poles of a magnet, an electric current is produced in the wire. How does this observation affect the argument of Scientist 3?

select

It supports Scientist 3's argument because it shows that a magnetic field can induce an electric current.

select

It weakens Scientist 3's argument because it shows that an electric current can produce a magnetic field.

select

It supports Scientist 3's argument because it shows that an electric current can produce a magnetic field.

select

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QUESTION 7:

Magnets and electric charges show certain similarities. For example, both magnets and electric charges can exert a force on their surroundings. This force, when produced by a magnet, is called a magnetic field. When it is produced by an electric charge, the force is called an electric field. It has been observed that the strength of both magnetic fields and electric fields is inversely proportional to the square of the distance between a magnet or an electric charge and the objects that they affect.

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7. Which of the following describes a difference between the explanations of Scientist 1 and Scientist 2?

select

Scientist 1 argues that electric charges and magnetic poles are unrelated, while Scientist 2 argues that electric charges are the same as magnetic poles.

select

Scientist 1 understands electricity as the movement of electrons, while Scientist 2 notes that electricity can take the form of static charges that can attract and repel each other.

select

Scientist 1 argues that magnetism is caused by the alignment of magnetic domains, while Scientist 2 argues that magnetism is caused by an excess of positive of negative charge.

select

Scientist 1 states that electricity flows from a region of more negative charge to a region of more positive charge, while Scientist 2 notes that electricity flows from a region of more positive charge to a region of more negative charge.

select

Scientist 1 implies that electricity is a stronger force than magnetism, while Scientist 2 notes that electricity and magnetism are equally strong.

QUESTION 8:

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8. Which of the following would be an example of electricity according to Scientist 2, but not according to Scientist 1?

select

Two negatively-charged objects repel each other.

select

Current flows along a wire between a negatively-charged object and an positively charged-object.

select

A wire conducts electrons from the negative terminal of a battery to the positive terminal.

select

A positively-charged object is attracted to a negatively-charged object and receives excess electrons from it.

QUESTION 9:

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9. Electric current is measured in *amperes* (A). According to Scientist 1 and the information in the passage, in which of the following situations would one measure the greatest amplitude for an electric field?

select

Measuring the field 10 cm away from a wire carrying 10 A of current

select

Measuring the field 10 cm away from a wire carrying 5 A of current

select

Measuring the field 1 cm away from a wire carrying 5 A of current

select

Measuring the field 1 cm away from a wire carrying 10 A of current

QUESTION 10:

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10. An iron magnet is hit repeatedly with a hammer. Afterwards, when the iron magnet is examined, it is found to be much less magnetic than it was before. What explanation would Scientist 1 most likely provide for this?

select

Hitting the magnet with the hammer created an electric field around the magnet, which interfered with the magnet's magnetic field.

select

Hitting the magnet with the hammer created an opposing magnetic field around the magnet, and this field weakened the magnet's own magnetic field.

select

Hitting the magnet with the hammer knocked the magnet's domains out of alignment, causing the magnet to lose its magnetism.

select

Hitting the magnet with the hammer destroyed the magnet's domains, causing the magnet to lose its magnetism.

select

Hitting the magnet with the hammer caused the magnet's domains to move into alignment, weakening the magnet's magnetism.

QUESTION 11:

Understanding the biological features of different bacteria that allow them to grow in unwelcoming environments is necessary to treat and prevent human disease. Modern scientific laboratories, such as those in major hospitals, take blood, urine, and mucus samples from patients and culture them for bacterial growth. During the culturing process, laboratory technicians stain the growing bacteria for a component of their cell wall, the structure that provides shape and rigidity to the bacterium, through a process called Gram staining. Bacteria are typically classified as Gram Positive or Gram Negative, a distinction that is important in selecting the most effective antibiotic for treatment. Gram Positive bacteria appear purple under a microscope, while Gram Negative bacteria appear red. However, some bacteria do not Gram Stain and cannot be seen under a microscope when prepared this way.

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Disease	Organism	Color Under Microscope	Selective Media Required
Sinus Infection	*H. influenzae*	Red	Chocolate Agar (Factors V and X)
Pneumonia (Lung Infection)	*S. pneumoniae*	Blue	None
Stomach Infection	*H. pylori*	None Visible	Sheep's Blood
Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

Scientists can take the bacteria cultured on the plate and further analyze their enzymes. Three enzymes—urease, catalase, and beta-lactamase—are important for bacterial survival against the human immune system. Urease is responsible for producing urea, a basic molecule that can counteract the bactericidal (bacteria-killing) activity of stomach acid. Catalase, on the other hand, helps bacteria neutralize toxic substances released from human immune cells, allowing them to survive oxidative stress in high-oxygen areas. Finally, beta-lactamase allows Gram Positive bacteria to break down antibiotics called penicillins. While this ability to break down penicillin and its related antibiotic ampicillin was not initially present, bacteria, especially *E. coli*, have adapted by developing the new enzyme beta-lactamase that opens the ring responsible for penicillin's bactericidal activity, rending the antibiotic ineffective. This and other examples of antibiotic resistance are becoming more common and are making treatment of serious human diseases very challenging.

11. According to information presented in the passage, which bacterium or bacteria is/are not susceptible to penicillin?

select

B. cerrius

select

E. coli

select

H. pylori

select

S. pneumoniae

QUESTION 12:

Understanding the biological features of different bacteria that allow them to grow in unwelcoming environments is necessary to treat and prevent human disease. Modern scientific laboratories, such as those in major hospitals, take blood, urine, and mucus samples from patients and culture them for bacterial growth. During the culturing process, laboratory technicians stain the growing bacteria for a component of their cell wall, the structure that provides shape and rigidity to the bacterium, through a process called Gram staining. Bacteria are typically classified as Gram Positive or Gram Negative, a distinction that is important in selecting the most effective antibiotic for treatment. Gram Positive bacteria appear purple under a microscope, while Gram Negative bacteria appear red. However, some bacteria do not Gram Stain and cannot be seen under a microscope when prepared this way.

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12. Ampicillin is not able to treat which of the following illnesses, according to information in the passage?

select

Pneumonia

select

Stomach Infection

select

Urinary Tract Infection

select

Diarrhea

QUESTION 13:

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Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

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13. A novice technician reverses the two materials needed to complete a Gram stain. Which of the following effects will this likely have on a patient's treatment?

select

The patient's disease will be correctly treated.

select

It is impossible to predict how this mix-up will affect the patient's treatment.

select

An incorrect antibiotic will be prescribed for the patient and it will not be effective in helping the patient recover.

select

An incorrect antibiotic will be prescribed for the patient, but it will be effective in helping the patient recover.

QUESTION 14:

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Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

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14. A bacterium that stains red in a Gram stain and requires lactose to grow is most likely to cause what disease?

select

Pneumonia

select

Urinary Tract Infection

select

Diarrhea

select

Sinus Infection

QUESTION 15:

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Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

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15. A patient with a sinus infection goes to the doctor and a culture of mucus is taken to determine the species of bacteria causing the disease. The technician appropriately selects the Chocolate Agar base but forgets to add Factor X. What effect will this have on the bacterial culture?

select

Cannot Be Predicted

select

No Growth

select

Normal Growth

select

Excess Growth

QUESTION 16:

Understanding the biological features of different bacteria that allow them to grow in unwelcoming environments is necessary to treat and prevent human disease. Modern scientific laboratories, such as those in major hospitals, take blood, urine, and mucus samples from patients and culture them for bacterial growth. During the culturing process, laboratory technicians stain the growing bacteria for a component of their cell wall, the structure that provides shape and rigidity to the bacterium, through a process called Gram staining. Bacteria are typically classified as Gram Positive or Gram Negative, a distinction that is important in selecting the most effective antibiotic for treatment. Gram Positive bacteria appear purple under a microscope, while Gram Negative bacteria appear red. However, some bacteria do not Gram Stain and cannot be seen under a microscope when prepared this way.

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Stomach Infection	*H. pylori*	None Visible	Sheep's Blood
Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

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16. Assume that no laboratory tests are conducted to determine which bacteria are causing patients' diseases and penicillin is prescribed to all patients. Using information presented in the passage, it could be inferred that the number of days required to treat an infection would do what?

select

Decrease

select

Increase

select

Remain the same

select

Cannot be predicted

QUESTION 17:

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17. According to the passage, the bacterium most likely to produce catalase would cause what type of infection?

select

Urinary tract infection

select

Stomach infection

select

Diarrhea

select

Pneumonia

QUESTION 18:

Understanding the biological features of different bacteria that allow them to grow in unwelcoming environments is necessary to treat and prevent human disease. Modern scientific laboratories, such as those in major hospitals, take blood, urine, and mucus samples from patients and culture them for bacterial growth. During the culturing process, laboratory technicians stain the growing bacteria for a component of their cell wall, the structure that provides shape and rigidity to the bacterium, through a process called Gram staining. Bacteria are typically classified as Gram Positive or Gram Negative, a distinction that is important in selecting the most effective antibiotic for treatment. Gram Positive bacteria appear purple under a microscope, while Gram Negative bacteria appear red. However, some bacteria do not Gram Stain and cannot be seen under a microscope when prepared this way.

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18. A patient with watery diarrhea comes to the doctor after eating spoiled food at a family event. The bacterium most likely responsible for causing the diarrhea would require what growth medium(a)?

select

Sheep's blood

select

Chocolate agar

select

Lactose

select

Lactose and chocolate agar

QUESTION 19:

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19. What is the most likely reason that some organisms will not Gram stain?

select

Beta-Lactamase is present.

select

They do not have a cell wall.

select

Urease is present.

select

Catalase is present.

QUESTION 20:

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20. A technician stains a slide using the gram stain procedure and sees nothing upon looking under the microscope. Which growth medium could be required to determine is a particular bacterium is causing disease?

select

None of the other answers

select

Lactose

select

Chocolate agar

select

Sheep's blood

QUESTION 21:

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21. Which of the following bacteria is most likely to produce urease?

select

S. pneumoniae

select

H. influenzae

select

H. pylori

select

E. coli

QUESTION 22:

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Urinary Tract Infection	*E. coli*	Red	Lactose
Diarrhea	*B. cerrius*	Blue	Lactose

Scientists can take the bacteria cultured on the plate and further analyze their enzymes. Three enzymes—urease, catalase, and beta-lactamase—are important for bacterial survival against the human immune system. Urease is responsible for producing urea, a basic molecule that can counteract the bactericidal (bacteria-killing) activity of stomach acid. Catalase, on the other hand, helps bacteria neutralize toxic substances released from human immune cells, allowing them to survive oxidative stress in high-oxygen areas. Finally, beta-lactamase allows Gram Positive bacteria to break down antibiotics called penicillins. While this ability to break down penicillin and its related antibiotic ampicillin was not initially present, bacteria, especially *E. coli*, have adapted by developing the new enzyme beta-lactamase that opens the ring responsible for penicillin's bactericidal activity, rending the antibiotic ineffective. This and other examples of antibiotic resistance are becoming more common and are making treatment of serious human diseases very challenging.

22. Assume a new growth medium was created that contained a mixture of sheep's blood, lactose, and Factors X and V (chocolate agar) but was also supplemented with penicillin. What type of bacteria could likely be cultured on this new medium?

select

E. coli

select

S. pneumoniae

select

H. influenzae

select

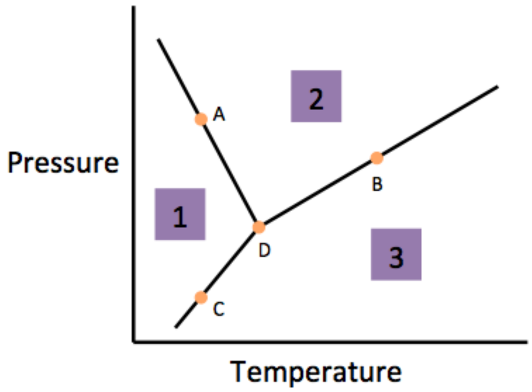
B. cerrius

QUESTION 23:

Chemists can model how solids, liquids, and gases behave at different temperatures and pressures with a graph called a phase diagram. When the pressure and temperature are simultaneously known, a scientist can predict whether the material will be in a specific state. The diagram is divided into sections depending on the phase and the lines between sections represent phase transitions occurring between two or more separate phases.

In general, solids of neatly stacked molecules exist when temperatures are low and pressures are intermediate. These values decrease the kinetic energy of the molecules enough to allow for attractive forces to begin the stacking process. Liquids, by contrast, are found at intermediate pressures and temperatures. The temperature is high enough to impart enough kinetic energy to prevent solid formation and the pressure is high enough to prevent the liquid from becoming a gas. Finally, a gas forms at low pressures and high temperatures. The high level of kinetic energy prevents molecules from associating with one another.

Materials can undergo processes called phase transitions, meaning they can transition from one phase to another. The transition from a solid to a liquid is called melting, while the reverse transition is called freezing. Vaporization occurs when a liquid becomes a gas, while condensation occurs when a gas becomes a liquid. Finally, in a process called sublimation, a solid can directly become a gas without passing through a liquid phase. Additionally, when a gas directly becomes a solid, this is known as deposition.



23. According to the figure, the material represented by area two is in what phase?

select

Liquid

select

Cannot Be Determined

select

Gas

select

Solid

QUESTION 24:

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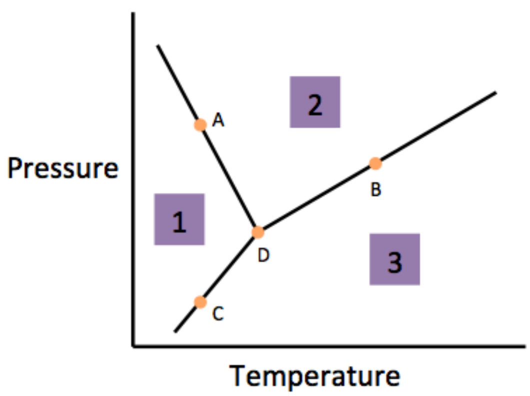

24. According to the figure, the material represented by area three is in what phase?

select

Gas

select

Cannot Be Determined

select

Solid

select

Liquid

QUESTION 25:

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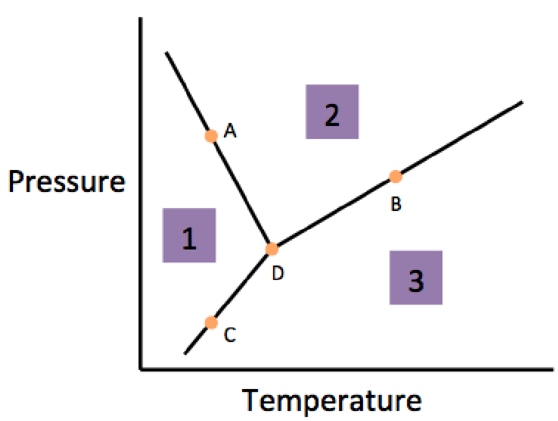

25. The process as a substance goes from its phase in area one to its new phase in area two is called __________.

select

Vaporization

select

Freezing

select

Melting

select

Condensation

QUESTION 26:

Chemists can model how solids, liquids, and gases behave at different temperatures and pressures with a graph called a phase diagram. When the pressure and temperature are simultaneously known, a scientist can predict whether the material will be in a specific state. The diagram is divided into sections depending on the phase and the lines between sections represent phase transitions occurring between two or more separate phases.

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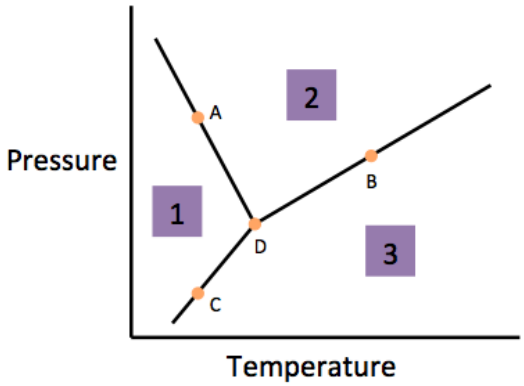

26. Which phase transition occurs as a material transitions from area two to area three in the figure?

select
Melting

select
Vaporization

select
Condensation

select
Freezing

QUESTION 27:

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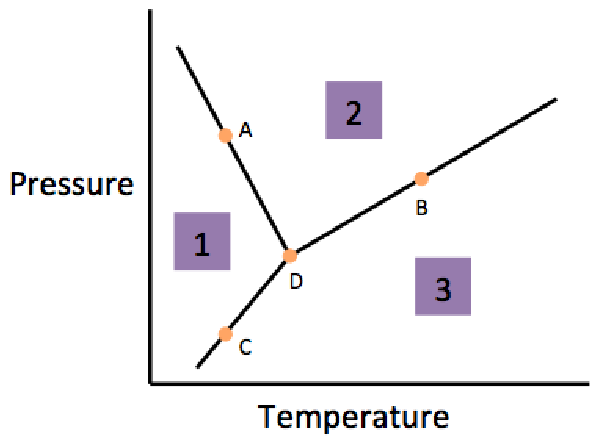

27. The phase transition occuring at Point C where a substance moves from area one to area three is called __________.

select

Deposition

select

Condensation

select

Sublimation

select

Vaporization

QUESTION 28:

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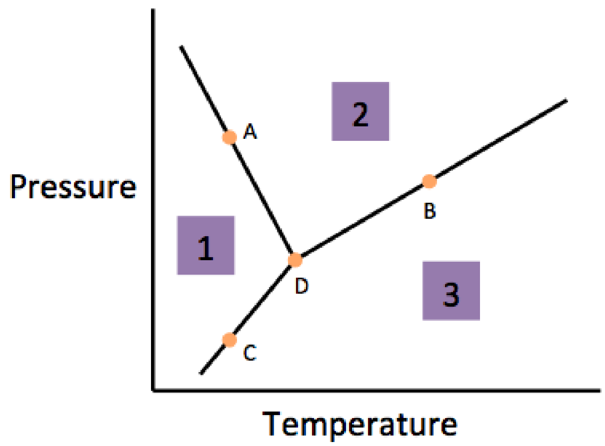

28. At point B, a material is transitioning from its phase in area three to its phase in area two. What is this phase transition called?

select

Deposition

select

Condensation

select

Vaporization

select

Sublimation

QUESTION 29:

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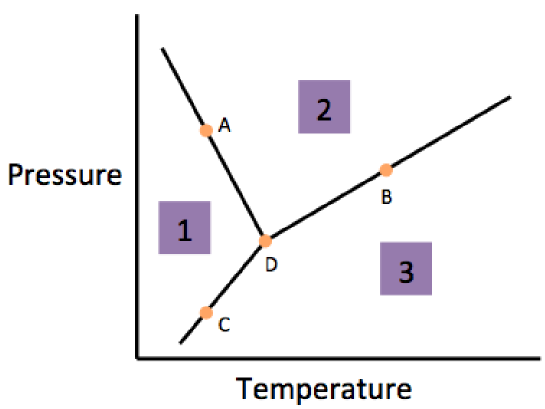

29. At Point D, the material is most likley in what phase(s)?

select
Solid, Liquid, and Gas

select
Gas

select
Liquid

select
Solid

QUESTION 30:

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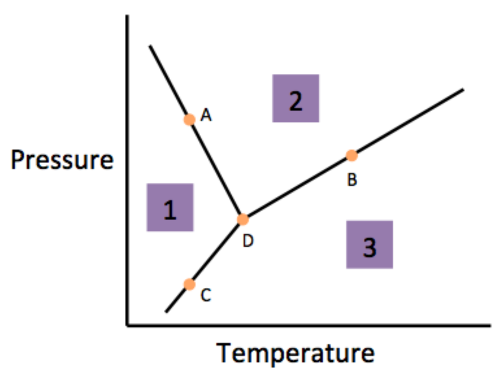

30. Solid carbon dioxide is commonly stored in freezing cold, low pressure rooms to prevent loss of the material. If the temperature in the room slowly warmed, the solid carbon dioxide would most likely become what?

select

Gas

select

Remain Solid

select

Liquid

select

Cannot Be Determined