

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.....

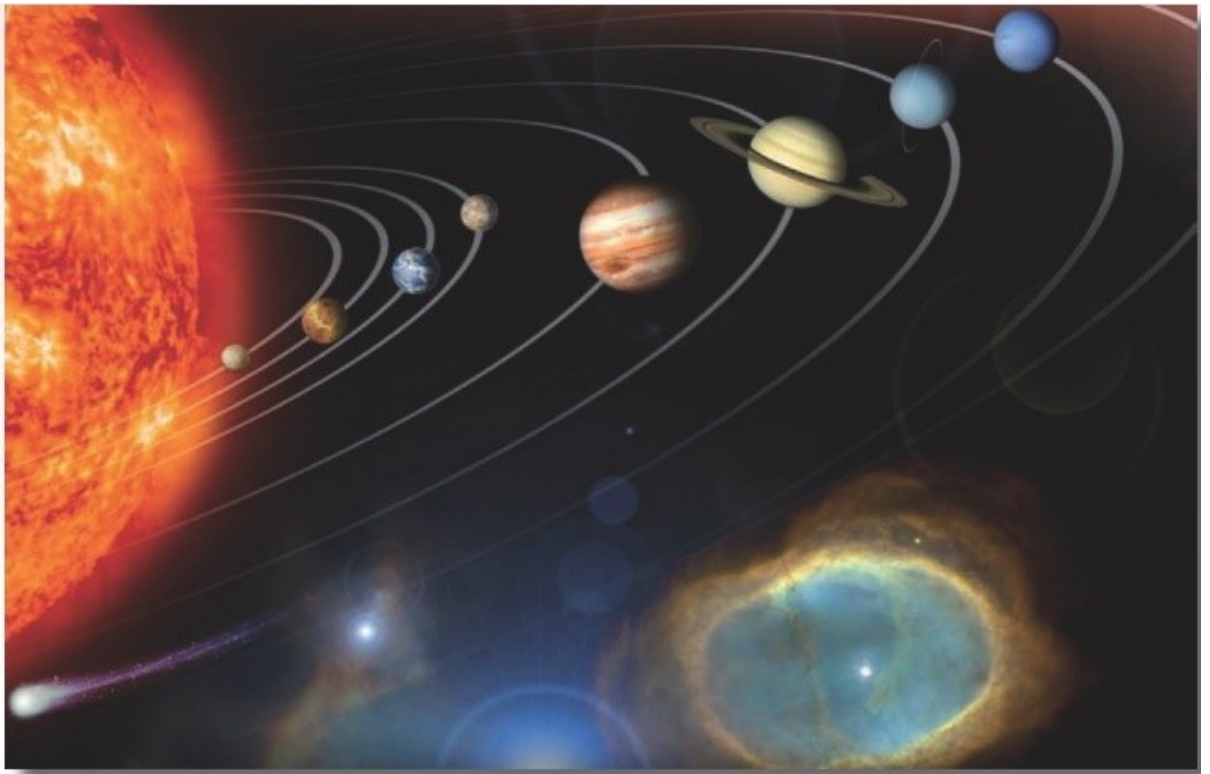
Gender.....

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 humansto liveon planets?

Source: (Hu & Adey, 2002)



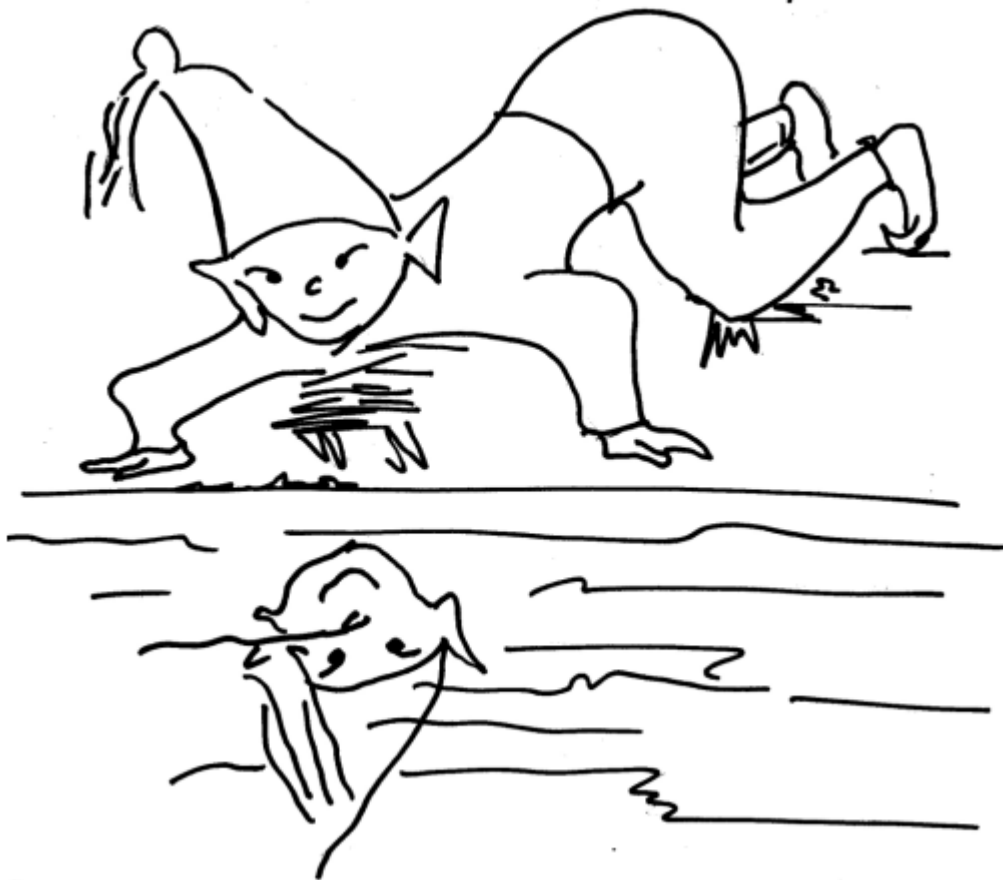
1. _____
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4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

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)



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

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.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

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)



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

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, makespoonsforcarrying liquids.

Source: (Pekmez, et al., 2009)



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



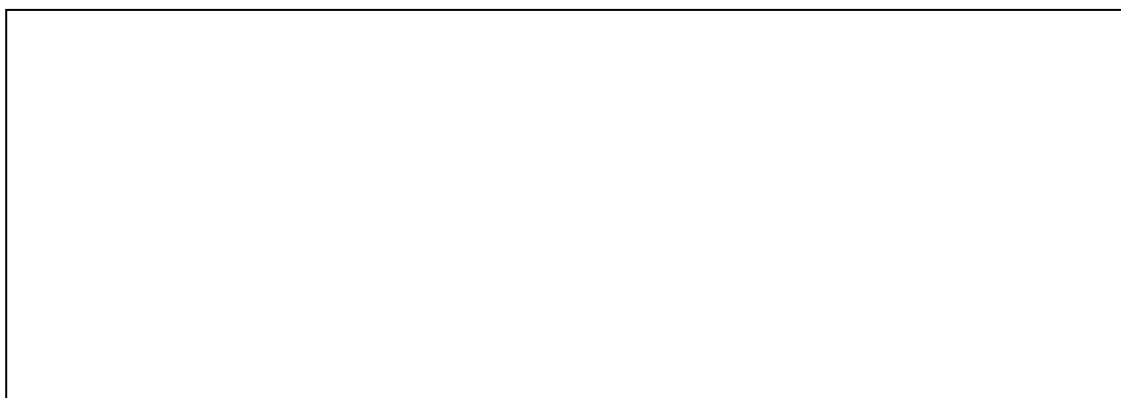
TASK 6: Supposing

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)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____



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.....

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 to infer that the nails ferrous metals are material 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:

T	If you believe that inference is absolutely TRUE that is, it logically follows on the facts presented in the statement.
PT	If you believe that inference is PROBABLY TRUE ; that it is more likely to be true than false.
ID	If you believe that there are INSUFFICIENT DATA to determine the true or false inference.
PF	If you believe that inference is PROBABLY FALSE ; that it is more likely to be false than true.
F	If you believe that the inference is FALSE without a doubt, either because they misinterpreting the facts or contradict these facts, or is contrary to the necessary inference from these facts

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.

	T	PT	ID	PF	F
1			√		
2		√			
3	√				
4				√	
5					√

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.

	T	PT	ID	PF	F
1					
2					
3					
4					
5					

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.

	T	PT	ID	PF	F
6					
7					
8					
9					
10					

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.

	T	PT	ID	PF	F
11					
12					
13					
14					
15					

TEST 2: RECOGNITING 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.

	Made	Not made
1		√
2	√	
3		√

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 will 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.

	Made	Not made
16		
17		
18		

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)

	Made	Not made
19		
20		
21		

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.

	Made	Not made
22		
23		
24		
25		

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)

	Made	Not made
26		
27		
28		
29		

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.

EXAMPLE

All mineral materials conductive to the heat, some minerals that conducts electricity

1. All material conductors the heat is a mineral material.
2. Everything is a heat-conductive electrically conductor.
3. There is material that conducts electricity and heat-conductive

	Follows	Does not follow
1	√	
2		√
3	√	

EXERSICS

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.

	Follows	Does not follow
30		
31		
32		

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.

	Follows	Does not follow
33		
34		
35		

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.

	Follows	Does not follow
36		
37		
38		

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.

	Follows	Does not follow
39		
40		
41		

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.

	Follows	Does not follow
42		
43		
44		

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 Follows'.

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.

	Follows	Does not follow
1	√	
2		√
3	√	

EXERCISES

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.

	Follows	Does not follow
45		
46		
47		

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.

	Follows	Does not follow
48		
49		
50		

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.

	Follows	Does not follow
51		
52		
53		

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.

Size (diameter) of hosepipe (mm)	Amount of diesel pumped per minute (liters)
8	1
13	2
20	14
26	7
31	12

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)

	Follows	Does not follow
54		
55		
56		
57		

TEST 5: EVALUATING 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.

	Strong	Weak
1	√	
2		√
3	√	

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)

	Strong	Weak
58		
59		
60		

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.

	Strong	Weak
61		
62		
63		

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.

	Strong	Weak
64		
65		
66		
67		

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.

	Strong	Weak
68		
69		
70		

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.....

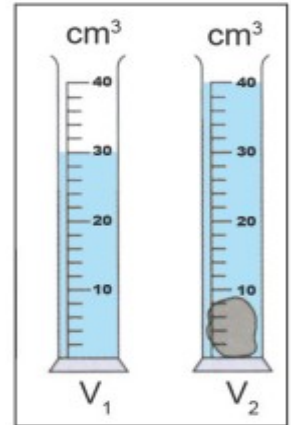
Gender.....

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 (30cm^3), then put in a stone, observed the height of the water rises to (40cm^3). What is the size of the stone?

- A) 40 cm^3
- B) 10 cm^3
- C) 30 cm^3
- D) 20 cm^3



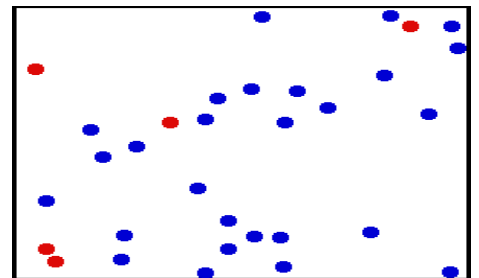
3- What is a type a light bulb?

- 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

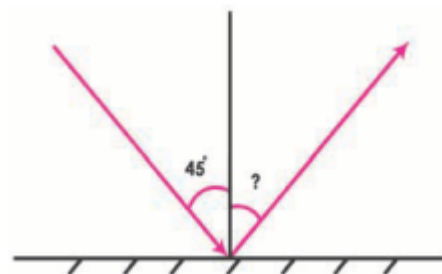


6- Which color of the spectrum has the shortest wavelength?

- 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- Whatkind of lens is appropriate for person complaining of farsightedness?

- A) Concave
- B) Convex
- C) Converging
- D) Diverging

15- When a lunar eclipse occurs?

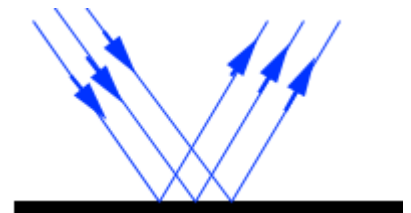
- A)The earth located between the sun and the moon.
- B) The moon located between the sun and earth.
- C) The sun located between the earth and moon.
- D) The earth located between sun and Venus.

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

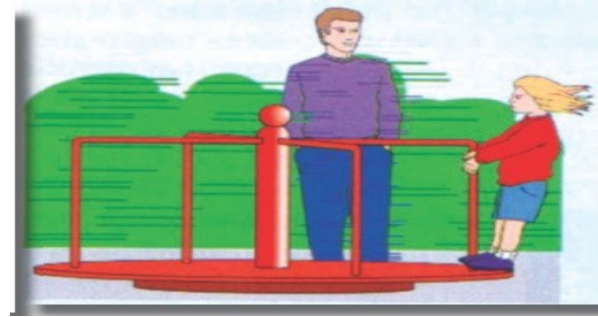
17- What is the reflection of the surface shown in the Figure below?

- A) RegularB) Irregular
- C) Parallel
- D) Orthogonal



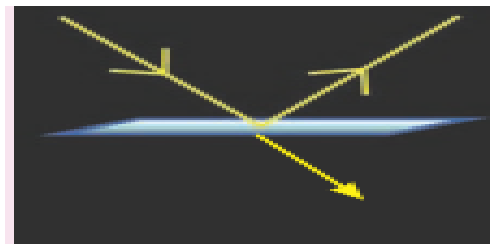
18- The movement of a girl in the Figure below is called.

- 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) $1 \backslash$ focal length

C) 50 cm

D) $1 \backslash$ optical center

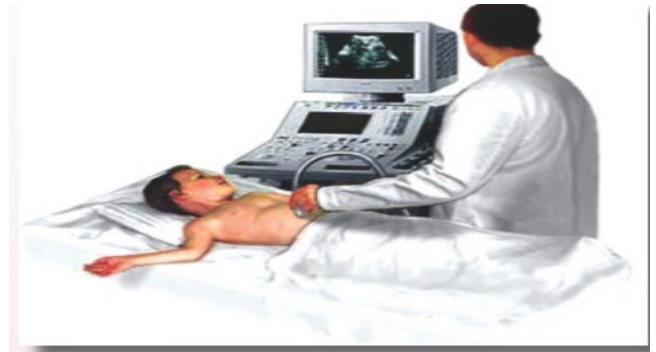
29- What forms of sound waves are used to diagnose diseases?

A) Audiowaves

B) Ultrasound

C) Waves underneath audio

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

15	I was able to predicate of new physics ideas .	1	2	3	4	5
Communication						
16	I had opportunity to participate in diversified classroom learning activities.	1	2	3	4	5
17	I had opportunity to participate in novel learning activities.	1	2	3	4	5
18	I was able to exchange ideas with my classmates.	1	2	3	4	5
19	I was able to discuss with my classmate.	1	2	3	4	5
20	I was able to express many ideas without being criticized.	1	2	3	4	5
21	I was able to respect of views and ideas of others, even though I did not fully agree with them.	1	2	3	4	5
22	I had the opportunity to listen to perspectives and points of view of my classmates and keep an open mind about their views.	1	2	3	4	5
23	I had the opportunity to play an important role as one of the main resource contributor during brainstorming session.	1	2	3	4	5
24	I was able to benefit from the ideas of others, through the development and build on it	1	2	3	4	5
Independent Learning						
25	I was able to do experiments on physics content	1	2	3	4	5
26	I was able to choose and apply my own strategy as when learning.	1	2	3	4	5
27	I was able to solved relevant physics problems.	1	2	3	4	5
28	I was able to learn new knowledge during problem-solving.	1	2	3	4	5
29	I was able to working independently.	1	2	3	4	5
30	I was able to think in different way to solve problems.	1	2	3	4	5

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**

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

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 it 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 : _____

Guidelines	Researcher Observation
<p>Part A: Note the learning environment (physical environment)</p> <p>a) Describe the physical settings (e.g., type of student seating, notice boards, etc.).</p> <p>b) Describe teacher physical movements and gestures during the class period.</p> <p>c) Describe the teaching- learning atmosphere (teaching techniques, student behavior, teacher behavior, etc.) in the classroom.</p> <p>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.).</p>	
<p>Part B: Describe the induction set that physics teacher used to start the lesson (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</p>	

between teacher and students.	
<p>Part C: Note the interactions between teacher-students & students-students during teaching and learning physics in the usual classroom.</p> <p>a) Describe verbal interactions between teacher and students during teaching and learning process of physics.</p> <p>b) Describe the students' verbal interactions with each other during physics learning.</p>	
<p>Part D: Note the content knowledge demonstrated / general competencies of by students (if applicable)</p> <p>a) Identify difficulty (ies) that students encounter during learning process.</p> <p>b) Describe students' action when students encounter difficulty (ies) during the learning process.</p>	
<p>Part E: Closure of the physics lesson</p> <p>Describe the method that the teacher has ended the physics lesson.</p>	
<p>Part F: Writing the observation report</p> <p>The complete observation report will be written based on the protocol above.</p>	

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 : _____

Guidelines	Researcher Observation
<p>Part A: Note the learning environment during brainstorming group (physical environment)</p> <p>a) Describe the physical settings (e.g., type of student seating, notice boards, etc.).</p> <p>b) Describe teacher physical movements and gestures during the class period.</p> <p>c) Describe the teaching- learning atmosphere (teaching techniques, student behavior, teacher behavior, etc.) in the classroom during the brainstorming session.</p> <p>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.).</p>	
<p>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 the brainstorming technique) during classroom.</p> <p>a) Describe verbal interactions between teacher and students when the teacher encounters students by the physics problems.</p>	

<p>b) Describe verbal interactions between group students during identify the physics problem.</p> <p>c) Describe interactions between group students for exchanged ideas related to the physics problem.</p> <p>c) Describe verbal interactions between group students during evaluation ideas generated.</p> <p>d) Describe verbal interactions between group students during selection right idea to solve the problem.</p>	
<p>Part C: Note the content knowledge demonstrated / general competencies of by students (if applicable)</p> <p>a) Identify difficulty (ies) that students encounter during brainstorming activity.</p> <p>b) Describe students' action when students encounter difficulty (ies) during the brainstorming activity.</p>	
<p>Part E: Writing the observation report</p> <p>The complete observation report will be written based on the protocol above.</p>	

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 be 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).

Guidelines	Researcher Observation
Part A: Note the learning environment (physical environment)	<p>The teacher standing in front of students. Each student sitting in his/her position. The physical settings of class were organizing as shown below.</p> <div style="text-align: center;"> </div> <p>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.</p>
Part B: Describe the induction set that physics teacher used to start the lesson	<p>Teacher started the lesson reminding students of two laws of refraction, which was explained in the previous lesson. She drew in blackboard refraction between two mediums. Some students were busy talking with others students sit in the class but any attention gave to the teacher.</p>
Part C: Note the interactions between teacher-students &	<p>There is a seldom the teacher interactive with students as well as the students never interactive with others each</p>

students-students during teaching and learning physics in the usual classroom.	student sit in his/her position and only listen to the teacher then write each word teacher said.
Part D: Note the content knowledge demonstrated / general competencies of by students (if applicable)	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.
Part E: Closure of the physics lesson Describe the method that the teacher has ended the physics lesson.	Teacher summarizes the physics topic by given some sentences and she asked students students' to write. At the end of lesson she asked student to prepare the next topic name (dispersion of light by prism).
Part F: Writing the observation report	Miss Zanib was completely used lecturemethod. 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 teacherdoesnotlink the topic with daily life. She onlytransferredinformationfrom the book ofphysicsexactly without anychange. 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.

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

Guidelines	Miss Roaa Observation
<p>Part A: Note the learning environment during brainstorming group (physical environment)</p>	<p>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.</p> <div data-bbox="842 645 1150 1279" data-label="Diagram"> <pre> graph TD T([T]) G2[G2 5 st] G1[G1 5 st] G4[G4 5 st] G3[G3 5 st] G6[G6 5 st] G5[G5 5 st] G8[G8 4 st] G7[G7 5 st] Me([Me]) T --- G2 T --- G1 G2 --- G4 G1 --- G3 G4 --- G6 G3 --- G5 G6 --- G8 G5 --- G7 G8 --- Me G7 --- Me </pre> </div> <p>Teacher was moved from group to others to sign leader, secretary, and members. Then she asked students to follow her instructions.</p>
<p>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</p>	<p>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.</p>

the brainstorming technique) during classroom.	
Part C: Note the content knowledge demonstrated / general competencies of by students (if applicable)	<p>Some difficulty encounter students during the activities for example, some student asked teacher for clarified the problem.</p> <p>Student told that the problem is very difficult. Other problem, one girl in group 3 asked teacher to reduce the noise in class.</p>
Part E: Writing the observation report	<p>All groups are given 30 minutes to solve problem (why the pen appears broken when you look at the surface of the water cup).</p> <p>Group1:</p> <p>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.</p> <p>Group 2:</p> <p>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.</p> <p>Group 3:</p> <p>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 secretary collected the papers from each members and all group participated again to discuss about the ideas which have been generated.</p> <p>Group 4:</p> <p>All the 30 minutes the students were very serious during the</p>

	<p>activity especially Mayssam who are the leader oh group 5.</p> <p>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.</p> <p>Group 5:</p> <p>There are interactions between all group members. However, I saw Ali moving his head in different directions and stand and sit several times.</p> <p>Group 6:</p> <p>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.</p> <p>Group 7:</p> <p>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.</p> <p>Group 8:</p> <p>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.</p>
--	--

T: Teacher	ML: Mayssam (Leader of group4)
ZM: Zahraa (Member)	AS:Ahmed (Secretary of griup4)
NM: Nizar (Member)	YM: Yusser (Member)

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- does not occurred, for example, in the dark we cannot see a broken pen in a cup.
- 11 ZM: Wait friend, I think it 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.
- 14 [No talking about 6 minutes]
- 15 ML: Ahmed is you collected the papers from all group members.
- 16 AM: Yes, this is five papers.
- 17 [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.
- 22 [Talking not clear].
- 23 ML: Some ideas illogical and funny.
- 24 AM: Correct.
- 25 [noising, talk not clear]
- 26 YM: lets 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 slope means increased of light refraction.

33 ML: So, this is new idea.

34 ML: Now, we have 13 ideas left.

35 AM: ideas 7, 11, 4, and 9 very weak

36 ML: Others whatdoyouthink.

37 ZM: He is right.

38 [no talking about 20 seconds]

39 YM: 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.

40 ML: Look to the idea 3 very interesting, Refraction occursbecause the optical density difference between the air and water.

41 AM: 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.

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

43 [nosing, sound not clear]

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

45 ZM: I think the ideas 5 is more suitable than idea 3 because optical density is different between air and water.

46 YM: I chose idea number 1.

47 ML: Yusser why

48 [talking not clear]

49 T: 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 physics subject from the members of my groups I do not 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 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 and fun. I see my friend happy and see my teacher smiley.
My group members help me to 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 groups to three, each 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 laughing among themselves.

In the second part of the time, a phase of evaluation where 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 who were working hard.

The teacher saw that group 1 and 8 did not stop discussion until the last moment.

In group 2 Ghassan, Amir and Muhammad and group 5 Ali were less interactive with the group. Nassim 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 refraction successfully, the leader of group placed the cup in front of the eyes of the members to watch them 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 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 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 are 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 am argue 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 an 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 accepted by my group members all my thoughts and my suggestions. All these factors had a major role in helping me to 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 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 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 tedious during physics lessons and I hope that the lesson ends quickly because I was not comfortable. In the new method I waited physics lesson eagerly and I hope during one day 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 these 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 skills 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 a physics lesson.
- MR Thank you Asa 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 idea 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 interpreted 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 ideasandopinionsfreelywithoutcriticism.

Doing physics experimentswith my colleagues.

Audacityto speakand I buildmanysocialrelations 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 ofsomemembers 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

Groups	Name	Role	Gender	Age
Group 1	Asal Khalal	Leader	F	14
	Abraham Ammer	Secretary	M	14
	Amna Sinan	Member	F	14
	Noor Alaa	Member	F	14
	Amer Abbas	Member	M	14
Group2	Ghassan Iyad	Leader	M	14
	Amir Sabah	Secretary	M	14
	Cardana Issam	Member	F	14
	Abdel Aziz Khaled	Member	M	14
	Iaa Ghassan	Member	F	14
Group3	Zafar Muzaffar	Leader	F	14
	Abdel Rahman Khaled	Secretary	M	14
	Hassan Thamer	Member	M	14
	Warda Youssef	Member	F	14
	Mohammad Amin	Member	M	14
Group 4	Mayssam Mohammed	Leader	F	14
	Ahmed Louay	Secretary	M	14
	Zahraa Kais	Member	F	14
	Nizar Ammar	Member	M	14
	Yusser Hisham	Member	F	14
Group 5	Mannar Safaa	Leader	F	14
	Khalil Jassem	Secretary	M	14
	Shaima Hassan	Member	F	14
	Muammil Iyad	Member	M	14
	Isra Abdullah	Member	F	14

Group 6	Reem Munief	Leader	F	14
	Ali Hussein	Secretary	M	14
	Dania Abdullah	Member	F	14
	Mustafa Adel	Member	M	14
	Sarah Ihsan	Member	F	14
Group 7	Sarah Essam	Leader	F	14
	Ahmed Mohamed Hashim	Secretary	M	14
	Rafal Ali	Member	F	14
	Ali Salamat	Member	M	14
	Manar Mohamed	Member	M	14
Group 8	Ahmed Adel	Leader	M	14
	Duha Hani	Secretary	F	14
	Obeida Ahmed	Member	M	14
	Mariam Abdel Maksoud	Member	F	14

F: Female M: Male

APPENDIX J: Tests (Arabic Version)

اختبار التفكير الإبداعي

عزيزي الطالب

هذا الاختبار يشمل ست مهام مختلفة، ولكل مهمة التحقيق 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

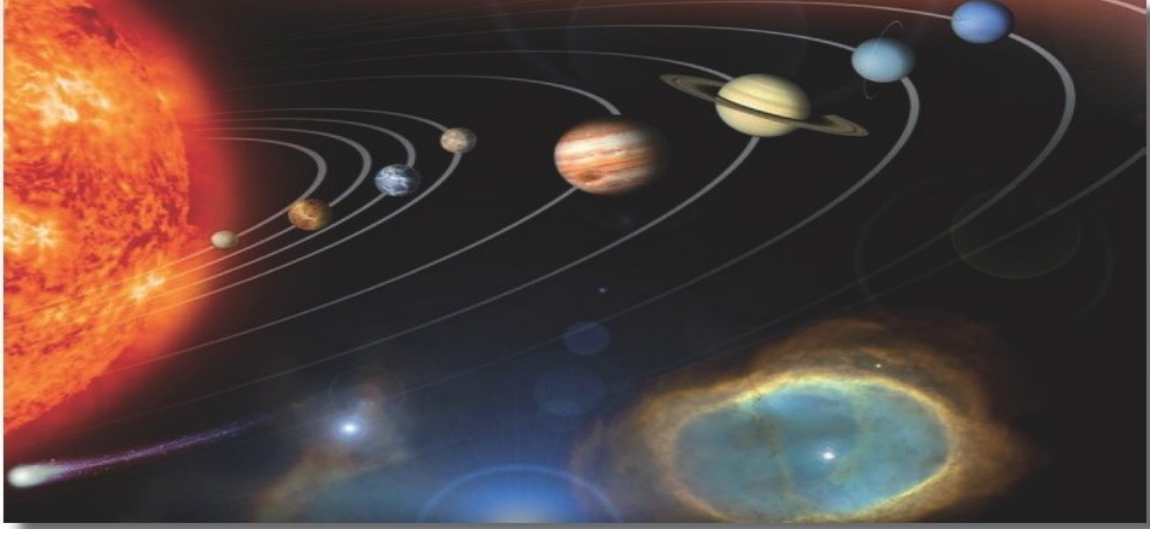
- 1 - الإجابة على جميع الأسئلة.
- 2 - يرجى محاولة استكمال جميع المهام في 45 دقيقة.
- 3 - لا تكتب أي شيء على ورقة الاختبار ويجب أن تكون جميع الإجابات مكتوبة على ورقة الإجابة التي يتم توفيرها.
- 4 - إذا كنت ترغب في تغيير إجابتك، تأكد من أنك قمت بمحو إجابتك الأصلي تماماً.

مع خالص التقدير

الاسم.....
الجنس.....

الاختبار 1: أسأل

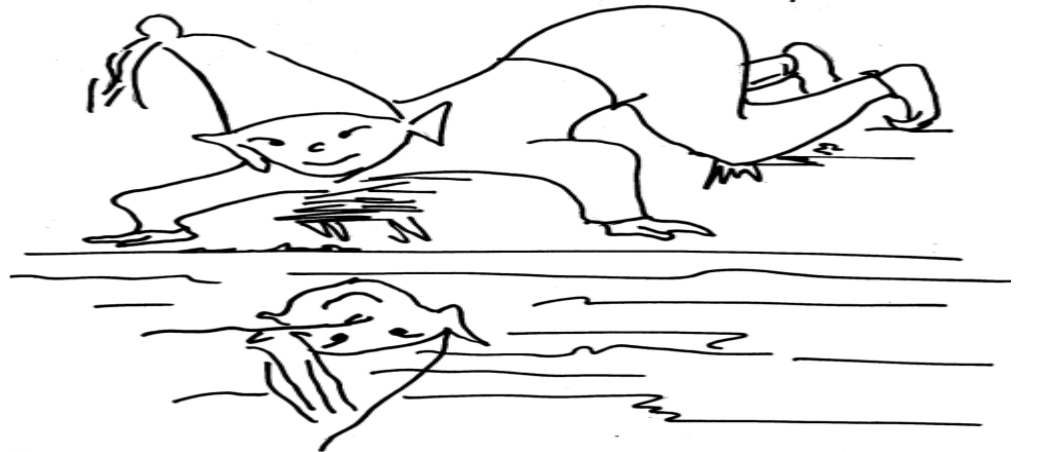
إذا أمكن أن تذهب إلى الكواكب، ما هي الأسئلة العلمية التي تريد أن تبحثها؟ اكتب قائمة الأسئلة الخاصة بك في الفراغات المتاحة. على سبيل المثال، هل هناك أي الكائنات الحية على هذا الكوكب؟



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

الاختبار 2: تخمين الاسباب

أكتب ما تستطيع أن تفكر فيه من أسباب ممكنة للحدث الموجودة في الصورة ، ويمكنك أن تفكر فيما يكون قد وقع قبل الحادث مباشرة أو بوقتٍ طويل وأدى إلى ذلك الحادث. على سبيل المثال، الشخص يرى صورته على الماء بسبب ظاهرة الانعكاس.



- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

الاختبار 3: تخمين النتائج

أكتب ما تستطيع أن تفكر فيه مما يمكن أن يحدث نتيجة للحدث الموجود في الصورة السابقة (2)، ويمكنك أن تفكر فيما يمكن أن يقع بعد الحدث مباشرةً أو بوقتٍ طويل .

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

الاختبار 4: تحسين المنتج

يرجى التفكير في التحسينات الممكنة في الدراجة العادية التي يجعلها أكثر إثارة للاهتمام، وأكثر فائدة وأكثر جمالا. اكتب قائمة إجاباتك في الفراغات المتاحة. (يمكنك الكتابة أو الرسم أو كليهما) . على سبيل المثال، جعل الإطارات عاكسة، بحيث يمكن النظر إليها في الظلام.



- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

- .7
- .8
- .9
- .10

الاختبار 5 : الاستعمالات غير الشائعة

أكتب كل ما تستطيع أن تفكر فيه من الاستعمالات العلمية الغير الشائعة الممكنة (على سبيل المثال، في المختبر) لعلبة من البلاستيك. اكتب قائمة إجاباتك في الفراغات المتاحة. (يمكنك الكتابة أو الرسم أو كليهما) . على سبيل المثال، صناعة أنبوب اختبار.



- .1
- .2
- .3
- .4
- .5
- .6
- .7
- .8
- .9
- .10

الاختبار 6: الافتراضات

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

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

اختبار التفكير الناقد

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 ولأغراض البحث فقط.

تعليمات

- 1 - الإجابة على جميع الأسئلة.
- 2 - يرجى محاولة لاستكمال جميع المهام في 70 دقيقة.
- 3 - قراءة التعليمات الخاصة بكل مجال من مجالات اختبار خمسة كما والمثال التوضيحي لكيفية 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 تمحي إجابتك الأصلي تماما.

مع خالص التقدير

الاسم.....
الجنس.....

الاختبار 1: الاستنتاج

هو القدرة على استخلاص نتيجة من عدة مقدمات أو حقائق أو آراء أو بيانات في المجالات الفيزيائية ، فمثلاً إذا قلنا لتلميذ أن المغناطيس يجذب المواد المصنوعة من الحديد فقط وعرضت عليه بعض المواد مثل الرمل والحصى والخشب ومسامير حديدية ومن ذلك يستطيع التلميذ أن يستنتج أن المسامير الحديدية هي المادة الوحيدة التي ستجذب إلى المغناطيس وغير ذلك من المواد لا يجذب إليه ، أو قد يستنتج شخصاً ما أن إنساناً في المنزل إذا رأى ضوءاً خلف الشباك ، ولكن هذا الاستنتاج قد يكون صحيحاً أو قد لا يكون فمن المحتمل أن أهل المنزل قد تركوه مضاً قبل أن يغادروه. يبدأ كل موقف من مواقف هذا الاختبار بتقديم حقائق صادقة وستجد بعد كل حقيقة استنتاجات قد تكون صحيحة أو خاطئة والمطلوب منك أن تفحص كل استنتاج على حدة وتقرر درجة صحته أو خطئه. اقرأ هذه العبارات جيداً ثم ناقش الاستنتاجات التي تليها وحدد صحة أو خطأ كل استنتاج وتسجله في ورقة الإجابة وكالاتي :

صح	إذا كنت تظن أن الاستنتاج صحيح تماماً أي أنه يترتب منطقياً على الحقائق المقدمة في العبارة.
احتمال صح	إذا كنت تعتقد ان الاستنتاج يكون اكثر احتمالية للصح من الخطأ
بيانات غير كافية	إذا كنت ترى أن البيانات الموجودة غير كافية لمعرفة صحة أو خطأ الاستنتاج.
احتمال خطأ	إذا كنت تعتقد ان الاستنتاج يكون اكثر احتمالية للخطأ من الصح
خطأ	إذا كنت ترى أن الاستنتاج غير صحيح بدون شك ، إما لأنه يسيء تفسير الحقائق أو يناقض هذه الحقائق ، أو يناقض الاستنتاجات الضرورية من هذه الحقائق.

ملاحظة :

قد يكون هناك أكثر من استنتاج (صحيح) وقد يكون هناك أكثر من استنتاج (غير صحيح) وقد تجد أكثر من استنتاج (بياناته غير كافية) المطلوب منك أن تحكم على كل استنتاج بحد ذاته والمثال الآتي يوضح ذلك هناك عدة مقاييس لقياس درجة الحرارة وأبسط هذه المقاييس هي حاسة اللمس فهي تستخدم لتقدير سخونة الأجسام.

1. يتحسس الناس سخونة الجو لمعرفة درجة حرارة الإنسان.
2. حاسة اللمس ضرورية لتحديد (تكميم) درجة حرارة الجسم.
3. تقدر سخونة شخص مصاب بالحمى بواسطة لمسه لغرض إسعافه وتخفيض درجة حرارته.
4. درجة حرارة الجسم يعتمد على درجة حرارة الغلاف الجوي.
5. درجة الحرارة من الأمور الضرورية لوصف الطقس (حالة الجو اليومية) لذا يهتم الفلاحون والطياريون بمسألة التنبؤ بالجو.

خطأ	احتمال خطأ	بيانات غير كافية	احتمال صح	صح
		√		1
			√	2
				√ 3
	√			4
√				5

التمرين

تصميم أواني الطبخ من مواد موصلة للحرارة أو الكهرياء.

1. جميع المواد الموصلة للكهربائية هي موصلة جيد للحرارة.
2. يتم صنع الأقداح الزجاجية بحيث تكون عازلة للحرارة.
3. توضع مادة عازلة للحرارة كـماسكات حمل القهور.
4. يعتمد في صنع المصابيح الكهربائية على الموصلات المعدنية المستخدمة في صنع وتحديد نوع الخويط.
5. تسهيل عملية الطهي.

خطا	احتمال خطأ	بيانات غير كافية	احتمال صح	صح
1				
2				
3				
4				
5				

يُزداد ضغط الجسم الصلب بزيادة وزنه عندما تكون مساحة قاعدة ثابتة لتقليل الضغط نعمل على:

6. وضع خشبية واسعة أسفل رافعة السيارة خاصة عندما يكون الطريق غير معبد.
7. صناع السكاكين وجعل الحافة حادة حتى يقلالضغط على اليد.
8. تصنع المسامير بنهاية مدبب واخرى واسعة لزيادة الضغط أثناء الاستخدام من قبل الفجار.
9. زيادة مساحة قاعدة التزلج على الثلج.
10. صناعة آلات الزراعة بعجلات كبيرة لزيادة السرعة.

خطا	احتمال خطأ	بيانات غير كافية	احتمال صح	صح
6				
7				
8				
9				
10				

تصل حرارة الشمس إلى الأرض وسكانه بواسطة الإشعاع الحراري المنبعث 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. يرتفع المنطاد أو البالون إلى أعالي الجو حين يكون وزنه مع المحتويات التي يحتويها أقل من قوة دفع الهواء ، لذا يعمل قائدوا المناطيد على تقليل الغاز كي يقل حجم الهواء المزاح.
13. تصميم مراوح الطائرة بحيث تكون قوة دفع الهواء لها أكبر من وزنها.
14. تصنع القوارب بحيث تكون مجوفة ومساحتها السطحية كبيرة.
15. تغطية النباتات بالبيوت الزجاجية.

خطا	احتمال خطأ	بيانات غير كافية	احتمال صح	صح
11				
12				
13				
14				
15				

الاختبار 2 : معرفة الافتراضات أو المسلمات

الافتراض أو المسلمة فكرة نثق بصحتها ونسلم بها كأساس في مناقشة أو حل مشكلة معينة ، فعندما يقرر طالب في كلية التربية بأنه سيتخرج بعد سنتين فإنه يفترض أو يسلم بأن يبقى سنتين في الكلية ، وأن ينجح في المواد الدراسية وما شابه ذلك ، إن هذه الافتراضات تكون مقبولة في ضوء عبارة الطالب أعلاه.

وفيما يلي عدد من العبارات ويتبع كل عبارة عدة افتراضات مقترحة ، والمطلوب منك أن تقرر فيما إذا كان الافتراض مسلماً به في ضوء محتوى العبارة. وإذا كنت ترى أن الافتراض (وارد) في ضوء ما جاء بالعبارة فضع علامة (✓) في المكان المناسب من ورقة الإجابة تحت كلمة (وارد). وإذا كنت تظن أن الافتراض غير مسلم به بالضرورة في العبارة فضع علامة (✓) في المكان المناسب من ورقة الإجابة أي تحت عبارة (غير وارد).

وفيما يلي مثال يوضح طريقة وضع علامة (✓) أمام الافتراضات وفي الأماكن المناسبة من ورقة الإجابة ويلاحظ أن في بعض الحالات يكون هناك أكثر من افتراض وارد بالضرورة وفي حالات أخرى لا يكون أي من الافتراضات وارداً.

أخذ طالب كمية من التربة من حديقة المدرسة ووزنها وثم وضعها جانباً في الشمس لمدة أسبوع. ثم طلب المعلم من الطالب أن يزن نفس الكمية من التراب مرة أخرى، فوجدت أن وزن التربة قل.

1. لأن التبخر أدى إلى اختفاء الرطوبة التي كانت موجودة في تربة الحديقة.

2. لأن الرياح أدت إلى طيران جزيئات التربة.

3. لأن الطلاب الآخرين لعبوا بالتربة.

	غير وارد	وارد
1	✓	
2		✓
3	✓	

التمرين

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

الافتراضات المقترحة

16. اكتشاف مصدر جديد من الطاقة لا يمنع نقص مصادر الطاقة.

17. مصادر الطاقة الجديدة قليلة.

18. بعد اكتشاف مصدر جديد للطاقة، فإن الطلب على الطاقة لا يسد الحاجة.

	غير وارد	وارد
16		
17		
18		

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

الافتراض المقترحة

19. إذا جميع البلدان عملت معاً في هذه المجالات، احتمال النزاع المسلح سيقول.

20. الاختلافات العرقية السياسية بين البشر لا يمنعهم من العمل معاً على الشؤون الإنسانية.

21. التعاون الدولي في مجال العلوم والتعليم يؤدي إلى تقليل المجتمعات المستقلة.

	غير وارد	وارد
19		
20		
21		

يتم دراسة كفاءة السيارات. الاختبار هو هل أن البنزين المضاف سيزيد من كفاءة السيارة. أخذت خمس سيارات متماثلة كل واحدة حصل علي نفس الكمية من البنزين وينطلقون ب نفس المسار حتى نفاد البنزين . فريق البحث سجل عدد الأميال لكل سيارة . كيف يتم قياس كفاءة السيارات في هذه الدراسة؟

الافتراض المقترحة

22. يحسب الزمن لكل سيارة نفذ منها البنزين.

23. تحسب المسافة لكل سيارة.

24. نقيس كمية البنزين المستخدمة.

25. نقيس كمية البنزين كميّة المضافة.

	غير وارد	وارد
22		
23		
24		
25		

احمد يتساءل إذا كان يتم تسخين الأرض والبحر بنفس الوقت عن طريق أشعة الشمس . فقرر إجراء تجربة . فملأ قديم من التربة وقدم آخر من نفس الحجم بالماء ووضعهما في مكان بحيث كليهما يستلم نفس الكمية من أشعة الشمس . وقد تم قياس درجة الحرارة من الساعة 8:00 صباحاً حتى 6:00 مساءً .
الافتراض المقترحة

26. كلما زادت كمية ضوء الشمس، التربة والمياه تصبح أكثر سخونة.
27. كلما زاد زمن بقاء التربة والماء تحت الشمس زادت سخونتهما.
28. تختلف المواد عن بعضها في قابليتها على التأثر بأشعة الشمس .
29. التربة والماء لتفكيكيات مختلفة من أشعة الشمس في أوقات مختلفة من اليوم.

	غير وارد	وارد
26		
27		
28		
29		

الاختبار 3: الاستنباط

وفي هذه العملية يستنبط الطالب معلومات جديدة من معلومات معروفة أو معروضة له ، ويتكون كل تمرين من التمرينات الآتية في هذا الاختبار من عبارتين (مقدمتين) يليهما عدة نتائج مقترحة ، وعليك أن تعتبر العبارتين صحيحتين تماماً وصادقتين بدون استثناء حتى ولو كانت إحداهما أو كلاهما ضد رأيك ، اقرأ النتيجة الأولى التي تلي العبارتين وإذا كنت تعتقد أنها تترتب بالضرورة على العبارتين فضع علامة (✓) في المكان المناسب من ورقة الإجابة أي تحت (النتيجة مترتبة) ، وإذا كنت تعتقد أنه ليس من الضروري أن تكون النتيجة مترتبة على العبارتين فضع علامة (✓) في المكان المناسب من ورقة الإجابة تحت (النتيجة غير مترتبة). اقرأ كل نتيجة واحكم عليها في حد ذاتها ولا تدع تحيزاتك تؤثر على حكمك ، أي ركز على العبارات واحكم على كل نتيجة على أساس أنها إذا كانت تترتب على المقدمتين . وفيما يأتي مثال يوضح هذه العملية.

التمرين

جميع المواد المعدنية الموصلة للحرارة تكون موصلة للكهرباء

1. جميع المواد الموصلة للحرارة هي مادة معدنية.

2. كل شيء موصل للحرارة موصل بالكهرباء.

3. هناك مواد موصلة للكهرباء والحرارة موصل

	غير مترتبة	مترتبة
1		✓
2	✓	
3		✓

تنجذب كافة الأجسام إلى الأرض في نفس السرعة . الكتاب والورقة هي أجسام .

30. الكتاب والورقة يسقطان في سرعات مختلفة، الورقة تستصل إلى الأرض قبل الكتاب.

31. الكتاب والورقة يسقطان في سرعات متساوية، الورقة تستصل إلى الأرض قبل الكتاب.

32. الكتاب والورقة يسقطان في سرعات متساوية وبالتالي كلاهما يصلان في نفس الوقت.

	غير مترتبة	مترتبة
30		
31		
32		

الفلزات هي موصلات جيدة للكهرباء، واللافلزات غير موصلة جيدة للكهرباء وبالتالي:

33. الحديد من الفلزات لذلك فهو موصل جيد للكهرباء.

34. الكبريت من اللافلزات لذلك فهو غير موصل جيد للتوصيل للكهرباء.

35. جميع المواد في الطبيعة جيدة التوصيل للكهربائية هي من الفلزات.

غير مترتبة	مترتبة
33	
34	
35	

ماء الحنفية يغلي بدرجة 100°C عند مستوى سطح البحر. الماء الموجود في وعاء عند مستوى سطح البحر.

36. إذا كانت درجة الحرارة تصل إلى 100°C فإن الماء في الوعاء يغلي.

37. إذا كانت درجة الحرارة تصل إلى 0°C فإن الماء في الوعاء يغلي.

38. إذا كانت درجة الحرارة تصل إلى 110°C فإن الماء في الوعاء يغلي.

غير مترتبة	مترتبة
36	
37	
38	

في واحدة من قرى العراق هناك 52 صف في خمس مدارس ثانوية. كل صف يحتوي على 10 تلميذاً. لذلك:-

39. هناك ما لا يقل عن صفين في القرية بالضبط تحتوي على نفس عدد التلاميذ.

40. صفوف المدارس الثانوية في معظم القرية تحتوي على 15 تلميذاً.

41. هناك على الأقل 550 التلاميذ في هذه المدارس الثانوية.

غير مترتبة	مترتبة
39	
40	
41	

هناك مواد في الطبيعة تتمدد في الحرارة ، وبعض من هذه المواد تتقلص بانخفاض درجة الحرارة.

42. المواد الصلبة تتمدد بالحرارة وتقلص بانخفاضها.

43. جميع المواد السائلة تخضع لقاعدة التمدد الحراري.

44. الغازات تخضع لقاعدة التمدد الحراري ، أي تتمدد بشكل كبير بحيث يكون تمددها الحقيقي معادلاً لتمددتها الظاهري.

غير مترتبة	مترتبة
42	
43	
44	

الاختبار 4: التفسير

المقصود بالتفسير هو القدرة على وزن الأدلة والتمييز بين الاعتقادات المسوغة وغير المسوغة ويعني أيضاً الدقة في فحص ما يرد من فقرات لكل موقف والتي تعد تفسيرات مقترحة. كل موقف يتكون من فقرة واحدة تتبعها عدة تفسيرات مقترحة لهذه الفقرة. ولتحقيق الهدف من الاختبار افترض أن كل ما هو وارد في الفقرة صحيح ، وكل ما هو مطلوب منك أن تحكم على كل تفسير مقترح فيما إذا كان يترتب على المعلومات الواردة في الفقرة أو لا يترتب. فإذا كنت تظن أن التفسير المقترح على البيانات الواردة في الفقرة بدرجة معقولة من اليقين ، فضع علامة (✓) في الحقل الذي عنوانه (تفسير صحيح) ، وإذا كنت تظن أن التفسير المقترح لا يترتب على البيانات الواردة في الفقرة فضع علامة (✓) في الحق الذي عنوانه (التفسير غير صحيح).

تذكر أن تعد أن الوقائع والبيانات الواردة في كل فقرة صحيحة وصادقة ، وأنه يترتب على المعلومات الواردة أكثر من تفسير صحيح ، وفي حالات أخرى قد تكون جميع التفسيرات المقترحة صحيحة وفي حالات أخرى قد تكون جميع التفسيرات المقترحة غير صحيحة. وفيما يأتي مثال يوضح ذلك :

يتعرض 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 نسبة سرطان الجلد.

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

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

3. ليس كل البشر يتعرضون إلى الأشعة فوق البنفسجية فهناك من لا يتأثر جسمه بهذا النوع من الأشعة.

غير مترتبة	مترتبة	
	√	1
√		2
	√	3

التمرين

في أيام الشتاء البارد نلاحظ بخار كثيف يخرج من فم الممتكلم ، بينما لا يلاحظ في أيام الصيف الحارة؟

45. حصول ظاهرة التكثيف بسبب حركة الهواء الرطب الدافئ إلى الهواء البارد.

46. تحول بخار الماء من الحالة الغازية.

47. بسبب الشوائب الموجودة في الغلاف الجوي.

غير مترتبة	مترتبة	
		45
		46
		47

احمد طابذك في الفيزياء ، وحصل على درجة عالية في الفيزياء . لذلك

48. جميع الطلاب حصلوا على درجات عالية في الفيزياء.

49. احمد متفوق في جميع المواد.

50. أحمد محبوب من قبل كل زملائه.

غير مترتبة	مترتبة	
		48
		49
		50

تستمر ريشة المروحة في الدوران لفترة معينة بعد انقطاع التيار الكهربائي عنها وإذا حاول شخص إيقاف الريشة بيده فإنه يجد صعوبة ، وقد يؤدي في ذلك أصابعه.

51. تستمر ريشة المروحة في الدوران بفعل تأثير الاستمرارية وتتوقف بفعل مقاومة الهواء.

52. إن الصعوبة التي يواجهها شخص ما في إيقاف المروحة هو بسبب الاستمرارية.

53. إن محرك المروحة يتوقف تماماً بعد انقطاع التيار الكهربائي بحيث لا يستطيع تسارع المروحة.

غير مترتبة	مترتبة	
		51
		52
		53

تستخدم خمسة خراطيم مياه مختلفة على ضخ الديزل من خزان ، وهي تستخدم المضخة نفسها لكلاً من الجدول التاليين نتيجة التحقيق الذي تم القيام به على كمية وقود الديزل التي يتم ضخها من كل أنبوب.

(mm) حجم الخرطوم	(liters) كمية الديزل في الدقيقة
8	1
13	2

20	14
26	7
31	12

الجدول يبين كمية وقود الديزل التي تضاف في الدقيقة الواحدة، التفسيرات التالية تصف تأثير حجم الخرطوم على ضخ كمية وقود الديزل في الدقيقة الواحدة.

54. قطر الخرطوم الأكبر يضاف كمية من الديزل.
55. تزداد كمية ضخ الديزل كلما زاد الوقت .
56. كلما صغر قطر الخرطوم تزداد سرعة ضخ الديزل.
57. قطر الخرطوم يؤثر على كمية ضخ الديزل.

	مرتبة	غير مرتبة
54		
55		
56		
57		

الاختبار 5: تقويم الحجج

عند مشاركتك في مناقشات حول قضايا مثيرة للجدل والخلاف يفترض بك أن تكون قادراً على التمييز بين الحجج القوية والحجج الضعيفة المتصلة بالقضية موضوع النقاش ، والحكم على قوة الحجة أو ضعفها يبنى على أساسين : الأول هو اتصال الحجة اتصالاً مباشراً بالسؤال المطروح. والثاني وزن الحجة وأهميتها ، فالحجج القوية تكون مهمة ومتصلة بالسؤال أما الحجج الضعيفة فتكون غير متصلة بصورة مباشرة بالسؤال حتى وإن كانت لها أهمية ضعيفة وتتصل بجوانب ثانوية من السؤال. في هذا الاختبار يجد سلسلة من الأسئلة تلي كل منها ثلاث حجج ، وعليك أن تحدد فيما إذا كانت الحجة قوية أو ضعيفة ، وطريقة الإجابة تتم بوضع علامة (√) في المكان الذي يقع تحت كلمة (قوية) إذ اعتبرتها كذلك ، وتضع علامة (√) في المكان الذي يقع تحت كلمة (ضعيفة) إذ وجدتتها كذلك. وتدون الإجابات على ورقة الإجابة وأمام رقم كل حجة ، وقد تكون جميع الحجج في بعض الأسئلة قوية أو تكون جميعها ضعيفة أو تجد واحدة ضعيفة وأخرى قوية وهكذا ... وفيما يأتي مثال يبين كيفية الإجابة

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 إذن المستمع ولا يصل الضوء إلى إذن المستمع.
3. سرعة الضوء أكبر / لأنه يمكن أن نرى ضوء البرق قبل أن نسمع صوت الرعد.

	قوية	ضعيفة
1	√	
2		√
3	√	

التمرين

حافلة احمد تعمل على الديزل. هذه الحافلات تسهم في التلوث البيئي. صديق احمد يستخدم حافلات الترولي وهي تعمل بواسطة محرك كهربائي. يتم توفير الطاقة لمثل هذا المحرك الكهربائي عن طريق خطوط هوائية (يتم توفير الكهرباء من قبل محطة توليد الكهرباء باستخدام الفحم). هل حافلات الترولي تساهم في التلوث البيئي؟

58. نعم، لأن العربات تجهز بالكهرباء.
59. لا، لأن محطة الكهرباء بتسبب تلوث الهواء أيضاً.
60. نعم، لأن الحافلات لا تلوث المدينة، ولكن محطة توليد الكهرباء تلوث البيئة.

	قوية	ضعيفة
58		
59		
60		

هل تظن أن تياراً كهربائياً مقداره (واحد أمبير) أو أكثر يسبب حروقاً خطيرة إذا مر خلال أنسجة الجسم ؟

58. إن تياراً أقل من هذا المقدار يسبب أضراراً أكثر من الحروق.

59. إن تياراً أكثر من هذا المقدار يؤدي إلى الوفاة فوراً.
60. إن مرور تيار كهربائي حتى ولو بقيمة أقل من هذه القيمة بعشرات المرات سيؤدي إلى حروق خطيرة في أنسجة الجسم.

	ضعيفة	قوية
58		
59		
60		

- هل أن بخار الماء أشد سخونة من الماء الساخن أم العكس؟
64. الماء الساخن أكثر سخونة من بخار الماء/لأن بخار الماء يفقد كمية كبيرة من الحرارة أثناء تكثيفه وتحوله إلى سائل.
65. بخار الماء أشد سخونة من الماء المغلي/لأنه عند رش بخار الماء على جسم أقل سخونة يسبب حرقاً أشد من الماء الساخن.
66. الماء الساخن أكثر سخونة من بخار الماء/لأن درجة حرارة بخار الماء دائماً تكون أقل من درجة حرارة الماء الساخن.
67. بخار الماء أكثر سخونة من الماء المغلي/لأن الطاقة الداخلية المخزنة في بخار الماء أكبر من الطاقة المخزنة في الماء المغلي.

	ضعيفة	قوية
64		
65		
66		
67		

- هل تعمل على فتح الشبابيك أولاً عند تسرب غاز الوقود في المطبخ ؟
68. نعم / وذلك للتقليل من سرعة انتشاره داخل المطبخ والسماح له بالخروج من خلال الشبابيك.
69. كلا / لأنه من المفروض غلق الصمام قبل البدء بفتح الشبابيك حتى لا نسمح بتسرب كمية أكبر مما هو موجود في المطبخ.
70. نعم / لأن الغاز يشغل حجماً أكبر من حجم المطبخ

	ضعيفة	قوية
68		
69		
70		

اختبار التحصيل

عزيزي الطالب

هذا اختبار تحصيلي في الفيزياء يتكون من (30) فقرة، كل فقرة تحتوي على عبارة رئيسية وأربعة بدائل (أ، ب، ج، د) بديل واحد فقط هو الصحيح والبدائل المتبقية على خطأ يرجى اتباع التعليمات التالية:

1- الإجابة على جميع الأسئلة.

2- اقرأ كل سؤال بعناية وبهدوء ويرجى المحاولة لاستكمال جميع الأسئلة في 45 دقيقة.

3- لا تكتب أي شيء على ورقة الاختبار، ووضع دائرة حول الحرف الذي يمثل الإجابة الصحيحة. كما في المثال التالي:

وسيتعامل جميع المعلومات بتسرية تامة ولأغراض البحث فقط.

هي مقياس لمعدل الحركة

أ) الحركة (ب) التعجيل

ج) الانطلاق (د) السرعة



4- إذا كنت ترغب في تغيير إجابتك، تأكد من أنك قمت بحذف إجابتك السابقة تماماً.

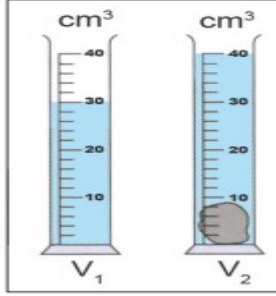
مع خالص التقدير

الاسم.....

الجنس.....

1 - ماهي المرآة التي لها مدى واسع للرؤية؟
 (أ) المحدبة (ب) المقعرة (ج) المستوية (د) الكروية

2 - صب ماء في اسطوانة مدرجة حتى (30cm³)، ثم وضع حجر، لاحظ ارتفاع الماء إلى (40cm³) ماهو حجم الحجر؟

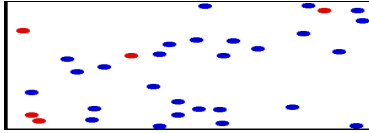


(أ) 40 cm³ (ب) 10 cm³ (ج) 30 cm³ (د) 20

3 - مانوع الضوء الصادر من المصباح الكهربائي
 (أ) معتمدة (ب) مضيئة (ج) مستضاءة (د) شفافة



4 - حركة الجزيئات في هذه الصورة تمثل حالة المادة في حالة:



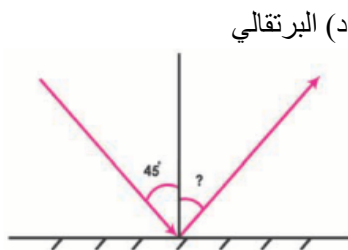
(أ) الصلبة (ب) السائلة (ج) الغازية (د) البلازما

5 - المنطقة المظلمة وراء الأشياء في الشكل أدناه تسمى:



(أ) الظل (ب) انعكاس الضوء (ج) انكسار الضوء (د) المرايا

6 - أي لون من ألوان الطيف لديها أقصر طول موجي؟
 (أ) الأحمر (ب) الأزرق (ج) البنفسجي (د) البرتقالي



7 - ماهي قيمة زاوية الانعكاس في الشكل المجاور؟
 (أ) 90° (ب) 60° (ج) 30° (د) 45°

8 - الأسماك داخل المياه تبدو للصيد وكأنها:
 (أ) أقرب إلى البعد الحقيقي (ب) في البعد الحقيقي (ج) أصغر منحجمها الحقيقي (د) أبعد إلى البعد الحقيقي

9 - ما هي العلاقة بين سرعة الضوء وكثافة الوسط الناقل
 (أ) خطية (ب) نسبية (ج) عددية (د) غير خطية

10 - ما الوقت من اليوم يظهر الظل أقصر؟
 (أ) الصباح (ب) بعد الظهر (ج) المساء (د) غروب الشمس

11 - البعد البؤري للعدسة المحدبة هو $D+50$ فان القدرة هي:
 (أ) 20 cm (ب) 40 cm (ج) 60 cm (د) 30 cm

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



13 - تسخين الهواء داخل البالون يؤدي إلى:
 (أ) توسع و تقليل الكثافة (ب) توسع، أكبر كثافة عالية منفي الهواء (ج) من زيادة الضغط العالي في الهواء (د) زيادة الضغط، وكثافة أكبر من ارتفاع في الهواء.

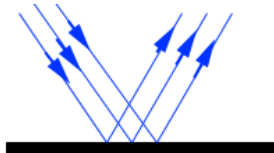
14 - أي نوع من العدسة مناسبة لشخص يشكو من طول النظر؟

(أ) مقعرة (ب) محدبة (ج) مفرقة (د) متباينة

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) بؤرة العدسة (د) بين حافة

العدسة ومركز العدسة

17 - ما نوع انعكاس السطح الموضح في الشكل ؟

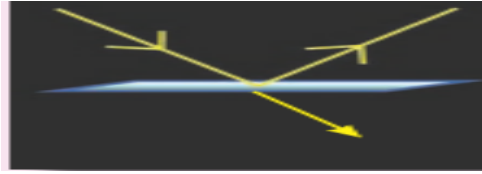
- أ) عادي ب) غير النظامية ج) الموازي د) متعامد

18- تسمحركة الفتاة فيالشكلأدناه.



- أ) دائرية ب) تناوب ج) دورية د) الخطي

19- الزجاج فيالشكلأدناهمن الأجسام:



- أ) شفاف ب) شبه شفافة ج) معتم د) كل الاحتمالات السابقة

20- هيقطعة من الزجاج تحتوي علىسطح مستوومصقوليعكسمعظمالأشعة

- أ) المرآة ب) العدسات

- ج) المنشور د) تلسكوب

21- أي منالقياساتالتاليةهي أقصر؟

- أ) 0.2 كم ب) 200 سم ج) 20 مم د) 0.001 م

22- تستخدمالنظارات الطبية ذات العدساتالمقعرةلعلاج:

- أ) طول النظر ب) قصر النظر ج) العملااستجماتيزم د) العشو الليلي

23- السرعة من الكميات

- أ) المتجه ب) ثابتة ج) القياسية د) القياسية والمتجه

24- انظر إلى الصورة أدناه، الصورة التي تشكلت في المرايا 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 من المرأة
د) حقيقية، مستقيمة، وأكبر من حجم الفتاة

25- موجات أشعة جاما هي:

- أ) طولية ميكانيكية
ب) ميكانيكية عرضية
ج) كهرومغناطيسية (كهروضوئية)
د) سرعة انتقال الضوء هي؟

26- سرعة انتقال الضوء هي؟
أ) 300 كم/س ب) 3000 كم/س ج) $300,000 \text{ كم/س}$ د) $300,000 \text{ كم/س}$

27- لماذا يظهر قوس قزح أثناء وبعد نزول المطر؟



- أ) نظرا لانكسار الضوء في قطرات المطر.
ب) سرعة الضوء في الهواء أكبر من في الماء.
ج) نظرا لاستقطاب الضوء.
د) نظرا لانعكاس الضوء في اتجاهات مختلفة

28- قوة عدسة التكبير هي؟

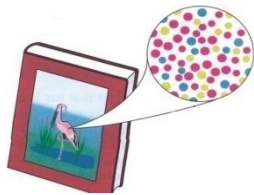
أ) طول الصورة أطول من الجسم ب) البعد البؤري ج) 50 سم د) المركز البصري

29- الموجات الصوتية التي تستخدم لتشخيص الأمراض هي؟



- أ) موجات الصوت
ب) الموجات فوق الصوتية
ج) موجات تحت الصوت
د) الموجات الكهرومغناطيسية

30- ألوان الحبر المستخدمة في تلوين الكتب ناتجة عن خلط ثلاثة أصباغ أساسية:



- أ) الأخضر والأزرق والأحمر
ب) الأحمر والأخضر والأبيض
ج) الأصفر والأزرق والأحمر
د) الأصفر والأرجواني والفيروز

استبيان لتصورات الطلاب في التعلم باستخدام تقنية العصف الذهني

عزيزي الطالب

الهدف من هذا الاستبيان هو لمعرفة تصورات الطلاب في التعلم عن طريق تقنية العصف الذهني .يتكون هذا

الاستبيان من ثلاثة أجزاء:

الجزء أ: الأسئلة المتعلقة لنتائج التعلم.

الجزء ب: الأسئلة التي تعكس ميزات تقنية العصف الذهني.

جزء ج: أسئلة مفتوحة حول أسلوب العصف 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 تشعر حول المعارف والمهارات التي

اكتسبتها عندما تتعلم عن طريق العصف الذهني:

1- لا أوافق بشدة

2- لا أوافق

3- عادي

4- اوافق

5- أوافق بشدة

تطبيق المعرفة والمهارات						
1	كنت قادرا على التفكير بنطاقا أوسع وأكثر من وجهات نظر متعددة(في محتوياتالفيزياء)	1	2	3	4	5
2	كنت قادرا علوضعحل لمشكلة الفيزياء	1	2	3	4	5
3	كنت قادرا علىتحليلالمشكلة.	1	2	3	4	5
4	كنت قادرا علىتوليدالأفكار الإبداعية.	1	2	3	4	5
5	كنت قادرا علىالتفكير بشكل نقدي.	1	2	3	4	5
6	كنت قادرا علىبناءصلة جديدةبينحقائقمختلفة.	1	2	3	4	5
7	كنت قادرا علىتقييمالأفكار والحقائق.	1	2	3	4	5
8	كنت قادرا علىالاحتفاظبما كنت قدتعلمتأكثر.	1	2	3	4	5
9	كنت قادرا علىتحديد القضايا البالغة الأهميةفيالفيزياءالمشاكل.	1	2	3	4	5
10	كنت قادرا علىتطبيقما تعلمته.	1	2	3	4	5
11	تحسينفهميالمحتوياتالفيزياء.	1	2	3	4	5
12	تحسين الذاكرة منمحتوىمادة الفيزياء.	1	2	3	4	5
13	كنتقادرا على التعرف علىالصلةما تعلمت أنحياتباليومية.	1	2	3	4	5

14	كنت قادرا على تطبيق المهارات التي اكتسبتها من استخدام تقنية العصف الذهني.	1	2	3	4	5
15	كنت قادرا على المسند من الأفكار الجديدة في أجواء مريحة ومرحة	1	2	3	4	5
التواصل						
16	كان لي فرصة المشاركة في أنشطة التعلم الصفية المتنوعة.	1	2	3	4	5
17	كان لي فرصة المشاركة في أنشطة التعلم الإبداعي.	1	2	3	4	5
18	كنت قادرا على تبادل الأفكار مع زملائي.	1	2	3	4	5
19	كنت قادرا على مناقشة مع زميل لي.	1	2	3	4	5
20	كنت قادرا على التعبير عن العديد من الأفكار دون تعرضها لانتقادات.	1	2	3	4	5
21	كنت قادرا على احترام وتقدير آراء وأفكار الآخرين، حتى ظننت أنني لم أتفق تماما معهم.	1	2	3	4	5
22	لقد أتيت لي الفرصة للاستماع إلى وجهات النظر وجهات نظر زملائي وبعقل مفتوح حول وجهات نظرهم.	1	2	3	4	5
23	لقد أتيت لي الفرصة للعب دورا هاما باعتبارها واحدة من المورد الرئيسي مساهم أثناء جلسة العصف الذهني.	1	2	3	4	5
24	كنت قادرا على الاستفادة من أفكار الآخرين، من خلال تطوير وبناء على ذلك	1	2	3	4	5
التعلم الذاتي						
25	كنت قادرا على القيام بالمزيد من التجارب على محتوى الفيزياء	1	2	3	4	5
26	كنت قادرا على اختيار وتطبيق استراتيجية بلدي كما هو الحال عندما تعلم.	1	2	3	4	5
27	كنت قادرا على حل المشاكل إثارة للاهتمام وذات الصلة الفيزياء.	1	2	3	4	5
29	كنت قادرا على تعلم المعارف الجديدة خلال حل المشاكل.	1	2	3	4	5
30	كنت قادرا على العمل بشكل مستقل.	1	2	3	4	5

الجزء ب: انعكاس الطلاب على تقنية العصف الذهني.

تعليمات

يرجى وضع دائرة حول الرقم 1، 2، 3، 4 أو 5 الذي يصف أفضل ما هو انعكاس الخاصة بك على تقنية العصف الذهني.

1- لا أوافق بشدة

2- لا أوافق

3- عادي

4- أوافق

5- أوافق بشدة

تطبيق المعرفة والمهارات						
1	العصف الذهني هو واحد من الأساليب الفعالة التي تركز على الطلبة.	1	2	3	4	5
2	كانت أنشطة التعلم في مجموعة العصف الذهني ممتعة.	1	2	3	4	5
3	زاد اهتمامي بتعلم الفيزياء نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
4	أنا أعزز تأكث نشاطات الفيزياء التعلم.	1	2	3	4	5
5	تعززت تقنيتي نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
6	تصوراتي عن الفيزياء هي أكثر ارتباطا بالحياة اليومية نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
7	زيادة حافزي لتعلم الفيزياء نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
8	أشعر فهمي للموضوعات الفيزيائية تحسنت نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
9	قدرتي على التلخيص والتعبير وبتدريسي وضعنت نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5
10	قدرتي على فهم العلاقات بين الأشياء ووضعنت نتيجة لاستخدام هذه التقنية في عملية التعلم.	1	2	3	4	5

الجزء ج: يرجى الإجابة على الاسئلة أدناه.

السؤال 1:

هل تعتقد أن العصف الذهني هو أسلوب مناسب لتعلم الفيزياء؟ شرح لماذا أو لماذا لا.

السؤال 2:

ما هي نتائج التعلم التي شعرت حصلت عليها نتيجة لاستخدام تقنية العصف الذهني؟

السؤال 3:

ما هي الخصائص الرئيسية لتقنية العصف الذهني؟

السؤال 4:

ما هي فعالية تقنية العصف الذهني على قدراتك التفكير؟

السؤال 5:

ماذا وجدت مفيد للغاية حول التعلم باستخدام تقنية العصف الذهني؟

السؤال 6:

ماذا وجدت الأقل فائدة حول التعلم باستخدام تقنية العصف الذهني؟ 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								
The statements	Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	SD
1 I was able to think broader and more from multip perspectives (over the physics content).	Frequencies	2	2	2	29	4	3.79	0.89
	Percent	5.12	5.12	5.12	74.35	10.25		
2 I was able to develop the solution for physics roblem.	Frequencies	1	3	5	24	6	3.79	0.89
	Percent	2.56	7.69	12.82	61.53	15.40		
3 I was able to analyze physics problem.	Frequencies	3	4	6	18	8	3.62	1.16
	Percent	7.7	10.3	15.4	46.2	20.5		
4 I was able to generate creative ideas.	Frequencies	5	6	9	14	5	3.21	1.23

The statements		Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
		Percent	12.8	15.4	23.1	35.9	12.8		
5	I was able to think critically.	Frequencies	8	9	7	11	4	2.85	1.32
		Percent	20.5	23.1	17.9	28.2	10.3		
6	I was able to built new link between different facts.	Frequencies	3	4	8	15	9	3.59	1.18
		Percent	7.7	10.3	20.5	38.5	23.1		
7	I was able to evaluate ideas and finding.	Frequencies	4	8	12	10	5	3.10	1.18
		Percent	10.3	20.5	30.8	25.6	12.8		
8	I was able to retain what I had learned more.	Frequencies	2	1	7	19	10	3.87	1.00
		Percent	5.1	2.6	17.9	48.7	25.6		

	The statements	Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
9	I was able to identify critical issues in physics problems.	Frequencies	3	5	8	13	10	3.56	1.23
		Percent	7.7	12.8	20.5	33.3	25.6		
10	I was able to apply what I have learned.	Frequencies	3	5	9	16	6	3.44	1.14
		Percent	7.7	12.8	23.1	41.0	15.4		
11	My understanding of the physics content improved.	Frequencies	1	2	6	20	10	3.92	0.92
		Percent	2.6	5.1	15.4	51.3	25.6		
12	Better memory of the physics subject content.	Frequencies	1	3	7	23	5	3.72	0.88
		Percent	2.6	7.7	7.9	59.0	12.8		

The statements		Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
13	I was able to recognize the related of what I learned to my own daily life.	Frequencies	3	4	10	18	4	3.41	1.06
		Percent	7.7	10.3	25.6	46.2	10.3		
14	I was able to apply my synthesis skills more deeply when using brainstorming technique.	Frequencies	2	4	12	14	7	3.51	1.07
		Percent	5.1	10.3	30.3	35.9	17.9		
15	I was able to predicate of new ideas in a relaxed and playful atmosphere.	Frequencies	1	3	4	23	8	3.87	0.92
		Percent	2.6	7.7	10.3	59.0	20.5		
Communication									
16	I had opportunity to participate in diversified classroom learning activities.	Frequencies	2	2	6	26	3	3.67	0.89
		Percent	5.1	5.1	15.4	66.7	7.7		

The statements		Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
17	I had opportunity to participate in novel learning activities.	Frequencies	4	5	11	13	6	3.31	1.19
		Percent	10.3	12.8	28.2	33.3	15.4		
18	I was able to exchange ideas with my classmates.	Frequencies	2	3	6	22	6	3.85	1.08
		Percent	5.1	7.7	12.8	46.2	28.2		
19	I was able to discuss with my classmate.	Frequencies	1	4	6	22	6	3.72	0.94
		Percent	2.6	10.3	15.4	56.4	15.4		
20	I was able to express many ideas without being criticized.	Frequencies	1	2	10	20	6	3.72	0.88
		Percent	2.6	5.1	25.6	51.3	15.4		

	The statements	Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
21	I was able to respect and appreciation of views and ideas of others, even though I did not fully agree with them.	Frequencies	1	1	9	18	10	3.90	0.91
		Percent	2.6	2.6	23.1	46.1	25.6		
22	I had the opportunity to listen to perspectives and points of view of my classmates and keep an open mind about their views.	Frequencies	3	4	10	13	9	3.54	1.18
		Percent	7.7	10.3	25.6	33.3	23.1		
23	I had the opportunity to play an important role as one of the main resource contributor during brainstorming session.	Frequencies	2	3	7	23	4	3.62	0.96
		Percent	5.1	7.7	17.9	59.0	10.3		
24	I was able to benefit from the ideas of others, through the development and build on it	Frequencies	-	2	6	20	11	4.05	0.79
		Percent		5.1	12.8	53.8	28.2		

Independent Learning

	The statements	Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
25	I was able to do experiments on physics content	Frequencies	2	4	6	24	3	3.56	0.96
		Percent	5.1	10.3	15.4	61.5	7.7		
26	I was able to choose and apply my own strategy as when learning.	Frequencies	3	6	10	13	7	3.38	1.18
		Percent	7.7	15.4	25.6	33.3	17.9		
27	I was able to solved interesting and relevant physics problems.	Frequencies	5	7	8	13	6	3.21	1.28
		Percent	12.8	17.9	20.5	33.3	15.4		
28	I was able to learn new knowledge during problem-solving.	Frequencies	1	2	6	23	7	3.85	0.87
		Percent	2.6	5.1	15.4	59.0	17.9		

The statements		Analysis	Strongly disagree	Disagree	Natural	Agree	Strongly agree	Mean	
29	I was able to working independently.	Frequencies	4	5	11	13	6	3.31	1.19
		Percent	10.3	12.8	28.2	33.3	15.4		
30	I was able to think in different and useful way to solve problems.	Frequencies	2	2	6	21	8	3.79	1.00
		Percent	5.1	5.1	15.4	53.8	20.5		

