APPENDIX A: Creative Thinking Test

Dear student

This test includes six different tasks, and each task investigates different scientific skills, giving you the opportunity to excel at what you are best at. These tasks will enable you to use your creativity, explore new ideas and solve problems.

All information will be treated as strictly confidential and for research purposes only.

Instructions

1- Answer all questions.

2- Please try to complete all the tasks in 45 minutes.

3 - Do not write anything on the test paper and all answers must be written on the answer sheet that is provided.

4 - If you want to change your answer, make sure you've erased your original answer completely.

With sincere appreciation

Name..............................................................................

Gender...............................................................................

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TASK 1: Asking

If you can go to the planets, what scientific questions would you want to research? List your questions in the blanks available.

For example, is it possible for humans to live on planets?

Source: (Hu & Adey, 2002)
TASK 2: Guessing the Causes

List down as many incidents as you can think might be the cause related to the picture below, list your answer in the blanks available.

For example, the person sees his image on the water because the phenomenon of reflection.

Source: (Torrance, 1966)

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TASK 3: Guessing the Effect of an Incident
Lists down as many effects as you can think of in the blanks available caused by the event in the picture given TASK 2.

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TASK 4: Improving Products

Please think of as many possible improvements as you can to a regular bicycle making it more interesting, more useful and more beautiful. List your answers in the blanks available. (You can write or draw or both)

For example, add a mirror on the sides, in order to avoid accidents.

Source: (Hu & Adey, 2002)
TASK 5: Extraordinary Uses

Please write down as many possible scientific uses (for example, in a lab) as you can for a plastic bottle. List your answers in the blanks available. (You can write or draw or both)

For example, make spoons for carrying liquids.

Source: (Pekmez, et al., 2009)
TASK 6: Supposing

Suppose there was no gravity; describe what the world would be like? List your answers in the blanks available. **(You can write or draw or both)**

For example, difficult to use electronic devices (mobile, laptop, ipad).

Source: (Hu & Adey, 2002)
APPENDIX B: Critical Thinking Test

Dear student

This test is designed to measure some of your skills or mental abilities and reveal your abilities in the analysis and the use of logic.

All information will be treated as strictly confidential and for research purposes only.

Instructions

1 – Answer all questions.

2- Please try to complete all the tasks in 70 minutes.

3- Read the instructions for each of the five test areas as well as the illustrative example as to how to answer.

4 - Do not write anything on the test paper and all answers must be written on the answer sheet that is provided.

5 - If you want to change your answer, make sure you've erased your original answer completely.

With Sincere appreciation

Name......................................................................

Gender..............................................................................

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TEST 1: INFERENCE

DIRECTION

Is the ability to draw a conclusion from multiple introductions or facts or opinions or data in the fields of science, for example, if we say to students that magnets attract materials made of iron and only offered him some materials such as sand, gravel, wood, metal spikes and nails, and so can the student infer that the nails are ferrous metals are materials only attracted to magnets and other materials are not attracted to him.

In this test, each situation begins with a statement of facts that you are to regard as true. After each statement of facts, you will find several possible inferences may be true or false. Examine each inference separately, and make a decision as to its degree of truth or falsity.

For each inference, you will find space on the answer sheet labeled T, PT, ID, PF and F. for each inference makes a mark on the answer sheet under the appropriate heading as follows:

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NOTE: the process sometimes, in deciding whether an inference is true or false, you will have to use certain commonly accepted knowledge or information that you have. The following example illustrates that. Look at the example, the correct answers are indicated in the block at the center.

There are several standards to measure the temperature and the simplest of these measures is the sense of touch they are used to assess hotter body.

1. People sensitive to the atmosphere heat to know the temperature of the human.
2. Sense of touch is necessary to determine the body temperature.
3. Estimated the hottest person with a fever by touching it for purpose of first aid and reduce the temperature.
4. The temperature of body depends on the temperature of the atmosphere.
5. Temperature of the necessary things to describe the weather (the weather daily), so farmers and pilots are interesting in the issue of predict weather.
EXERCISE

Design the cooking pots from conductive materials for heat or electric.

1. All the electrical conductive material is a good conductor of heat.
2. Making glass mug to be insulating.
3. Put the heat insulating material such as masks to carry the pots.
4. The manufacture of light bulbs depends on the metal connectors used in making and determines the type of string.
5. Facilitate the cooking process.

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Increasing pressure of solid body because increased weight when the base space is constant so to reduce the pressure:

6. Put a broad wooden down the car crane, especially the roads are unpaved.
7. Makers of knives make a sharp edge until it is used less pressure from the hand.
8. Nails are made so that makes one end tapered and the other broad to increase the pressure during use by the carpenter.
9. Increase the base area of ski skiing.
10. Agricultural machinery has large wheels to increase the speed.

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Reach the sun's heat to the earth and its population by thermal radiation emitted of them.

11. Different the temperature of the atmosphere from one region to another result of the difference fall angle of the X-ray and also a result of rotation of the Earth
12. The streets heated by impact of the sun's heat so drivers of cars filled the wheel in small amounts of air to overcome the expansion of the air.
13. Saved a lot of material necessary for the treatment of blood and medicines in the system of thermally insulated to overcome the effects of the atmosphere.
14. The human being adapted to the impacts of heat through clothing, housing and type of food that is eaten.
15. Cover plants by greenhouses.
TEST 2: RECOGNITION OF ASSUMPTION

DIRECTIONS

An assumption is something presupposed or taken for granted. When you say, ‘I’ll be a qualified solicitor in two months; you take it for granted that you will be alive in two months, that you will pass the relevant examinations, and similar things.

Below are a number of statements. Each statement is followed by several proposed assumptions. You are to decide for each assumption, whether a person, in making the given statement, is really making that assumption, i.e., taking it for granted, justifiably or not. If you think that the given assumption is taken for granted in the statement, mark ‘YES’ under ‘Assumption made’ in the proper place on the answer sheet. If you think, the assumption is not necessarily taken for granted in the statement, mark ‘NO’ in the space under ‘Assumption not made’. Remember to judge each assumption independently.

Below is an example. The box at the center shows how these items should be marked on the answer sheet.

EXAMPLE

Student taking amount of soil from school garden and it’s weighing and then put it aside in the sun for a week. Then teacher asked student weight the same amount of the soil again, and found that the weight of the soil is less.
1. Because the evaporation which led to disappear the moisture that existed in the soil of the garden.
2. Because the wind, which led to the flying soil particles, which was uncovered under the sun.
3. Because other students played with soil.

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EXERCISE

There are many new energy sources that will be discovered in the future, if we discover the new source of energy, this will prevent lack of energy source in the future.

Proposed assumption

61. A new source of energy wills not overloading the power more than the new power has generated.
62. New sources of energy are limited.
63. After the new source of energy is discovered, the demand for energy will not exceed the supply.

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Development in science, the environment conversation, and education will be maximized if all countries work together rather than independently.

Proposed assumption

64. If all countries work together in these fields, there will be fewer likelihoods of armed conflict.
65. Ethnic and politic differences between human beings will not prevent them from working together on related humanly affairs.
66. International cooperation in science and education will lead to fewer independent societies.

Source: (Watson & Glaser, 1980)

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A study of auto efficiency is done. Tested is that a gasoline additive will increase auto efficiency. Five identical cars each one receive the same amount of gasoline but different amounts of Additive A. They travel the same track until they run out of gasoline. The research team records the number of miles each car travel. How is auto efficiency measured in this study?

Proposed assumption

67. The time for each car runs out of gasoline.
68. The distance for each car travels.
69. The amount of gasoline used.
70. The amount of additive a used.
Marie wondered if the earth and oceans are heated equally by sunlight. She decided to conduct an investigation. She filled a bucket with soil another bucket of the same size with water. She placed them so each bucket received the same amount of sunlight. The temperature in each was measured every hour from 8:00 a.m. to 6:00 p.m.

**Proposed assumption**

71. The greater amount of sunlight, the soil and water becomes more warmer.
72. The longer the soil and water are in the sun, the warmer they become.
73. Different types of materials are warmed differently by the sun.
74. Different amounts of sunlight are received at different times of the day.

Source: (Burns, et al., 1985)

**TEST 3: DEDUCTION**

**DIRECTIONS**

In this test, each exercise consists of several statements (premises) followed by several suggested conclusions. For the purpose of this test, consider the statements in each exercise as true without exception. Read the first conclusion beneath the statements. If you think it necessarily follows from the statements given, mark ‘√’ under ‘Conclusion follows’ in the proper place on the Answer Sheet. If you think, it is not a necessary conclusion from the statements given mark ‘√’ under ‘Conclusion not follows’, even though you may believe it to be true for your general knowledge.

Similarly, read and judge each of the other conclusions. Try not to let your prejudices influence your judgment – just stick to the given statements (premises) and judge whether each conclusion necessarily follows. The word ‘some’ in any of these statements means an indefinite part of quantity of a class of things. ‘Some’ means at least a portion, and perhaps all of the class. Thus, ‘Some holidays are rainy’ means at least one, possibly more than one, and perhaps even all holidays are rainy.

Study the example carefully before starting the test.
EXERSCIS

All objects are attracted to the earth at the same speeds. A folder and a bit of paper are objects.

75. A folder and a bit of paper will fall to the Earth at the different speeds, and the bit of paper will arrive before the folder.
76. A folder and a bit of paper will fall to the Earth at the same speeds, and the bit of paper will arrive before the folder.
77. A folder and a bit of paper will fall to the Earth at the same speeds and will therefore arrive at the same time.

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Metals are the good conductors of electrical, non-metals are not and therefore:

78. Iron from the metal so it is good conductors of electricity.
79. Sulfur from non-metals in this case it is not good for the conductor the electricity.
80. All minerals in nature with high electrical conductivity are from the metals.

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All water from the tap boils at 100 C° at sea level. The water in my pot contains water at sea level.

81. If the temperature reaches 100 C° the water in my pot will boil.
82. If the temperature reaches 0 C° the water in my pot will boil.
83. If the temperature reaches 110 C° the water in my pot will boil.
In one Iraq town, there are 52 physics classes in the five secondary schools. Each class contains 10 pupils. Therefore

84. There are at least two classes in the town with exactly the same number of pupils.
85. Most secondary school classes in the town contain than 15 pupils.
86. There are at least 550 pupils in these secondary schools.

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Source: (Watson & Glaser, 1980)

There is material in nature stretch in the heat, and some of these materials shrink in the decline of temperature.

87. Solid materials stretch by heat and shrink in the decline of temperature.
88. All liquid material subject to the base thermal expansion.
89. Gases subject to the base thermal expansion, which stretches dramatically so that it is really extended equivalent to the virtual extended.

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Source: (Alwani, 1999)

TEST 4: INTERPRETATION

DIRECTIONS

Each of the following exercises consists of a short paragraph followed by several suggested conclusions.

For the purpose of this test, assume that everything in the short paragraph is true. The problem is to judge whether or not each of the proposed conclusions logically follows beyond a reasonable doubt from the information given in the paragraph.

If you think that the proposed conclusion follows beyond a reasonable doubt (even though it may not follow absolutely and necessarily), mark under ‘Conclusion Follows’
in the proper place on the answer sheet. If you think that the conclusion does not follow beyond a reasonable doubt from the facts, mark under ‘Conclusion doesn’t Follow’.

EXAMPLE
The human body is exposed to the types of radiation, including ultraviolet radiation in sunlight, where this radiation causes increased up to the body to the high rate of skin cancer.
1. The body is exposed to radiation in addition to other sunlight almost every material contains trace amounts of toxic substances.
2. The X-rays are ultraviolet radiation exposed to the human body.
3. Not all humans are exposed to ultraviolet light there is from his body is not affected by this type of radiation.

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EXERCIES

In the days of the cold winter observed dense vapor out of the mouth of the speaker, while not observed in the hot summer days?

90. Movement of warm wet air to cold air and obtain the phenomenon of condensation.
91. Shift water vapor from liquid to the gaseous state.
92. Impurities' existence in the atmosphere.

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Ahmed intelligent student in physics, Ahmed got a high mark in physics. Therefore,

93. All students received high marks in Physics.
94. Potential to be superior in all subjects.
95. Ahmad's student is loved by all his colleagues.

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Fan blade continues to spin for a certain period after a power outage it and if someone tries to stop the blade in his hand a person finds it difficult, has hurt the fingers.

96. Fan feather continues to spin due to the impact of continuity and stop due to air resistance.
97. The difficulty faced by a person to stop the fan is because of continuity.
98. The fan engine stops completely after a power outage so that it cannot accelerate the fan.

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Five different hosepipes are used to pump diesel from a tank; the same pump is used for each hosepipe. The following table shows the result of an investigation that was done on the amount of diesel pumped from each hosepipe.

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<th>Size (diameter) of hosepipe (mm)</th>
<th>Amount of diesel pumped per minute (liters)</th>
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Table shows the amount of diesel pumped per minute. The following statement describes the effect of the size of the hosepipes on the amount of diesel pumped per minute.

99. The larger the diameter of the hosepipes, the more the amount of diesel pumped.
100. The more the amount of diesel pumped, the more the time used to pump it.
101. The smaller the diameter of the hosepipe, the higher the speed at which the diesel is pumped.
102. The diameter of the hosepipe affects the amount of diesel pumped.

Source: (Monica, 2005)

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TEST 5: EVALATEING ARGUMENT

DIRECTIONS

In making decisions about important questions, it is desirable to be able to distinguish between arguments that are strong and arguments that are weak, as far as the question at issue is concerned. For an argument to be strong, it must be both important and directly related to the question. An argument is weak if it is not directly related to the question (even though it may be of great general importance), or if it is of minor importance, or if it is related only to trivial aspects of the question.
Below is a series of questions. Each question is followed by several arguments. For the purpose of this test, you are to regard each argument as true. The problem then is to decide whether it is a strong or a weak argument.

Mark ‘STRONG’ on the answer sheet under ‘Argument’ if you think the argument is strong, or ‘WEAK’ if you think the argument is weak. Judge each argument separately on its own merit. Try not to let your personal attitude toward the question influence your evaluation of the argument, since each argument is to be regarded as true. In the example, note that the argument is evaluated as to how well it supports the side of the question indicated.

**EXAMPLE**
Do you think that the speed of light is greater or less than the speed of sound?
1. The speed of light is greater, because the light reaching the target before the sound.
2. The speed of light is less; because sound reaches the listener ear but light does not reach the ear listener.
3. The speed of light is greater, because it can see the light of the lightning before hear thunder.

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**EXERCISE**

Ray’s bus is powered by a diesel engine. These buses contribute to environmental pollution. A colleague of Ray uses trolley buses. They are powered by an electric engine. The voltage needed for such an electric engine is provided by overhead lines (like electric trains). The electricity is supplied by a power station using coal. Supporters of the use of trolley buses say that these buses don’t contribute to air pollution. Are these supporters right?

103. Yes, because the trolley supplied by electricity.
104. No, because the power station causes air pollution as well.
105. Yes, because the buses don’t pollute the city, but the power station pollute.

Source: (OECD, 2000)

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Do you think that the electric current amount, one ampere or more cause serious burns if it passed through the body tissue?

106. The current is less than this amount causes more damage from burns.
107. That the current more than this amount leads to death immediately.
108. That the passage of electric current, even if the value is less than ten times this value will lead to serious burns in the body tissue.

<table>
<thead>
<tr>
<th></th>
<th>Strong</th>
<th>Weak</th>
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<tbody>
<tr>
<td>61</td>
<td></td>
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<tr>
<td>62</td>
<td></td>
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<tr>
<td>63</td>
<td></td>
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</tbody>
</table>

It is that water vapor hotter than boiling water or vice versa and both at a temperature of 100°C?

109. Boiling water hotter than the water vapor / because of water vapor loses a large amount of heat during condensing and turning into a liquid.
110. Water vapor the most hotly of boiling water / because when sprayed water vapor on the body is fewer hot cause burns stronger than boiling water.
111. Boiling water hotter than the water vapor / because of the temperature water vapor is always less than the temperature of boiling water.
112. Water vapor the most hotly of boiling water / because internal energy stored in the water vapor is greater than the energy stored in the boiling water.

<table>
<thead>
<tr>
<th></th>
<th>Strong</th>
<th>Weak</th>
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<tbody>
<tr>
<td>64</td>
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<tr>
<td>67</td>
<td></td>
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</tr>
</tbody>
</table>

When the gas leakage in the kitchen, are you started to open the windows?

113. Yes, to reduce the speed of its spread within the kitchen and let him out through the windows.
114. No, because it is supposed to close the valve before start to open the windows so as not to allow leakage large amount in the kitchen.
115. Yes, because the gas occupies a size larger than the size of the kitchen.

<table>
<thead>
<tr>
<th></th>
<th>Strong</th>
<th>Weak</th>
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</thead>
<tbody>
<tr>
<td>68</td>
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<td>69</td>
<td></td>
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<tr>
<td>70</td>
<td></td>
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</tr>
</tbody>
</table>

Source: (Alwani, 1999)
APPENDIX C: Physics Achievement Test

Dear student

This physics achievement test includes (30) items, each item contain a key phrase and four alternatives (A, B, C, D). Only one alternative is true and the remaining alternatives are wrong. Please, follow the instructions below:

1- Answer all questions.

2- Read each question carefully and quietly and please try to complete all the questions in 45 minutes.

3- Do not write anything on the test paper; and put a circle around the letter that represents the correct answer. As in the following example:

All information will be treated as strictly confidential and for research purposes only.

The rate or a measure of the rate of motion is the:

A) Motion

B) Displacement

C) Speed

D) Velocity

4- If you want to change your answer, make sure you've erased your previous answer completely.

With Sincere appreciation

Name...........................................................................................................

Gender........................................................................................................
1- What is the mirror that has a wide field of view?
A) Plane                                           B) Convex
C) Concave                                     D) Spherical

2- Pour water in the graduated cylinder up to (30cm³), then put in a stone, observed the height of the water rises to (40cm³). What is the size of the stone?
A) 40 cm³   B) 10 cm³
C) 30 cm³   D) 20 cm³

3- What is a type a light bulb?
A) Luminous                            B) Transparent
C) Opaque                                D) Illuminated

4- The movement of molecules in this image represents the state of matter in the state of:
A) Solid                     B) Liquid
C) Gaseous                D) Plasma

5- Dark area formed behind objects in the Figure below called:
A) Shadow       B) Reflection of light
C) Refraction of light       D) Mirage
6- Which color of the spectrum has the shortest wavelength?
   A) Red       B) Blue
   C) Violet    D) Orange

7- What is the value of reflection angle in the Figure Below?
   A) 90°       B) 30°
   C) 60°       D) 45°

8- The fish inside the water appear to the fisherman like:
   A) Closer to the its real dimension       B) at the its real dimension
   C) Smaller than its real size             D) farther to the its real dimension

9- What is the relation between speed of light and the density of the medium?
   A) Non-linear B) Linear
   C) Relative  D) Numerical

10- What time of day does the shadow appear the shortest?
    A) Morning       B) Afternoon
    C) Evening      D) Sunset

11- The focal length of the converging lens of 50+D powers is:
    A) 20 cm         B) 40 cm
    C) 60 cm        D) 30 cm

12- Unit of measurement for the capacity of lens is called:
    A) Diopter     B) Meter
    C) Kilometers  D) Mol
13- Heating air inside the balloon causes the balloon, to:
A) Expands, less density than high in the air.
B) Expands, bigger density than high in the air.
C) Increase pressure than high in the air.
D) Increase pressure, bigger density than high in the air.

14- What kind of lens is appropriate for person complaining of farsightedness?
A) Concave
B) Convex
C) Converging
D) Diverging

15- When a lunar eclipse occurs?
A) The earth located between the sun and the moon.
B) The moon located between the sun and earth.
C) The sun located between the earth and moon.
D) The earth located between sun and Venus.

16- The point which is the optical radiation passes and does not suffer refraction is
A) Edge of lens
B) Optical center
C) Focus of lens
D) Between edge and center of lens

17- What is the reflection of the surface shown in the Figure below?
A) Regular
B) Irregular
C) Parallel
D) Orthogonal
18- The movement of a girl in the Figure below is called.
A) Circular B) Rotation
C) Periodical D) Linear

19- The glass in the Figure below from objects:
A) Transparent B) Semi-transparent
C) Opaque D) All previous possibilities

20- What is a piece of glass called that has a flat and polished surface that reflects the most of incoming radiation?
A) Mirror B) lenses
C) Prism D) Telescope

21- Which of the following measurements is the shortest?
A) 0.2 km B) 200 cm
C) 20 mm D) 0.001 m

22- Eyeglasses with concave lenses are used to treat:
A) Farsightedness B) Nearsightedness
C) Astigmatism D) Night blindness

23- What is the velocity of the quantities called?
A) Vector B) Constant
C) Vector and scalar     D) Scalar

24- Look to the picture below, the image formed in plane mirrors is:
A) (Virtual, upright, left-right reversed, and the same size as the girl)
B) (Virtual, upright, and right-left reversed)
C) (Real, upright, and the same distance from the mirror to the girl distance)
D) (Real, upright, and bigger than the size of the girl)

25- Waves of Gamma ray are:
A) Mechanical longitudinal     B) Mechanical transverse
D) Electromagnetic     C) Photoelectric

26- What is the amount transmission speed of light?
A) 300 km/s
B) 3000 km/s
C) 30,000 km/s
D) 300,000 km/s

27- Why do rainbows show up during and after it rains?
A) Due to the refraction of light in rain drops.
B) The speed of light in air greater than in water.
C) Due to the polarization of light.
D) Due to the light reflection in different directions

28- What is the zoom lens power?
A) Image length \ body length  B) l / focal length  
C) 50 cm  D) l / optical center

29- What forms of sound waves are used to diagnose diseases?
A) Audiowaves  
B) Ultrasound  
C) Waves undergroundaudio  
D) Electromagnetic waves

30- Colors of ink used in the coloring books resulting from mixing three basic pigments:
A) (green, blue and red)  
B) (red, green and white)  
C) (yellow, blue and red)  
D) (yellow, purple and turquoise)
APPENDIX D: Survey of Students’ Perception of Learning Using Brainstorming Technique

Dear student,

The objective of this survey is to seek to understand the students’ perception of learning by brainstorming technique. This survey consists of three parts:

Part A: questions concerning to the learning outcomes.

Part B: questions that reflect on brainstorming technique features.

Part C: open-ended questions about brainstorming technique used during semester two of the academic year.

Please read and follow the instructions.
Part A: Learning Outcomes

Instructions

Please circle the number 1, 2, 3, 4 or 5 that best describes how you feel about the knowledge and skills you gained when learning by brainstorming:

1- Strongly Disagree
2- Disagree
3- Neutral
4- Agree
5- Strongly Agree

Application Knowledge and Skills

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I was able to think broader and more from multiple perspectives (over the physics content).</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>I was able to develop the solution for physics problem.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>I was able to analyze problem.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>I was able to generate creative ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>I was able to think critically.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>I was able to build new link between different facts.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>I was able to evaluate ideas and finding.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>I was able to retain what I had learned more.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>I was able to identify critical issues in physics problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>I was able to apply what I have learned.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>My understanding of the physics content improved.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>Better memory of the physics subject content.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>I was able to recognize the related of what I learned to my own daily life.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>I was able to apply my synthesis skills more deeply when using brainstorming technique.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
15 I was able to predicate of new physics ideas .

Communication

16 I had opportunity to participate in diversified classroom learning activities.  
17 I had opportunity to participate in novel learning activities.  
18 I was able to exchange ideas with my classmates.  
19 I was able to discuss with my classmate.  
20 I was able to express many ideas without being criticized.  
21 I was able to respect of views and ideas of others, even thought I did not fully agree with them.  
22 I had the opportunity to listen to perspectives and points of view of my classmates and keep an open mind about their views.  
23 I had the opportunity to play an important role as one of the main resource contributor during brainstorming session.  
24 I was able to benefit from the ideas of others, through the development and build on it

Independent Learning

25 I was able to do experiments on physics content  
26 I was able to choose and apply my own strategy as when learning.  
27 I was able to solved relevant physics problems.  
28 I was able to learn new knowledge during problem-solving.  
29 I was able to working independently.  
30 I was able to think in different way to solve problems.

PART B Students reflection on brainstorming technique.

Instructions

Please circle the number 1, 2, 3, 4 or 5 that best describes of what is your reflection on brainstorming technique.
1. **Strongly Disagree**
2. **Disagree**
3. **Neutral**
4. **Agree**
5. **Strongly Agree**

<table>
<thead>
<tr>
<th>Features</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Brainstorming is one of the effective students-centered approaches.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2 The learning activities in the brainstorming group were enjoyable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3 My interest in learning physics increased as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4 I was more actively enhanced in learning physics.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5 My confidence was enhanced as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6 My perceptions that physics is more related to daily-life as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7 My motivation to learn physics increased as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8 I feel my understanding of physics subjects improved as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9 My ability to fluency in expression and intuitive developed as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10 My ability to grasp the relationships between things developed as result of using this technique to learning.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
PART C Please answer the question below.

QUESTION 1:

Do you think the brainstorming is a suitable technique for you to learn physics? Explain why, or why not.

________________________________________________________________
________________________________________________________________
________________________________________________________________

QUESTION 2:

What are the learning outcomes that you felt you obtained as a result of using brainstorming technique?

________________________________________________________________
________________________________________________________________
________________________________________________________________

QUESTION 3:

What are the major characteristics of brainstorming technique?

________________________________________________________________
________________________________________________________________
________________________________________________________________

QUESTION 4:

What is the effectiveness of brainstorming technique on your thinking abilities?

________________________________________________________________
________________________________________________________________
QUESTION 5:
What did you find to be most useful about learning using brainstorming technique?

________________________________________________________________

________________________________________________________________

________________________________________________________________

QUESTION 6:
What are the disadvantages of learning via brainstorming technique? Could you add any suggestions for how this technique may be improved or made more useful for learning physics?

________________________________________________________________

________________________________________________________________

________________________________________________________________
APPENDIX E: Observation Protocol

This protocol designed for traditional group to assist the researcher in:

1. Noting all verbal interaction when the physics teacher facilitates group activities.

2. Describing the context in detail in which the verbal interactions occur.

Reminders:

a) Read through rough notes made during observation
b) Write the report in detail based on guidelines
c) Write the initial analysis, interpretation, feedback and feeling
d) Write the report on the same day to avoid fading of memory

(Fill put prior to observing classes)

Date : ____________________

Time : ____________________

Topic : ____________________

Students : ____________ M ( ) F ( )

Location of observation : ____________________

Activity (ies) : ____________________

Student learning outcomes : ____________________
<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Researcher Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part A: Note the learning environment (physical environment)</strong></td>
<td></td>
</tr>
<tr>
<td>a) Describe the physical settings (e.g., type of student seating, notice boards, etc.).</td>
<td></td>
</tr>
<tr>
<td>b) Describe teacher physical movements and gestures during the class period.</td>
<td></td>
</tr>
<tr>
<td>c) Describe the teaching-learning atmosphere (teaching techniques, student behavior, teacher behavior, etc.) in the classroom.</td>
<td></td>
</tr>
<tr>
<td>d) Describe the variability among students with regard to codes applied (e.g., if students worked in small groups, to what extent did groups behave and engage similarly in lesson, etc.).</td>
<td></td>
</tr>
<tr>
<td><strong>Part B: Describe the induction set that physics teacher used to start the lesson</strong> (e.g., teacher tells interesting stories about the lesson, teachers sets the instructions about the lesson to get the attention of students or the teacher speaks and that the students listen carefully to hear, etc.) and any interactions that occur</td>
<td></td>
</tr>
</tbody>
</table>
between teacher and students.

<table>
<thead>
<tr>
<th>Part C: Note the interactions between teacher-students &amp; students-students during teaching and learning physics in the usual classroom.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Describe verbal interactions between teacher and students during teaching and learning process of physics.</td>
</tr>
<tr>
<td>b) Describe the students’ verbal interactions with each other during physics learning.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part D: Note the content knowledge demonstrated / general competencies of by students (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Identify difficulty (ies) that students encounter during learning process.</td>
</tr>
<tr>
<td>b) Describe students’ action when students encounter difficulty (ies) during the learning process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part E: Closure of the physics lesson</th>
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</thead>
<tbody>
<tr>
<td>Describe the method that the teacher has ended the physics lesson.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part F: Writing the observation report</th>
</tr>
</thead>
<tbody>
<tr>
<td>The complete observation report will be written based on the protocol above.</td>
</tr>
</tbody>
</table>
Observation Protocol for Brainstorming Group

This protocol designed for brainstorming group to assist the researcher in:

1. Noting all verbal interaction when the physics teacher facilitates group activities.
2. Describing the context in detail in which the verbal interactions occur.

Reminders:

a) Read through rough notes made during observation
b) Write the report in detail based on guidelines
c) Write the initial analysis, interpretation, feedback and feeling
d) Write the report on the same day to avoid fading of memory

(Fill put prior to observing classes)

Date : _______________________

Time : __________ to __________

Topic : _______________________

Students : ___________ M ( ) F ( )

Observer : ________________

Location of observation : ________________________

Activity (ies) : ______________________________

Student learning outcomes : ____________________________
<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Researcher Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part A: Note the learning environment during brainstorming group</strong></td>
<td></td>
</tr>
<tr>
<td>(physical environment)</td>
<td></td>
</tr>
<tr>
<td>a) Describe the physical settings (e.g., type of student seating, notice</td>
<td></td>
</tr>
<tr>
<td>boards, etc.).</td>
<td></td>
</tr>
<tr>
<td>b) Describe teacher physical movements and gestures during the class</td>
<td></td>
</tr>
<tr>
<td>period.</td>
<td></td>
</tr>
<tr>
<td>c) Describe the teaching-learning atmosphere (teaching techniques, student</td>
<td></td>
</tr>
<tr>
<td>behavior, teacher behavior, etc.) in the classroom during the</td>
<td></td>
</tr>
<tr>
<td>brainstorming session.</td>
<td></td>
</tr>
<tr>
<td>d) Describe the variability among students with regard to codes applied</td>
<td></td>
</tr>
<tr>
<td>(e.g., if students worked in small groups, to what extent did groups</td>
<td></td>
</tr>
<tr>
<td>behave and engage similarly in lesson, etc.).</td>
<td></td>
</tr>
<tr>
<td>**Part B: Note the interactions reflected collaborative working</td>
<td></td>
</tr>
<tr>
<td>relationships and productive discourse among students and between</td>
<td></td>
</tr>
<tr>
<td>teacher and students while engaged in _________________________________</td>
<td></td>
</tr>
<tr>
<td>(name of the activity based on the brainstorming technique) during</td>
<td></td>
</tr>
<tr>
<td>classroom.</td>
<td></td>
</tr>
<tr>
<td>a) Describe verbal interactions between teacher and students when the</td>
<td></td>
</tr>
<tr>
<td>teacher encounters students by the physics problems.</td>
<td></td>
</tr>
</tbody>
</table>
b) Describe verbal interactions between group students during identify the physics problem.

c) Describe interactions between group students for exchanged ideas related to the physics problem.

c) Describe verbal interactions between group students during evaluation ideas generated.

d) Describe verbal interactions between group students during selection right idea to solve the problem.

<table>
<thead>
<tr>
<th>Part C: Note the content knowledge demonstrated / general competencies of by students (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Identify difficulty (ies) that students encounter during brainstorming activity.</td>
</tr>
<tr>
<td>b) Describe students’ action when students encounter difficulty (ies) during the brainstorming activity.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part E: Writing the observation report</th>
</tr>
</thead>
<tbody>
<tr>
<td>The complete observation report will be written based on the protocol above.</td>
</tr>
</tbody>
</table>
APPENDIX F: Students Feedback Journal

Dear student

You have finished an activity just now. Please think of the questions below and give your answers. The information you provide will treated as confidential and not influence physics exam grade.

Date:

Subject:

Gender:

1- What do you gained from this learning activity that you didn’t have/understanding/thinking skills / communication?

2- What are your feelings and opinions toward this learning activity?

3- What problems you have faced during brainstorming sessions?

4- Do you have any suggestions to improve this teaching method?

5- DO you have any other thoughts/comments/ feedback on this learning activity.
APPENDIX G: Interview Protocol

Informed Consent

Good morning (afternoon). My name is Farah Alrubai. Thank you for taking the time to talk with me. My purpose in talking with you is to learn more about your thoughts, feelings, and experiences with the brainstorming technique.

Your participation in this interview is completely voluntary, and you may stop at any time if you feel uncomfortable.

The interview will be done privately and will take about 30 minutes. During this time, you have a set of questions that researcher would like to cover. All information you provide in this interview will be confidential. Nothing you say will be personally attributed to you in any reports that result from this interview.

If you have any questions about this interview, you can contact Farah Alrubai [mrs.shareefy@gmail.com].

Do you agree to participate in this interview?

Yes/ No

---------------------------------------------------------------
Signature of participants
---------------------------------------------------------------

Data

Thank you for your agreeing to participate.
Sample of Interview Question

Time of interview : ------------------------

Position : ------------------------

Data : ------------------------

Interviewer : ------------------------

Interviewee : ------------------------

1. What were the major differences between brainstorming technique activities and that in their usual physics lessons? What were the major characteristics of these activities?

2. How you had able to generate a large number of ideas to solve the physics problem?

3. How you had able to evaluate and select best ideas (solution) to solve the problem at hand?

4. What your feelings about the learning and teaching process via brainstorming technique?

5. Do you find the brainstorming technique influence of the learning approach? Explain why. Or why not.

6. What problems you have encountered during learning process via brainstorming technique; any suggestions for improvements?

7. Do you have any additional comments about learning via brainstorming technique which haven't already discussed?

Thank you for your time!
APPENDIX H: Example of Data

Example of observation filed note (Miss Roaa, observation for control group, Refraction of light, 12/3/2013).

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Researcher Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part A: Note the learning environment (physical environment)</td>
<td>The teacher standing in front of students. Each student sitting in his/her position. The physical settings of class were organizing as shown below.</td>
</tr>
<tr>
<td></td>
<td>![Diagram of classroom setup]</td>
</tr>
<tr>
<td></td>
<td>During the lesson period I never see the teacher move between students, he never change her position all the lesson she stand in front of the students.</td>
</tr>
<tr>
<td>Part B: Describe the induction set that physics teacher used to start the lesson</td>
<td>Teacher started the lesson reminding students of two law of refraction, which was explained in the previous lesson. She draws on blackboard refraction between two mediums. Some students were busy talking with others, students sit in the class but any attention gave to the teacher.</td>
</tr>
<tr>
<td>Part C: Note the interactions between teacher-students &amp;</td>
<td>There is a seldom the teacher interactive with students as well as the students never interactive with others each</td>
</tr>
<tr>
<td>students-students during teaching and learning physics in the usual classroom.</td>
<td>student sit in his/her position and only listen to the teacher then write each word teacher said.</td>
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</tr>
<tr>
<td><strong>Part D: Note the content knowledge demonstrated / general competencies of by students (if applicable)</strong></td>
<td>Some students asked teacher to explain more about the topic the teacher explained but not enough for student to understand the topic very well. I felt from face expressions of the student that student was shy to ask the teacher again to give him more clarifications.</td>
</tr>
<tr>
<td><strong>Part E: Closure of the physics lesson</strong> Describe the method that the teacher has ended the physics lesson.</td>
<td>Teacher summarizes the physics topic by given some sentences and she asked students’ to write. At the end of lesson she asked student to prepare the next topic name (dispersion of light by prism).</td>
</tr>
<tr>
<td><strong>Part F: Writing the observation report</strong></td>
<td>Miss Zanib was completely used lecture method. The lesson was very quit without any interaction between teacher and students or between students-student. Not all students were pay attention to the lesson or what the teacher said. I saw two students slept during the lesson. One student was busy drown cartoon characters. In contrast, teacher was strongly focused on the physics topic without carrying about the students understanding or interactive. I noted that the teacher does not link the topic with daily life. She only transferred information from the book of physics exactly without any change. Students were only listening to the teacher and write everything the teacher said without any understanding. I found from students faces expressions that students were felt the lesson very bored.</td>
</tr>
</tbody>
</table>
Example of observation filed note (Miss Roaa, observation for experimental group, Refraction of light, 12/3/2013).

<table>
<thead>
<tr>
<th>Guidelines</th>
<th>Miss Roaa Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part A: Note the learning environment during brainstorming group (physical environment)</strong></td>
<td>I stayed at the end of the class observing the situation. Physics teacher (Miss Zanb) started the lesson by divided the students to the 8 group, she spent about 5 minutes. So the class was organized as shown below.</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diagram of groups and teacher" /></td>
</tr>
<tr>
<td></td>
<td>Teacher was moved from group to others to sign leader, secretary, and members. Then she asked students to follow her instructions.</td>
</tr>
<tr>
<td><strong>Part B: Note the interactions reflected collaborative working relationships and productive discourse among students and between teacher and students while engaged in (name of the activity based on)</strong></td>
<td>After the teacher identified physics problem, she gave 30 minutes for all groups to discuss to find solutions. Students sitting closely to discuss. Most of time, groups students was verbal interactions. Most groups’ students seem work hard to solve problem presented by the teacher.</td>
</tr>
</tbody>
</table>
the brainstorming technique) during classroom.

| Part C: Note the content knowledge demonstrated / general competencies of by students (if applicable) | Some difficulty encounter students during the activities for example, some student asked teacher for clarified the problem. Student told that the problem is very difficult. Other problem, one girl in group 3 asked teacher to reduce the noise in class. |
| Part E: Writing the observation report | All groups are given 30 minutes to solve problem (why the pen appears broken when you look at the surface of the water cup).
Group1:
All members of the group participated in the discussion and exchange of ideas, except Abraham, who was rarely involved in the discussion because he was isolated and sits a little far from the group members.
Group 2:
Leader and secretary in group 2 were not interesting to do the activities and solve the physics problem with group members. They were busy talking loudly with each other’s, only the other group member who were tried to solve the problem.
Group 3:
All students in the group were work very hard, they discussed and they did physics experiment by using the pen and cup of water. They work all the time with each others. I saw the sectary collected the papers from each members and all group participated again to discuss about the ideas which have been generated.
Group 4:
All the 30 minuets the students were very serious during the
activity especially Mayssam who are the leader of group 5. She enhanced his group members to generate many ideas and encourage students after she collected ideas to discuss to evaluate ideas. I heard her said to the group members we have to solve the problem to be the best groups.

Group 5:

There are interactions between all group members. However, I saw Ali moving his head in different directions and stand and sit several times.

Group 6:

The group members sit closely to each other. During first 15 minutes students were talk to each other exchange views and opinion. Then, each students write in his/her paper. The last 15 minutes students back to talk and discussion. They did the physics experiment by using pencil and cup of water.

Group 7:

During first 15 minutes students were very active to do the activity. However, after this time the students start talking and laughing loudly out of the physics problem.

Group 8:

Especially these group members were very happy and enjoy during all time. They discuss with each other, sitting closing, and comfortable with the rules and steps of the educational method.
Example of an audio-taped group interactions transcript (Group 4, reflection of light, 12/03/2013)

T: Teacher                              ML: Mayssam (Leader of group4)
ZM: Zahraa (Member)           AS:Ahmed (Secretary of group4)
NM: Nizar (Member)             YM: Yusser (Member)

1 T: Salamalikum, class organized in groups, as in the previous lesson and don’t forget the four rules no criticism, focus on quantity, freewheeling is welcome, and combine and improve ideas. You have 30 minutes to solve problem, first 15 you discus with group member then write ideas in own paper. Second 15 minutes submit your paper to the secretary and start to group the ideas to evaluate it then discus with group to select best ideas. Now I will identify the physics problem you must write the question in own paper. The question is why the pen appears broken when you look at the surface of the water cup?

2 ML: Ahmed, Yusser, Zahraa, Nizar, the question is why the pen appears broken when you look at the surface of the water cup? Anyone have ideas or information about this question

3 ZM: I think because of the refraction of light in a glass of water because water and air from different mediums.

4 AM: I think because of the pen increases its size when placed in water for its size becomes almost twice its normal size.

5 NM: Perhaps the different optical density

6 NM: Sorry, or perhaps because the pen put slashes in the glass so can not the light pass.

7 ML: Because generate imaginary picture of a pen inside of the cup because of refraction and remained true picture in the non-submerged in water.

8 YM: Or because of the resistance of the water molecules led to therefraction of light beam.

9 [sound is not clear]

10 ML: The light has a significant role and because of the existence of light the refractive
does not occurred, for example, in the dark we cannot see a broken pen in a cup.

11 ZM: Wait friend, I think is because the cup is transparent surface which allows the passage of radiology light.

12 YM: Other words the surface of the cup is reflective.

13 ML: So group spent about 10 minutes in discussion. Now each one write in own paper the ideas about the question then submit to the secretary.

[No talking about 6 minutes]

15 ML: Ahmed is you collected the papers from all group members.

16 AM: Yes, this is five papers.

[ no talking about 30 seconds]

18 T: Now should every group finish write ideas and the leader start discuss with group member about the ideas which have been generated. Don’t forget the four criteria of evaluation ideas. Excluded ideas, not applicable, interesting, and useful (ideas help other processes).

19 ML: We have 19 ideas.

20 YM: Can we know these ideas?

21 ML: Of course.

[Talking not clear].

23 ML: Some ideas illogical and funny.

24 AM: Correct.

25 [noising, talk not clear]

26 YM: Let’s classify it according to the four criteria

27 ML: first we should discuss each ideas then classify it

28 AM: Ok

29 ZM: Look, there are seven similar ideas in the list of ideas.

30 ML: I deleted six ideas and I kept one idea.

31 YM: Do not you think that if you put the pen in a vertical does not seem refracted?

32 NM: Yes, true, increase of pen slop means increased of light refraction.
So, this is new idea.

Now, we have 13 ideas left.

ideas 7, 11, 4, and 9 very weak

Others what do you think.

He is right.

[no talking about 20 seconds]

Look, Whenever the pen zoom out of the eye it seems large size and refraction increases whenever the pen proximity of the eye is seems getting smaller size and less refractive.

Look to the idea 3 very interesting, Refraction occurs because the optical density difference between the air and water.

from idea 5 and 1 we can conclude that the water is heterogeneous medium the light cannot pass through it, and the light passes in the air because it is homogeneous medium, so water impedes the passage of the optical package that seems the pen is broken into the water, but it is normal and unbroken.

Now we have only five ideas, so which one the best idea for solving the problem.

I chose idea number 3 because I know that the air and water from different medium.

I think the ideas 5 is more suitable then idea 3 because optical density is different between air and water.

I chose idea number 1.

Yusser why

Class time is over, now I will collect the papers from each group then I will ask the leader of each group about the best solutions.
Example of a video-taped whole class transcript (Video, refraction of light, 12/3/2013)

Part 1, 00:03- 1:59: All eight groups were serious to do the activities, talking with each other, discussion, listen to each other. During the first 5 minutes leader and secretary in group 2 was laughing and talking loud. Ali in group 5 was very mobile, and he seldom talk with his group member. Sarah, she is a leader of group 8 was very happy during the activity and she discussing with her group members with smiley face.

Part 6, 00:10-1:21: two students in group 7 were not set closely to the group not talking, must of time silent they seems not enjoy with group.

Example of a student’s feedback journal (Duha, feedback journal, refraction of light, Group 8, 12/3/2013)

1- What do you gained from this learning activity that you didn’t have/understanding/thinking skills / communication?

I have gained from these activities; I used my mind during learning and not relied to conservation the information in the book only. I raised my thoughts freely, boldness to talk, I have gained a lot of information and ideas on the physicists subject from the members of my groups I don’t know this information before, which it is useful in the future; I have gained a cooperative spirit, sharing ideas and views as well as the spirit of competition between the members of the group. The most important I have gained from these activities is better understanding of the subject compared with the previous method of the teacher. I have understanding the topic from my group better from the teacher.

2- What are your feelings and opinions toward this learning activity?
I felt enjoyment, fun. I seem my friends happy and see my teacher smiley. My group members help me correct my thoughts and my information. I did not feel tired or bored.

3- Do you have any suggestions to improve this teaching method?

Changing the members of groups from time to time to be able to acquire new information and experiences, reduce the number of group to the three, group must be composed of members of the high, medium and low levels.

4- Do you have any other thoughts/comments/feedback on this learning activity.

I am never forgetting this experience.

**Example of teacher’s comments** (Teacher, comments, refraction of light, 12/3/2013),

Time: 1.20pm-2.15pm

The teacher noticed that all students are very enthusiastic and active for learning. Some students asked her for extra clarification to the problem, Sarah in Group 6 asked for some information to assist her in reaching a solution, but the teacher replied that you should discuss with your group members to get more information.

The teacher noticed that during the first 15 minutes all the groups were discussing and exchanging opinions and sometimes laughs among them.

In the second part of the time, a phase of evaluation ideas were less active and seemed to ask the teacher a lot of questions in order to reach a solution quickly, some of whom completed the process of evaluating ideas very quickly without deep thought, except for the group 8 and 1 were very working hard.

The teacher saw that group 1 and 8 did not stop discussing until the last moment.
In group 2 Ghassan, Amir and Muhammad and group 5 Ali were less interactive with the group. Nassm from group 2 and Ahmed from group 5 complained that some students do not contribute to the discussion or provide information to help to reach a solution.

Group 3 was very active; it was the first group that has achieved experience of light refractions successfully, the leader of the group placed the cup in front of the eyes of the members to watch the process of pen refraction.

The last 10 minutes the teacher collected solutions from all groups and teacher was surprised of the high-quality and distinctive ideas, then the teacher asked the groups to pay attention because she will present all the ideas and solutions groups to everyone in the class to see who are the best group.

At this time, the teacher noticed that all the students paid strongly attention and they had a strong curiosity to know who group has good ideas and solutions.

**Example of an audio-taped student interview transcript** (Asal, interview, refraction of light, Group 1, 12/3/2013)

**MR**: Miss Roaa          **AK**: Asal Khalal

**MR**   Good afternoon
**AK**   Good afternoon

**MR**   You wrote here [show the feedback journal] this way of teaching it is really useful. Can you tell me why?
**AK**   because this way of teaching is very different from the usual way

**MR**   Can you explain more what is the differences between these two methods
**AK**   In the normal lesson I did not join in the discussion or exchange of ideas and opinions with my colleagues, there is no opportunity to put my thoughts or my information, there is no collectively work each student keeps useful information for himself and no
shared it with others. Teacher is committed to what information exists in the book does not attempt to provide us with more information on the topic from outside the book. I was only conserve without thinking or understanding the laws, equations, or how phenomena occur.

MR  What is the characteristics of the new method

AK  The new method is characterized by fun, increase competition among students, also encouragement me to think, increased my information through I listen the ideas and information of others students, and a best understanding of the topic because I amargue with my colleagues also discovery of information by myself and is no longer conserve the information and sit down to listen only. The last one is develop the spirit of cooperation between the students.

MR  What do you gained from this method

AK  Stimulate the mind to generate new ideas, new and useful information, and participation in the debate to solve the question.

MR  You said a moment ago the new teaching method stimulate your mind to generate new ideas. Can you tell me how?

AK  I was able to generate ideas in easy and fast way. Through discussion and interaction with my group members in a atmosphere of laughter and fun. Most of the ideas put forward by members of the group during the time of the discussion were useful. And accept of my group members all my thoughts and my suggestions. All these factors had a major role in helping me generate ideas in my mind very quickly.

MR  Can you tell me how you had able to evaluate many ideas and select best ideas

AK  This was a hard part for me

MR  Why, can you explain more

AK  At this stage, I found that the group's ideas incompatible with my thoughts. After leader of the group gather all ideas the of the group's members in one list. He asked group to back to the discussion. In this time, all ideas were analyzed and classified into categories according to the criteria that we supplied by teacher, as well as many new ideas generated, repeated
ideas deleted. During this stage and after listening to the ideas of the group members and analyzing the problem from all sides, I am rethinking about the problem from different aspects. Especially when the leader asked me to give a reason in the selection of the idea. Finally, after deep thought I chose the idea 3.

MR Why you are chose the ideas 3
AK Because I've evidence for my selection
MR How you had reached the evidence?
AK I had reached the evidence through discussion with members of group
MR What your feelings about teaching process via new method named (brainstorming technique)
AK I was very happy and interactive and enthusiastic to learn and planted love and harmony among students. In usual lesson, I was feeling boring and tediously during physics lessons and I hope that the lesson ends quickly because I was not comfortable. In the new method I waited for the physics lesson eagerly and I hope oneday to be more than two lessons for physics.

MR Do you find the brainstorming technique influence of the learning approach?
AK Yes
MR Can you explain why?
AK There are many reasons
MR Can you said the reasons
AK Make students active during the learning process.

There is no pressure from the teacher or tired, but laughter and fun.

Develop the spirit of competition.

Helps to cancel individual differences.

Stop talking about 30 second

MR Do you have more reasons
AK Yes
MA Tell me what
KR  Develop the skill of communication between students;
     Break the shyness case with a lot of students;
     Reduce selfishness among some students;
     Develop a spirit of cooperation;
     Helps to understand physics topics; and
     Classroom atmosphere helps to think.

MR  Did you encounter problems during learning process via brainstorming technique?

AK  High noise in the classroom
     Leader of the group was not well-manages the group
     Some of the students in the group did not participate in the discussion

MR  Do you have others?
     Stop talking 15 seconds.

AK  Time is sometimes not enough.

MR  Do you have any suggestions for improvements?

AK  The leader must be able to manage the group and well-liked among students.
     The teacher must try to reduce noise.
     Group to be mixed between of the high, medium and low students levels.

MR  Do you have Additional suggestions

AK  No, that’s all

MR  Do you have any comments about learning via brainstorming technique which haven't already discussed?

AK  No
     Stop talking 10 second

AK  But I hope that all the lessons of other materials use this method not only in physics lesson.

MR  Thank you Asal for your cooperation in answering all questions
Example of open-ended questions (Ahmed, open-ended questions, group 8, 21/5/2013)

QUESTION 1:

Do you think the brainstorming is a suitable technique for you to learn physics? Explain why, or why not.

Yes is very useful method for teaching method. Because it is help me to understand many laws and physics phenomena I was not understanding in usual lesson. Lesson steps are encouraged to participate in thinking and discussion without the pressure by the teacher.

QUESTION 2:

What are the learning outcomes that you felt you obtained as a result of using brainstorming technique?

Discussion with others about problem is very important because it leads to get the best ideas to solve the problem. I gained many ideas, information and experiences from others. I learnt that I should stimulate my mind to reach the largest possible number of ideas that help solve the problem. I do not forget information, definitions and laws physics. I realized that physics related to our daily lives, and a lot of natural phenomena interpret due to the physics.

QUESTION 3:

What are the major characteristics of brainstorming technique?
Fun.
Encourages cooperation among students.

**QUESTION 4:**

What is the effectiveness of brainstorming technique on your thinking abilities?

It stimulates my mind for thinking.
I learnt to analysis and look to the problem from all sides.
My ability to generated ideas has been developed.

**QUESTION 5:**

What did you find to be most useful about learning using brainstorming technique?

Gave me a chance to put my ideas and opinions freely without criticism.
Doing physics experiments with my colleagues.
Audacity to speak and I build many social relations with new friend.

**QUESTION 6:**

What did you find to be least useful about learning using brainstorming technique?

Could you add any suggestions for how this technique may be improved or made more useful?

Incompatibility group members
Dependency of some members on other
My suggestion is provide each group computer with internet to gain a lot of information help student to solve problem and in the same time increase their information.
### APPENDIX I: Groups of brainstorming technique

<table>
<thead>
<tr>
<th>Groups</th>
<th>Name</th>
<th>Role</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>Asal Khalal</td>
<td>Leader</td>
<td>F</td>
<td>14</td>
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<tr>
<td></td>
<td>Abraham Ammer</td>
<td>Secretary</td>
<td>M</td>
<td>14</td>
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<tr>
<td></td>
<td>Amna Sinan</td>
<td>Member</td>
<td>F</td>
<td>14</td>
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<td></td>
<td>Noor Alaa</td>
<td>Member</td>
<td>F</td>
<td>14</td>
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<td></td>
<td>Amer Abbas</td>
<td>Member</td>
<td>M</td>
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<tr>
<td>Group 2</td>
<td>Ghassan Iyad</td>
<td>Leader</td>
<td>M</td>
<td>14</td>
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<td></td>
<td>Amir Sabah</td>
<td>Secretary</td>
<td>M</td>
<td>14</td>
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<td></td>
<td>Cardana Issam</td>
<td>Member</td>
<td>F</td>
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<td></td>
<td>Abdel Aziz Khaled</td>
<td>Member</td>
<td>M</td>
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<td></td>
<td>Iaa Ghassan</td>
<td>Member</td>
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<tr>
<td>Group 3</td>
<td>Zafar Muzaffar</td>
<td>Leader</td>
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<td>Abdel Rahman Khaled</td>
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<td>Hassan Thamer</td>
<td>Member</td>
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<td>Warda Youssef</td>
<td>Member</td>
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<td>Mohammad Amin</td>
<td>Member</td>
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<tr>
<td>Group 4</td>
<td>Mayssam Mohammed</td>
<td>Leader</td>
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<td></td>
<td>Ahmed Louay</td>
<td>Secretary</td>
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<td></td>
<td>Zahraa Kais</td>
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<td>Nizar Ammar</td>
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<td>Yusser Hisham</td>
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<tr>
<td>Group 5</td>
<td>Mannar Safaa</td>
<td>Leader</td>
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<td>Khalil Jassem</td>
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<td>Shaima Hassan</td>
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<td>Muammil Iyad</td>
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<td>Isra Abdullah</td>
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<td><strong>Group 6</strong></td>
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<td></td>
<td>Reem Munief</td>
<td>Leader</td>
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<td></td>
<td>Ali Hussein</td>
<td>Secretary</td>
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<td>Dania Abdullah</td>
<td>Member</td>
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<td>Mustafa Adel</td>
<td>Member</td>
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<td></td>
<td>Sarah Ihsan</td>
<td>Member</td>
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<tr>
<td><strong>Group 7</strong></td>
<td>Sarah Essam</td>
<td>Leader</td>
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<td>14</td>
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<tr>
<td></td>
<td>Ahmed Mohamed Hashim</td>
<td>Secretary</td>
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<td></td>
<td>Rafal Ali</td>
<td>Member</td>
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<td></td>
<td>Ali Salamat</td>
<td>Member</td>
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<td></td>
<td>Manar Mohamed</td>
<td>Member</td>
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<tr>
<td><strong>Group 8</strong></td>
<td>Ahmed Adel</td>
<td>Leader</td>
<td>M</td>
<td>14</td>
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<tr>
<td></td>
<td>Duha Hani</td>
<td>Secretary</td>
<td>F</td>
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<tr>
<td></td>
<td>Obeida Ahmed</td>
<td>Member</td>
<td>M</td>
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<tr>
<td></td>
<td>Mariam Abdel Maksoud</td>
<td>Member</td>
<td>F</td>
<td>14</td>
</tr>
</tbody>
</table>

F: Female    M: Male
اختبار التفكير الإبداعي

عزيزي الطالب,

هذا الاختبار يشمل ست مهام مختلفة، وكل مهمة التحقق في المهارات العلمية المختلفة، مما يتيح لك الفرصة للتفوق. وتمكنك من استخدام إبداعك، واستكشاف الأفكار الجديدة وحل المشكلات.

وسيتم معاملة جميع المعلومات بسرية تامة ولأغراض البحث فقط.

تعليمات

1 - الإجابة على جميع الأسئلة.
2 - يرجى محاولة استكمال جميع المهام في 45 دقيقة.
3 - لا تكتب أي شيء على ورقة الاختبار ويجب أن تكون جميع الإجابات مكتوبة على على ورقة الإجابة التي يتم توفيرها.
4 - إذا كنت ترغب في تغيير إجابتك، تأكد من أنك قمت بمسح إجابتك الأصلي تمامًا.

مع خالص التقدير

إلاسم..........................................................

الجنس.........................................................
لاختبار 1: أسأل
إذا أمكن أن تذهب إلى الكوكب، ما هي الأسئلة العلمية التي تريد أن تبحثها؟ اكتب قائمة الأسئلة الخاصة بك في
الفراغات المتاحة. على سبيل المثال، هل هناك أي الكائنات الحية على هذا الكوكب؟

لاختبار 2: تحديد الأسباب
أكتب ما تستطيع أن تكون فيه من أسباب ممكنة للحدث الموجودة في الصورة، ويمكن أن تفكر فيما يكون قد وقع
قبل الحادث مباشرةً أو بوقت طويل وادي إلى ذلك الحادث. على سبيل المثال، الشخص يرى صورته على الماء
بسبب ظاهرة الانعكاس.
الاختيار 3: تحمين النتائج
أكتب ما تستطيع أن تفكر فيه مما يمكن أن يحدث نتيجة للحادث الموجود في الصورة السابقة (2)، ويمكن أن تفكر فيما يمكن أن يقع بعد الحادث مباشرة أو بوقت طويل.

الاختيار 4: تحسين المنتج
يرجى التفكير في التحسينات الممكنة في الدراجة العادية التي يجعلها أكثر إثارة للاهتمام، وأكثر فائدة وأكثر جمالًا. أكتب قائمة إجاباتك في الفراغات المتاحة. (يمكنك الكتابة أو الرسم أو كليهما). على سبيل المثال، جعل الإطارات عاكسة، بحيث يمكن النظر إليها في الظلام.
الاختبار 5: الاستعمالات غير الشائعة

أكتب كل ما تستطيع أن تفكر فيه من الاستعمالات العلمية غير الشائعة الممكنة (على سبيل المثال، في المختبر) لعلة من البلاستيك. أكتب قائمة إجاباتك في الفراغات المتاحة. (يمكنك الكتابة أو الرسم أو كليهما). على سبيل المثال، صناعة أنبوب اختبار.
الاختبار 6: الأفكارات

تنقّر عدم وجود الجاذبية، صوف ما سيكون عليه العالم؟ اكتب قائمة إجاباتك في الفراغات المتاحة. (يمكنك الكتابة أو الرسم أو كليهما). على سبيل المثال، سوف يطفو البشر

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اختبار التفكير النقدي

عزيزي الطالب

تم تصميم هذا الاختبار لقياس بعض المهارات الخاصة بك أو قدراته العقلية وتكشف قدراتك في التحليل واستخدام المنطق.

وسيتم معاملة جميع المعلومات بسرية تامة لأغراض البحث فقط.

تعليمات

1 - الإجابة على جميع الأسئلة.
2 - برجي محاولة استكمال جميع المهام في 70 دقيقة.
3 - قراءة التعليمات الخاصة بكل مجال من مجالات اختبار خمسة كما والمثال التوضيحي للكيفية الإجابة.
4 - لا تكتب أي شيء على ورقة الاختبار ويجب أن تكون مكتوبة على جميع الإجابات على ورقة الإجابة التي يتم توفيرها.
5 - إذا كنت ترغب في تغيير إجابتك، تأكد من أنك قمت تغيير إجابتك الأصلي تماما.

مع خالص التقدير

اسم ..........................................................

الجنس ..........................................................
الاختيار 1: الاستنتاج

القيمة على استخلاص نتيجة من عدة مقدمات أو حقائق أو أراء أو بيانات في المجالات الفيزيائية، فمثلاً.

إذا فَّكَ ظَٔدَ بِهِمَاتِنَا الْمَعْتَفَسَةَ يَجِبُنَ التَّغِيِّرَةُ فِي النَّهَايَةِ فَقَطَ وَعَرَضَتْ عَلَى بَعْضِ الْمَوَادِ مَثَلِ الْرُّمْلِ،
وَالْحَيَّةِ وَالْحَلَقِ حَدِيدَةِ وَمِن ذَلِكثُ مَن يَسْتَمِتُ الْتَغِيِّرَةُ أَنَّ الْمَسْمَارِيَّةِ الْحَدِيدَةِ مِثَلُ الْهَالِبِ 
الذي يُسْتَجِبُ إِلَى الْمَعْتَفَسَةِ وَغَيْرُ ذَلِكَ مِن الْمَوَادِ لَا يَجِبُنَ إِلَيْهِ، أَوَّرْتَ جَدِيدًا مَا أَنَّ إِسْتَنَا في النَّزْلِ إِذَا 
رَأَيَ ضَوَأً مَهَّلَ فَشَكَلَ، وَلَكِنَ هَذَا الْعَلَيْجُ أَنَّهُ صَحِيحًا أَوَّرْتَ جَدِيدًا مَا أَنَّ إِسْتَنَا في النَّزْلِ إِذَا 
تَرَكَ مَعْضَاً قَبِلَ أَنَّ يَغَيِّرَوْهُ. يَبْدَا كَلَّ مَوْفِقٍ مِن مَوَاقِفْ هَذَا الْعَلَيْجُ بِقَتْدِمِ حَقَائِقِ صَادِقَةٍ وَسَتَجِدْ بَعْضِ كَلَّ حَقِيقَةٍ
بَسْتَجِدْ بَعْضِ كَلَّ حَقَائِقِ صَادِقَةٍ وَسَتَجِدْ بَعْضِ كَلَّ حَقِيقَةٍ أَفْرَا هَذَا الْعَبَرَاتِ جَدِيدًا ثُمَّ نَافِضُ الْعَلَيْجُ مِنْ هَذَا الْحَقَائِقِ وَتَسْجِيلُهُ فِي وَرَقَة
لَجْمَةِ وَكَالُأَتِ.

ملاحظة:
قد يكون هناك أكثر من استنتاج صحي و قد يكون هناك أكثر من استنتاج غير صحي وقد تجد أكثر من استنتاج
بَسْتَجِدْ بَعْضِ كَلَّ حَقِيقَةٍ أَفْرَا هَذَا الْعَبَرَاتِ جَدِيدًا ثُمَّ نَافِضُ الْعَلَيْجُ مِنْ هَذَا الْحَقَائِقِ وَتَسْجِيلُهُ فِي وَرَقَة
الأصول:
1. يَحْصِ النَّاسِ سَخْوَهُ الْجَوُ مَعْرَفَةً دِرِجةَ حَرَارَةِ الْإِنسَانِ.
2. حَاَةٌ الْلَّمْسِ ظَرِيْرَةً لِلْحَدِیِدِ (تَكُمْ) دِرِجةَ حَرَارَةِ الْجَمْسِ
3. تَقْدِرُ سَخْوَهُ شَخْصٌ مَصْبَ بِالْحَمْيَ بِوَاسِطَةَ لَمْسٍ لَغَرْضٍ إِسْعَأْفِهِ وتَحْفِیَدُ دِرِجةَ حَرَارَةِ
4. دِرِجةَ حَرَارَةِ الْجَسْمِ يَعْمَدُ عَلَى دِرِجةَ حَرَارَةِ الغَلَفِ الْجَوِّيِ
5. دِرِجةَ الْحَرَارَةِ مِن النَّامِيَ الْظَرِيْرَةِ لَوْصُفٌ الْطَّنْسِ (حَالَةَ الْجَوِّ الْبَوْمِيَّةِ) لَا يَهْتَمُ الْفَلْحَانَ وَالْطَيْرَانِ

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التصنيف الأولي للطيف من مواد موصولة للحرارة أو الالنيا:
1. جمع المواد الموصولة للكراتيا هي موصولة جيد للحرارة.
2. يتم صنع الأدوات الزجاجية بحيث تكون عازلة للحرارة.
3. توضع عادة عدة عازلة للحرارة كمكاسات حمل اليوبر.
4. يعتمد في صنع المصابيح الكهربائية على المكونات المعدنية المستخدمة في صنع وتحديد نوع الخيوط.
5. تسيب عملية الطهي.

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يُهاذ ضغط الجسم الصلب بزيادة وزنة عندما تكون مساحة قاعدة ثابتة لتقليل الضغط تعمل على:

6. وضع خشبة واسعة أسفل رافعة السيارة خاصة عندما يكون الطريق غير معبد.
7. صناع السكاكين وجعل الحافة حادة حتى يقلل الضغط على اليد.
8. تصنع المسامير بعجلة مدبب وأخرى واسعة لزيادة الضغط أثناء الاستخدام من قبل النيجار.
9. زيادة مساحة قاعدة النزلج على اللحج.
10. صناعة آلات الزراعية بعجلات كبيرة لزيادة السرعة.

تصل حرارة الشمس إلى الأرض وسكانه بواسطة الإشعاع الحراري المتبع منها.

11. تغوص القطعة المعدنية في وسط البحر ، في حين يمكن للسفينة لو وضعت بنفس المكان أن تطفو على ماء البحر على الرغم من كبر حجمها.
12. يرتقي المنطاد أو البلون إلى أعلى الجو حين يكون وزنه مع المحتملات التي يحتويها أقل من قوة فعّاء الهواء ، لذا يفعل كأنها المناطيد على تقليل الغاز كي يقل حجم الهواء المزاج.
13. تصميم مراوح الطائرة بحيث تكون قوة دفع الهواء لها أكبر من وزنها.
14. تصنف القوارب بحيث تكون مجوفة ومساحتها السطحية كبيرة.
15. تعطية النباتات بالبيوت الزجاجية.

الاختبار 2: معرفة الأفكار أو المشكلات

الإفكار أو المسمى إذا فكره وسكة كأعمال في مناقشة أو حل مشكلة معينة ، فعندما يقرر طالب
في كلية التربية أنه سيخرج بعد ستين فإنه يفرض أو يسلم بأن يهف ستينات فلتكن الكلية ، وأن ينجح في المواد
الدراسية وما شابه ذلك ، إن هذه الأفكار أو المشكلات تكون مطولة في ضوء عبادة الطالب أعلاه.
وفيما يلي عدد من العبارات ويتبع كل عبارة عدة أفكار أو مطولة متفرقة ، ومتطلب منك أن تقرر فيما إذا كان
الإفكار أو المسمى فكره في ضوء محتمل العبارة ، وإذا كنت ترى أن الأفكار (وارد) في ضوء ما جاء بالعبارة فضع
عامة (√) في المكان المناسب من ورقة الإجابة تحت كلمة (وارد). وإذا كنت تظن أن الأفكار غير مسلم به
بالضرورة في العبارة فضع عامة (√) في المكان المناسب من ورقة الإجابة أي تحت عبارة (غير وارد).
فيما يلي مثال يوضح طريقة وضع علامة (√) أمام الاقتراحات وفي الأماكن المناسبة من ورقة الإجابة.

وألاحظ أن في بعض الحالات يكون هناك أكثر من اقتراح وارد بالضرورة، وفي حالات أخرى لا يكون أي من الاقتراحات واردًا.

أخذ طلب كمية من المياه من حديقة المدرسة ووزنها في الوضعية للأساس لمدة أسبوع، ثم طلب المعلم من الطالب أن يفتح نفس الكمية من التربة مرتين أخرى، فهيئة أن وزن التربة قليل.
1. لأن التربة أخذت من احتواء الرطوبة التي كانت موجودة في حديقة المدرسة.
2. لأن الرياح أدخلت طيران جزيئات التربة.
3. لأن الطالب الآخرين لعبوا بالقرب.

التمرين

هناك العديد من مصادر الطاقة الجديدة التي سيتم اكتشافها في المستقبل، إذا تم اكتشاف مصدر جديد للطاقة، هل سيمنع نفس مصدر الطاقة في المستقبل.

الاقتراحات المطرحه
16. اكتشاف مصدر جديد من الطاقة لا يمنع نفس مصادر الطاقة.
17. مصادر الطاقة الجديدة قليلة.
18. بعد اكتشاف مصدر جديد للطاقة، فإن الطلبات على الطاقة لا يسد الحاجة.

التطوير في مجالات العلوم والبيئة والتعليم سيتوسع إذا جميع البلدان تعمل معاً، من من العمل بشكل مستقل.

الاقتراحات المقررة
19. إذا جميع البلدان تعمل معًا هذا المجالات، اعتمادًا على الوضعية المثلث.
20. الاختلافات العرقية السياسية بيئي نشأة من اعتبارهم العلماء عالمًا الإنسانية.
21. التعاون الدولي في مجالات التعليم والعلوم يؤدي إلى تقليل المجتمعات المستقلة.

التسلسل الزمني في مجالات utils:

بمجرد كفاءة السيارات، الاختيار هو هل إنتاج البنزين المضاد للإجهاد من كفاءة السيارة، أخذه خمس سيارات من كلية.

الاقتراحات المقررة
22. يحسب الزمن للسيارة بنوكًا منها البنزين.
23. تحسين المكمل للسيارة.
24. نفس كمية البنزين المضاد للإجهاد.
25. نفس كمية البنزين المضاد للإجهاد.
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الاختبار 3: الاستنباط
وفي هذه العملية يستنبط الطالب معلومات جديدة من معلومات معروفة أو معرفة له، ويكون كل تمرين من التمرينات الأدنى في هذا الاختبار من عباقرين (مقدمين) بليهما عدة متي قررة، وعليه أن تحدد بيترتين صحيتين تمامًا وصحيتين دون أخطاء حتى لو كانت إحداهما أو كلاهما تربك، فليا النتيجة الأولى التي تمكن الرازيز إذا كنت تعقد أنها تربك بالضرورة على الرازيز في ختم علاجٍ (أ)، في هذا المناصب حتى إذا كانت إحداهما أو كلاهما صحيتين، فإن النتيجة غير صحيحة، وإذا كانت النتيجة غير صحيحة في هذا المناصب، فتقوم علاجٍ (أ) في هذا المناصب حتى إذا كانت إحداهما أو كلاهما صحيتين، فإن النتيجة غير صحيحة، وإذا كانت النتيجة غير صحيحة في هذا المناصب، فتقوم علاجٍ (أ).

المواد المدمجة
جميع المواد المدمجة الموصولة للكهرباء
1. جميع المواد المدمجة موصولة بلكهرباء.
2. كل شيء موصول بالكهرباء.
3. هناك كهرباء ومحرك موصول.

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<tr>
<td>موصولة</td>
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الهيكلية: الإحساس بالاضرار بفبين السرعة، الكتاب والورقة. الإحساس
30. الكتاب والورقة يستعمل في صناعات مختلفة، الورقة يستعمل إلى الاضتقالكتاب.
31. الكتاب والورقة يستعمل في صناعات متساوية، الورقة تستعمل إلى الاضتقالكتاب.
32. الكتاب والورقة يستعمل في صناعات متساوية وبالتالي كلاهما يصلان في نفس الوقت.

<table>
<thead>
<tr>
<th>البطاقة المدمجة</th>
<th>الموصولة للكهرباء</th>
</tr>
</thead>
<tbody>
<tr>
<td>غير موصولة</td>
<td>√</td>
</tr>
<tr>
<td>موصولة</td>
<td>√</td>
</tr>
</tbody>
</table>
اللغزات هم وصلات جديدة للطرق، ولللغزات غير موصولة جيدة للطرق وبالتالي:

الحديد من اللغزات، وذلك فهي تصل بالطريق.

1. الكهرباء وэр للانفصالات، لذلك فهي غير جيدة للطرق.

جميع المواد الطبيعية جيدة للطرق cong بين اللغزات.

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td></td>
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<tr>
<td>34</td>
<td></td>
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<tr>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

ماء الجنوبية هي وفي درجة: 100C عند مستوى سطح البحر. الماء الموجود في وعاء عند مستوى سطح البحر.

1. إذا كانت درجة الحرارة تصل إلى 100C فإن الماء في الوعاء.
2. إذا كانت درجة الحرارة تصل إلى 50C فإن الماء في الوعاء.

في واحدة من غرف العراق هناك 52 صفة في خمس مدارس ثانوية. كل صف يحتوي على 10 تلميذ. لذلك:

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
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</thead>
<tbody>
<tr>
<td>39</td>
<td></td>
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<td>40</td>
<td></td>
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<tr>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>
تذكر أن تعد الوقائع والبيانات الواردة في كل فترة صحية وصادقة، وأنه يترتب على المعلومات الواردة أكثر من تفسير صحيح، وفي حالات أخرى قد تكون جميع التفسيرات المفترضة صحية وفي حالات أخرى قد تكون جميع التفسيرات المفترضة غير صحيحة، وفيما يأتي مثال يوضح ذلك:

يتعثر جسم الإنسان إلى أنواع مختلفة من الأشعة منها الأشعة فوق البنفسجية في ضوء الشمس حيث يؤدي هذا الإشعاع المتزايد الذي يصل إلى الجسم على ارتفاع استثنائي سرطان الجلد.

1. يتعثر الجسم لإشعاعات أخرى بالإضافة إلى ضوء الشمس فكل المواد تترسب تحتوي على كميات ضئيلة من المواد السامة.

2. تعتبر الأشعة السينية (أشعة إكس) هي الأشعة فوق البنفسجية التي يتعثر لها جسم الإنسان.

3. ليس كل البشر يتعثرون إلى الأشعة فوق البنفسجية هذه من لا يتأثر جسمه بهذا النوع من الأشعة.

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
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</thead>
<tbody>
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<td>1</td>
<td>√</td>
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<tr>
<td>2</td>
<td>√</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

التمرين

في أيالسنتا البارد لالاحظخاركتييرخ من فم المكمل، بينما لا يلاحظخاركيام الصيف الحارة؟

45. حصول ظاهر التكثيف بسبب حركة الهواء البارد النافذ إلى الهواء البارد.
46. تحول خارك المركب إلى حالة الغازية.
47. يحدث الهواء الموجود في الغلاف الجوي.

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td></td>
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<td>46</td>
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<tr>
<td>47</td>
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</tbody>
</table>

أحمدطلالكفي الفيزياء، وحصل على درجة عالية في الفيزياء. لذلك

48. جمع الطلاب حصلوا على درجة عالية في الفيزياء.
49. أحمد متوفيق في جميع المواد.
50. أحمد مقبول في كل زمالاته.

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
</tr>
</thead>
<tbody>
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<td>48</td>
<td></td>
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<td>49</td>
<td></td>
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<tr>
<td>50</td>
<td></td>
</tr>
</tbody>
</table>

تستمر ريشة المرحة في الدوران لفترة معينة بعد اقتشاط البيع الكهربائي عنها وإذا حاول شخص إيقاف

الريشة بيد فإنه يجد صعوبة، وقد يؤدي في ذلك أصابعه.

51. تستمر ريشة المرحة في الدوران بفعل تمريز الإستمرارية وتتوقف بعد مقاومة الهواء.
52. إن الصعوبة التي يواجهها شخص ما في إيقاف المرحة هي بسبب الاستمرارية.
53. إن مدرك المرحة يتوقف تماما بعد اقتشاط البيع الكهربائي بحيث لا يستطيع تسارع المرحة.

<table>
<thead>
<tr>
<th>غير مترتبة</th>
<th>مترتبة</th>
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</thead>
<tbody>
<tr>
<td>51</td>
<td></td>
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<td>52</td>
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<tr>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

تستخدم مخصصة خرائط مياه مختلفة على ضخادن البحار، وهي تستخدم مضخات خرائط البحار. الجدول
التاليينيتيجتي التحفيقالي تم القيام بهعلى كميات الماء الذين يتم ضخها مكتلاوب.

<table>
<thead>
<tr>
<th>حجم الخزام (mm)</th>
<th>كمية الماء في الدقيقة (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>2</td>
</tr>
</tbody>
</table>

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الجداول التالية تضمن الدقيقة الواحدة التفسيرات التالية لعند تحليل حجم الخراطيم على ضغط:

<table>
<thead>
<tr>
<th>الدقيقة</th>
<th>كمية ضخ الديزل في الدقيقة الواحدة</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
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<tr>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

- قطر الخراطيم الأكبر يتيح حجم كميات من الديزل.
- تزداد كمية ضخ الديزل كلما زاد الوقت.
- سرعات ضخ الديزل تزداد سرعات ضخ الديزل.
- قطر الخراطيم يؤثر على كمية ضخ الديزل.

الاختبار 5: تقييم الحجج

عند مشاركتك في مناقشات حول قضايا مثيرة للجدل والخلاف بفرض أن تكون قادراً على التمييز بين الحجج القوية والحجج القوية المنفصلة بالموضوع، والحكم على فحاول الحجة أو ما يراعي على أساسين: القبول المثير للاهتمام أولاً بوجود الديزل، أما الحجج القوية فيكون منفصلة بصورة مباشرة بالسلاسل الخاصة حتى وإن كانت لها أهمية ضعيفة، والسلسلة وتكون وجوبية من السلاسل. في هذا الاختيار، السلاسلة من الأسئلة تأتي كل منها ثلاثة حجج، ولكنه في الحالات حيث إذا كانت الحجة أو ما يراعي على ضمن عامة (أ)， في المكان الذي يقع تحت كلمة (ضعيفة) إذا وجدتها كذلك ودون الإجابات على وقفة الإجابة، إما على الحكم، وقد تكون الحجج في بعض الأسئلة قوية أو تكون جميعها ضعيفة أو تجد واحدة ضعيفة وأخرى قوية وهكذا...

هل أن سرعة الضوء هي أكبر أم أقل من سرعة الصوت؟

1. سرعة الضوء أكبر لأن الضوء يصل إلى الهدف قبل الصوت.
2. سرعة الضوء أقل لأن الصوت يصل إلى المكان، ولا يصل الضوء إلى المكان.
3. سرعة الضوء أكبر لأنه يمكن أن نرى ضوء البرق قبل أن نسمع صوت العصر.

التمرين

حالة أحمد عبد العزيز عازف على نص النص: "هذه الحافلات تسمى فينتوك البينكي بسبب احتفالات الحريري، وهي تعمل بواسطة محرك كهربائي، ولكن تفريغ الطاقة (مثل هذا المحرك الكهربائي) عن طريق خطوط هوائية، يتم توفير الكهرباء من محطة توليد الكهرباء باستخدام المولد). هل حافلات النرو يساهم في التلوث البيئي؟

- نعم، لأن العلامة تجهز بالكثبان.
- نعم، لأن المحطة الكهربائية تسببت في تلوث البيئي أيضا.
- نعم، لأن المحطة الكهربائية تسببت في تلوث البيئي، ولكن محطة توليد الكهرباء تقلل من التلوث البيئي.

<table>
<thead>
<tr>
<th>الدقيقة</th>
<th>كمية ضخ الديزل في الدقيقة الواحدة</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td></td>
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<tr>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

هل تظن أن تياراً كهرباء ناقص (واحد أمبير) أو أكثر يسبب حروفاً خطيرة إذا مر خلال أنجمة الجسم؟

- نعم، إن تياراً أقل من هذا المعدل يسبب أضرارًا أكثر من الحروق.

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59. إن تيار أكثر من هذا المقدار يؤدي إلى الوفاة قورأ.

60. إن مرور تيار كهربائي حتى ولو بقيمة أقل من هذه القيمة بعشرات المرات سيؤدي إلى حروق خطيرة في أنسجة الجسم.

<table>
<thead>
<tr>
<th>قوية</th>
<th>ضعيفة</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td></td>
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<tr>
<td>59</td>
<td></td>
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<tr>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

هل أن بخار الماء أشد سخونة من الماء الساخن أم العكس؟

64. الماء الساخن أكثر سخونة منبخار الماء/لأن بخار الماء يفقد كمية كبيرة من الحرارة أثناء تكثيفه وتحويله إلى سائل.65. بخار الماء أشد سخونة من الماء المعلق/لأن عند رش بخار الماء على جسم أقل سخونة بسبب حروقاً أشد من الماء الساخن.

66. الماء الساخن أكثر سخونة منبخار الماء/لأن درجة حرارة بخار الماء دائما تكون أقل من درجة حرارة الماء الساخن.

67. بخار الماء أشد سخونة من الماء المعلق/لأن الطاقة الداخلية للمذخنة فيبخار الماء أكبر من الطاقة المذخنة في الماء المعلق.

<table>
<thead>
<tr>
<th>قوية</th>
<th>ضعيفة</th>
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</thead>
<tbody>
<tr>
<td>64</td>
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<td>65</td>
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<td>66</td>
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</tr>
</tbody>
</table>

هل تعمل على فتح الشبابيك أولاً عند تسرب غاز الوقود في المطبخ؟

68. نعم / وذلك لتقليل من سرعة انتشاره داخل المطبخ والسماح له بالخروج من خلال الشبابيك.69. كلاً/ لأنه من المفروض غلق الصمام قبل البدء في فتح الشبابيك حتى لا تسرب كمية أكبر مما هو موجود في المطبخ.

70. نعم / لأن الغاز يشكل حجماً أكبر من حجم المطبخ.
اختبار التحصيل

عزيزي الطالب،

هذا اختبار تحصيلي في الفيزياء يتكون من (30) فقرة، كل فقرة تحتوي على عبارة رئيسيّة أربعة بدائل (أ، ب، ج، د)، بيد أن واحد فقط من هذه البدائل يكون صحيحًا. يرجى اختيار البدائل الصحيحة في كل فقرة. جميع فقرات الامتحان تشير إلى مسائل بحثية متعددة، ولا تقتصر على النطق أو النكت أو الأسئلة المبنية على صيغة الجملة باللغة العربية. هذه الاختبارات تعزز الفهم العميق لل مواضيع المدرسية.

1- الإجابة على جميع الأسئلة.
2- أفكارك سوأل بناء وابدأ ويرجي المحاولة لاستكمال جميع الأسئلة في 45 دقيقة.
3- لا تكتب أي شيء على ورق الاختبار، ووضع دائرة حول الحرف الذي يمثل الإجابة الصحيحة كما في المثال التالي:

وسيتم معاينة جميع المعلومات المكتوبة ناسخة لأغراض البحث فقط.

هي مقياس لمعدل الحركة:

(أ) الحركة  
(ب) التعجيل  
(ج) الانطلاق  
(د) السرعة

4- إذا كنت تريد تغيير إجابتك، تأكد من أنك قمت بحذف الإجابة السابقة تمامًا.

مع خالص التقدير

الاسم:...........................................................................................

الجنس:...........................................................................................
1 - ما هي المراة التي لها مدى واسع للرؤيا؟
(د) المستوية (ج) المفرزة (ب) المحدبة (أ) الكروية

2 - صب ماء في اسطوانة مدرجة حتى (30cm³)، ثم وضع حجر، لاحظ ارتفاع الماء إلى (30cm³)
(أ) جدول حجر
(ب) 30 cm³ (ج) 10 cm³ (د) 40 cm³

3 - مائع الضوء الصادر من المصباح الكهربائي ممثة (ب) مضيئة (ج) مستضاءة (د) شفافة

4 - حركة الجنينات في هذه الصور تمثل حالة المادة في حالات:
(أ) الصلبة (ب) السائلة (ج) الغازية (د) البلازما

5 - المنطقة المظلمة أو الأشياء في الشكل التالي تسمى:
(أ) الظل (ب) انكسار الضوء (ج) انكسار الضوء (د) المرايا

6 - أي لون من الألوان الطيفي يقصر طول موجي؟
(أ) الأحمر (ب) الأزرق (ج) البنفسجي (د) البرتقالي

7 - ما هي قيمتها الزاوية لانعكاس الضوء المجاور?
(أ) 90° (ب) 60° (ج) 30° (د) 45°
8 - الأسماد يكون لها: 
أ) أقرب (الدقيقة الحقيقية) ب) في الدقيقة الحقيقية ج) أصغر منهما (الدقيقة ب) بعيد
الدقيقة الحقيقية

9 - ما هي العلاقة بين سرعة الضوء وكثافة الوسط المائع؟ 
أ) خطية
ب) نسبية
ج) عديدة
د) غير خطية

10 - ما الوقت من اليوم يظهر الأظافر؟ 
أ) الصباح
ب) بعد الظهر
ج) غروب الشمس

11 - البعد البؤر العدسة المحددة هو 50+D، فان القدرة هي: 
أ) 30 cm
ب) 60 cm
ج) 40 cm
د) 20 cm

12 - وحدة فياس قدرة العدسة هي: 
أ) الديوبتر
ب) المول
ج) الكيلومتر
د) متر

13 - تسويع الهواء داخل البالون يؤدي إلى: 
أ) توسع ونفل الكثافة
ب) توسع أكبر كثافة عالية من شفافية الهواء
ج) منزلي وضغط عالي في الهواء (د) زيادة الضغط، وكثافة أكبر من الرطوبة في الهواء.

14 - أي نوع من التسمية مناسبة لشخص يشكو من تشوه النظر؟ 
أ) مقعرة (ب) محددة (ج) مفرغة (د) متينة

15 - متى يحدث خسوف القمر؟ 
أ) الأرض تقع بين الشمس والقمر
ب) القمر يقع بين الشمس والأرض
ج) الشمس تقع بين الأرض والقمر
د) الأرض تقع بين الشمس وكوكب الزهرة

16 - النقطة التي يمر بها الإشعاع الضوئي ولا يعاني الانكسار 
أ) حافة العدسة (ب) المركز البصري (ج) بوزرة العدسة (د) بين حافة العدسة ومركز العدسة
17 - ما نوع انعكاس السطح الموضح في الشكل؟
أ) عادي  ب) غير النظامية  ج) المباين  د) متعامد

18 - تسمح لحركة الفتق بالسكاكادنا:
أ) دائرة  ب) نصف دائرة  ج) خطية  د) الخطى

19 - الزجاج في السكاكادنا من الأجسام:
أ) شفاف  ب) شبة شفافة  ج) مصبوغ  د) كل الاحتمالات السابقة

20 - هيئطة من الزجاج تحتوي على سطح مستوي مصقوولي يسمى عامل الأشعة
أ) الاستثناء  ب) العدسات  ج) المشرق  د) إلكترونا

21 - أي من النقطات التالية هي أقصر?
أ) 0.2 كم  ب) 20 سم  ج) 20 مم  د) 0.001 م

22 - تستخدم نظرات الطبية ذات النظارات المقرن للعلاج:
أ) طول النظر  ب) قصر النظر  ج) العماد الاستماعاتي  د) العين الليثي

23 - السرعة من الكميات
أ) المتجه  ب) الجدائلية  ج) القياسية والمتوجهة  د) الجدائلية والمتجه
- 24- انظر إلى الصورة أدناه، الصورة التي تشكلت في المرآة المستوية:

  (أ) ظاهرة، مستقيمة، معكوسة من اليسار إلى اليمين
  (ب) بنفس حجم الفتاة ظاهرة، مستقيمة معكوسة من اليمين إلى اليسار
  (ج) حقيقية، مستقيمة، وعلى مسافة واحدة منالمرأة
  (د) حقيقية، مستقيمة، وأكبر من حجم الفتاة

- 25- موجات أشعة جاماهي:

  (أ) طولية ميكانيكية (ب)الكهرمغناطيسية (ج)كهروضونية

- 26- سرعة انفتاح الضوء هي؟

  (أ) 300كما س (ب) س 300-000كم س (ج) 300،000كم س

- 27- لماذا يظهر قطرات في قطرات المطر؟

  (أ) نظرا لأنكسار الضوء في قطرات المطر.
  (ب) سرعة الضوء في الهواء أكبر منفي الماء.
  (ج) نظرا لاستقطاب الضوء.
  (د) نظرا لانعكاس الضوء في اتجاهات مختلفة

- 28- قوة عدسة التكبير هي؟

  (أ) 1 (ب) (طول الجسم 1) / (ب) (البؤري ج) 50سم / (ج) المركز البصري

- 29- الموجات الصوتية التي تستخدم تشخيص الأمراض هي؟

  (أ) موجات الصوت (ب) موجات فوق الصوتية
  (ج) موجات تحت الصوت (د) الموجات الكهرمغناطيسية

- 30- ألوان الحبر المستخدمة في التلويكانتبئاجة عنخلل ثلاثة أصباغ أساسية:

  (أ) الأخضر والأزرق والأحمر
  (ب) الأحمر والأحمر والأبيض
  (ج) الأحمر والأزرق والأحمر
  (د) الأحمر والأحمر والأبيض

404
استبيان لتصورات الطلاب في التعليم باستخدام تقنية العصب الذهني

عززي الطالب:

الهدف من هذا الاستبان هو لمعرفة تصورات الطلاب في التعليم عن طريق تقنية العصب الذهني. سيكون هذا الاستبان من ثلاثة أجزاء:

الجزء أ: الاستبان المتعلقة لنشر التعليم.

الجزء ب: الأسئلة التي تعكس ميزات تقنية العصب الذهني.

جزاءج: أسئلة مفتوحة حول أسلوب العصب الذهني التي استخدمت خلال الفصل الدراسي الثاني من العام الدراسي.

يرجى قراءة واتباع التعليمات.

الجزء أ: مخرجات التعلم

تعليمات

يرجى وضع دائرة حول الرقم 1, 2, 3, 4 أو 5 الذي يصف كيف تشعرك بالمعارف والمهارات التي اكتسبتها خلال التعلم عن طريق العصب الذهني:

1- لا أوافق بشدة
2- لا أوافق
3- عادي
4- أوافق
5- أوافق بشدة

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>كنت قادرًا على التعرف على الأصول التعلمية البيئية</td>
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<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
لا يمكنني قراءة النص العربي بشكل طبيعي. يرجى تحويل النص إلى نص إنجليزي أو إس箐 لكي أتمكن من مساعدتك بشكل أفضل.
هل تعتقد أن العصاف الذهن هو أسلوب مناسب لتعلم الفيزياء؟ شرح لماذا أو لماذا لا.

السؤال 2:
ما هي نتائج التعلم التي شعرت عليها نتيجة باستخدام تقنية العصاف الذهن؟

السؤال 3:
ما هي الخصائص الرئيسية لتقنية العصاف الذهن؟

السؤال 4:
ما هي فعالية تقنية العصاف الذهن على قدرات التفكير؟

السؤال 5:
ماذا وجدت مفيد للغاية حول التعلم باستخدام تقنية العصاف الذهن؟

السؤال 6:
ماذا وجدت الأقل فائدة حول التعلم باستخدام تقنية العصاف الذهن؟ يمكنك إضافة أي اقتراحات بشأن الطريقة التي يمكن بها تحسين هذه التقنية أو جعلها أكثر فائدة؟
### APPENDIX K: Physics students’ perceptions of brainstorming technique

#### Application Knowledge and Skills

<table>
<thead>
<tr>
<th>The statements</th>
<th>Analysis</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Natural</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>Mean</th>
<th>SD</th>
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<td>1 I was able to think broader and more from multiple perspectives (over the physics content).</td>
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<td>2</td>
<td>2</td>
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<td>5.12</td>
<td>5.12</td>
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<td>3 I was able to analyze physics problem.</td>
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<td>I was able to think critically.</td>
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<td>17.9</td>
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<td>I was able to build new link between different facts.</td>
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<td>I was able to evaluate ideas and finding.</td>
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<td>I was able to retain what I had learned more.</td>
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<td>19</td>
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<td>Strongly agree</td>
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<tr>
<td>9 I was able to identify critical issues in physics problems.</td>
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<td>5</td>
<td>8</td>
<td>13</td>
<td>10</td>
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<td>12 Better memory of the physics subject content.</td>
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<td>13 I was able to recognize the related of what I learned to my own daily life.</td>
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<td>16 I had opportunity to participate in diversified classroom learning activities.</td>
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<th>Natural</th>
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<td>18 I was able to exchange ideas with my classmates.</td>
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<td>21 I was able to respect and appreciation of views and ideas of others, even thought I did not fully agree with them.</td>
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<td>25.6</td>
<td>33.3</td>
<td>23.1</td>
<td>1.18</td>
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<tr>
<td>23 I had the opportunity to play an important role as one of the main resource contributor during brainstorming session.</td>
<td>Frequencies</td>
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<td>7</td>
<td>23</td>
<td>4</td>
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<td>7.7</td>
<td>17.9</td>
<td>59.0</td>
<td>10.3</td>
<td>0.96</td>
</tr>
<tr>
<td>24 I was able to benefit from the ideas of others, through the development and build on it</td>
<td>Frequencies</td>
<td>-</td>
<td>2</td>
<td>6</td>
<td>20</td>
<td>11</td>
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<td>12.8</td>
<td>53.8</td>
<td>28.2</td>
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<td>0.79</td>
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<td>Analysis</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Natural</td>
<td>Agree</td>
<td>Strongly agree</td>
<td>Mean</td>
</tr>
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<tr>
<td>25 I was able to do experiments on physics content</td>
<td>Frequencies</td>
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<td>4</td>
<td>6</td>
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<td>3</td>
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<td>15.4</td>
<td>61.5</td>
<td>7.7</td>
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<tr>
<td>26 I was able to choose and apply my own strategy as when learning.</td>
<td>Frequencies</td>
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<td>10</td>
<td>13</td>
<td>7</td>
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<td>25.6</td>
<td>33.3</td>
<td>17.9</td>
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<tr>
<td>27 I was able to solved interesting and relevant physics problems.</td>
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<td>7</td>
<td>8</td>
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<td>6</td>
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<td>20.5</td>
<td>33.3</td>
<td>15.4</td>
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<tr>
<td>28 I was able to learn new knowledge during problem-solving.</td>
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<td>6</td>
<td>23</td>
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<tr>
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<td>Analysis</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Natural</td>
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<td>Strongly agree</td>
<td>Mean</td>
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<td>29 I was able to working independently.</td>
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<tr>
<td>30 I was able to think in different and useful way to solve problems.</td>
<td>Frequencies</td>
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<td>2</td>
<td>6</td>
<td>21</td>
<td>8</td>
<td>3.79</td>
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<tr>
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