SOUTH AFRICAN AGENCY FOR SCIENCE AND TECHNOLOGY ADVANCEMENT

11th NATURAL SCIENCE OLYMPIAD

GRADES 7 - 9

2022

INSTRUCTIONS

Please read the instructions carefully before answering the questions

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This is a multiple choice paper. Please answer all the questions on the answer sheet provided. Each question is followed by answers marked A, B, C, and D. **Only one answer is correct**. Choose the correct answer and shade the corresponding circle on the answer sheet completely, using an HB pencil.

NB! The answer sheets are marked electronically – do not make any other dots or marks on the answer sheet. Select only one answer for each question or your answer will be discarded**. Ensure that you shade your selection clearly.**

Note that the question numbers 1 to 100 on the answer sheet moves from top to bottom in several columns. Ensure that the number of your selection on the answer sheet corresponds with the number of the question in your examination paper. Should you make a mistake, please erase the incorrect answer completely

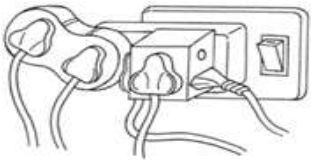
The use of **non-programmable** electronic calculators is permitted.

To avoid disqualification - You are required to complete **all** the information requested on the answer sheet. Please complete the information in script, as well as shade the corresponding blocks. If the corresponding blocks are not shaded appropriately, your results will be returned without a name and you will be disqualified. Do not fold the answer sheets.

Three hours are allowed to answer the questions.

Turn page over to start

1. Plugging too many appliances into the one power point may result in an overload that can cause a short circuit and quite possibly a fire.



This is due to:

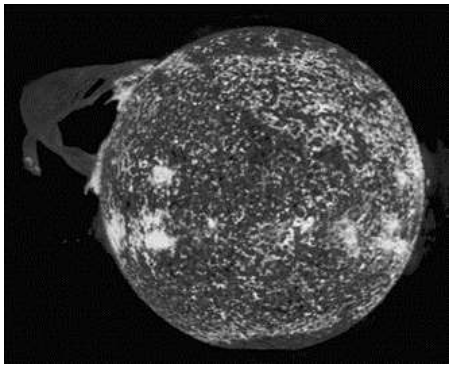
A. appliances are in parallel and exceeds the maximum amperage
B. appliances are in parallel and exceeds the maximum voltage
C. appliances are in series and exceeds the maximum amperage
D. appliances are in series and exceeds the maximum voltage

2. A thermometer is placed in a beaker of hot water as shown here.

A student, watching carefully, notices that the mercury column **drops** by a small amount but then starts to rise as it responds to the heat of the water. It rises until it is reading the temperature of the hot water correctly. Why does the mercury drop initially?

A. The shock of entering the hot water cause the mercury to shrink at first.
B. The thermometer has a tiny crack, and some mercury leaks out.
C. The heat of the water reaches the glass first, causing the bulb to expand and the cool mercury sinks into the enlarged bulb. Heat then gets to the mercury and it expands up the tube in the normal way.
D. The student is in error – the mercury began to expand immediately.

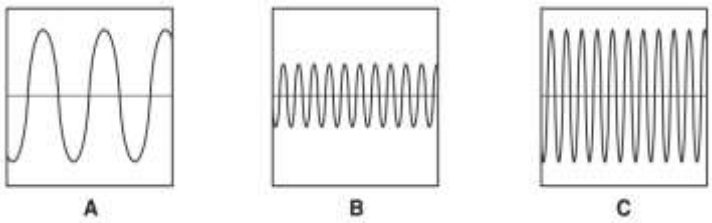
3. The Sun dominates our Solar System. It is 333 000 times heavier (more massive) than Earth and is powered by a nuclear fusion reaction that turns hydrogen into helium and gives off light and heat.



Since light travels at 300 000 km per second, and the sunlight takes 500 seconds to reach Earth, how far are we away from the Sun?

A. 6 000 km
B. 150 000 000 km
C. 15 000 000 km
D. There is insufficient data to calculate this.

4. The diagrams below show the patterns produced on an oscilloscope by three different sound waves.



Which one of the following is correct?

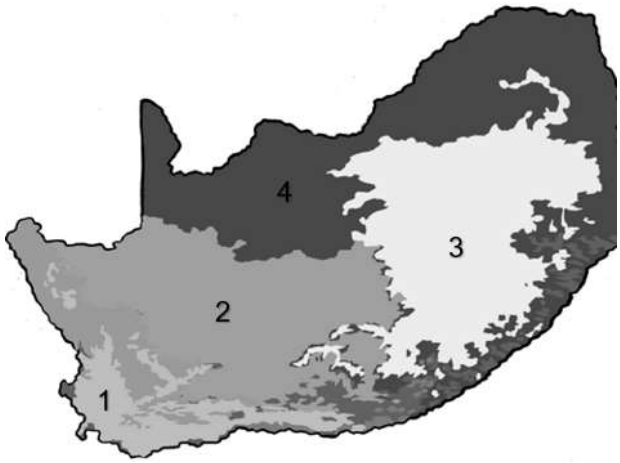
A. A and C have the same loudness but have a different pitch
B. B and C have the same loudness but have a different pitch
C. B and C have the same loudness and the same wavelength
D. B and C have different loudness but the same amplitude.

5. Hydroponics is the science of growing terrestrial plants in a …

   A. Laboratory
   B. Desert
   C. Lake
   D. Aerated solution

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 6 TO 7.

The most recent classification of the terrestrial biomes in South Africa divides the region into the following biomes:



6. Which of the following correctly indicates the four biomes (ecosystems which share similar climate conditions) indicated above in the correct order 1 to 4?

   A. Fynbos, Nama Karoo, Grassland, Savannah
   B. Fynbos, Forest, Nama Karoo, Savannah
   C. Forest, Nama Karoo, Grassland, Savannah
   D. Forest, Savannah, Fynbos, Nama Karoo

7. In which of these biomes will you find the South African national flower?

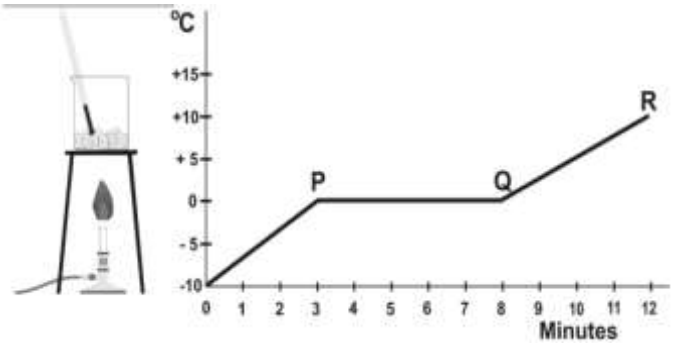
   A. 1
   B. 2
   C. 3
   D. 4

8. A body is falling from a height h. Ignore air friction and assume energy is conserved. After it has fallen a height ¾h, it will possess ...

   A. only potential energy
   B. only kinetic energy
   C. more kinetic energy than potential energy
   D. more potential energy than kinetic energy

QUESTIONS 9 AND 10 REFER TO THE FOLLOWING EXPERIMENT

Ice at -10°C is removed from the deep freezer and placed in a glass beaker over a Bunsen flame. A thermometer tracks the temperature until all the ice has melted and until the temperature registers +10°C. A student observes the experiment and records the reading on the thermometer every 1 minute on this **temperature *versus* time** graph.



9. What did the student observe after 3 minutes [**P**] up to the 8th minute [**Q**]?

   A. The water started to boil.
   B. The ice melted while the temperature remained constant.
   C. The beaker cracked, and all the water leaked out.
   D. Steam began to rise from the ice at **P**, but this ended at **Q**.

10. Which one of the following statements best describes the recordings on the graph?

    A. **P** represents the melting point of ice, while **Q** represents the boiling point of water.
    B. Heat causes the temperature to rise except while the state changes from solid to liquid.
    C. The student fell asleep for 5 minutes and failed to record the steady rise in temperature.
    D. The flame of the Bunsen burner went out at **P** and was reignited at **Q.**

11. The number of joules contained in 1 kWh is…

    A. $3{,}6 \times 10^7$ J
    B. 36×10^5 J
    C. 36×10^8 J
    D. $3{,}7 \times 10^7$ J

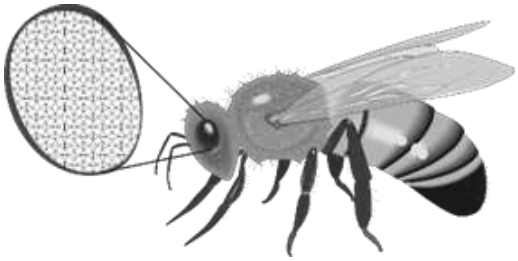
12. This photograph shows water striders walking on the surface of a pond. These predators are stalking the helpless fly that has fallen into the water.

How are the water striders able to *walk on water*?

    A. They have very big feet.
    B. The water is more dense than these insects.
    C. These particular insects weigh less than nothing.
    D. Cohesive forces create “surface tension” forming a thin film able to support their weight.

13. Arthropods like the insects have “**compound eyes**” consisting of **arrays** of hundreds of small lenses that are controlled by the animal’s brain. This gives them advantages over the “simple eyes” of mammals like us.

This illustration shows a honey bee vision system. Astronomers have used this idea from nature to set up arrays using optical telescopes like the Very Large Telescope array (VLT) in Chile which took the first photograph of an exoplanet.



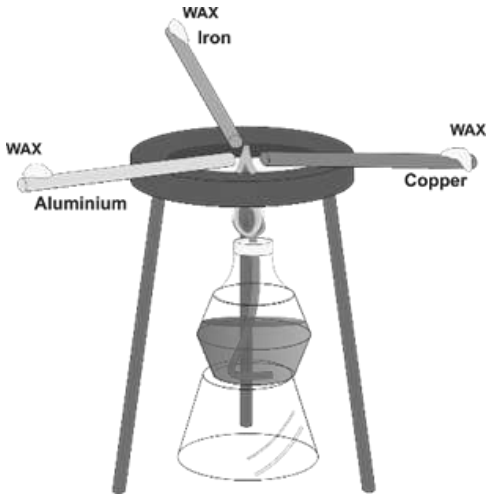
The main advantage of using multiple telescopes in a coordinated array are …

    A. Astronomers can analyse the atmosphere around a super-Earth exoplanet.
    B. Astronomers can measure stars and exoplanets very accurately.
    C. Astronomers can track the movement of individual stars around the black hole at the centre of our galaxy
    D. All of the above have been achieved.

14. In SONAR, we use

    A. ultrasonic waves
    B. infrasonic waves
    C. radio waves
    D. audible sound waves

15. The diagram represents an experiment done to compare the Thermal Conductivity of three different metals: Iron, Copper and Aluminium. Three bars of the metals are all the same sizes. Wax is used to identify which metal conducts the heat from the flame to the end of the bar most quickly. The heat source is a Spirit Burner, and the Bars are balanced on a Tripod Stand. The thermal conductivities will be revealed by order in which the wax melts.



Which of these statements gives the correct order that the wax will melt to reveal the thermal conductivity of the three metals being tested?

A. First **iron** then **aluminium** then **copper.**
B. First **aluminium** then **iron** then **copper.**
C. First **copper** then **aluminium** then **iron.**
D. They all melt at the same time because they use the same heat source.

16. Telescopic arrays can use optical wavelengths (in other words: “visible light”) as well as infrared, microwaves and especially **radio waves.** South Africa has several **Radio Telescope Arrays** in the pipeline.

Which one of the following does not fit into this category?

A. SALT
B. Meerkat
C. The Africa VLBI Network
D. The Square Kilometre Array

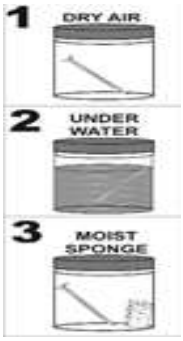
17. Which one of the following reactants can be used to test for the presence of Carbon dioxide gas?

A Copper hydroxide
B Milky white lime water
C Clear lime water
D Iodine solution

18. The speed of a bicycle increases from 2 $m \cdot s^{-1}$ to 8 $m \cdot s^{-1}$. Its kinetic energy increases by a factor of …

A. 4
B. 6
C. 8
D. 16

19. In order to investigate what factors may be involved in causing iron to rust, a student placed three identical iron nails in bottles as shown.



Bottle #1 contained a nail sealed with dry air.
Bottle #2 contained a nail completely under water.
Bottle #3 contained a nail sealed with a moist sponge.

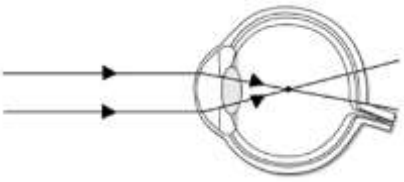
Which one of these observations after 1 week are most likely?

A. Bottle #1 showed the most rust on the nail**.**
B. Bottle #2 showed the most rust on the nail**.**
C. Bottle #3 showed the most rust on the nail**.**
D. Rusting was not seen in any bottle because the lids were all sealed.

20. To make the most of the SKA we need a community of radio astronomers in Africa. South Africa is assisting several of our neighbours to convert their existing, but outdated satellite communications antennae to function as Radio Telescopes. They will then form part of the European Very Long Base Network.

A. This will improve the accuracy of the array.
B. This will create highly skilled jobs in Africa.
C. This will help prepare systems for the SKA which is being built mainly in South Africa.
D. All three of these advantages are true.

21. The diagram represents an eye defect.

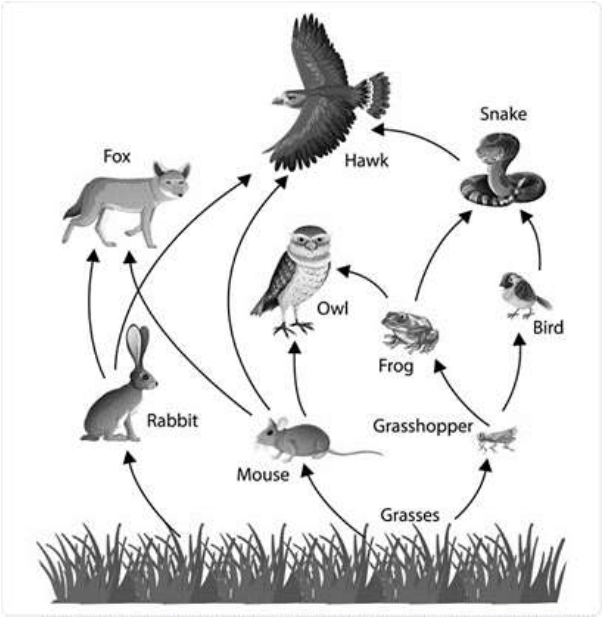


Which of the following is correct for this defect?

	Defect	Correction	Near Objects Appear
A	Near sighted	Convex lens	Blurry
B	Far sighted	Convex lens	Blurry
C	Near sighted	Concave lens	Clear
D	Far sighted	Concave lens	Clear

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 22 TO 23.

Consider the following food chain:



22. What will happen to the numbers of the following if all the hawks were killed by hunters?

	Snakes	Birds	Grasshoppers
A	Decrease	Decrease	Increase
B	Increase	Increase	Decrease
C	Decrease	Increase	Decrease
D	Increase	Decrease	Increase

23. Which of the following shows a correct feeding relationship?

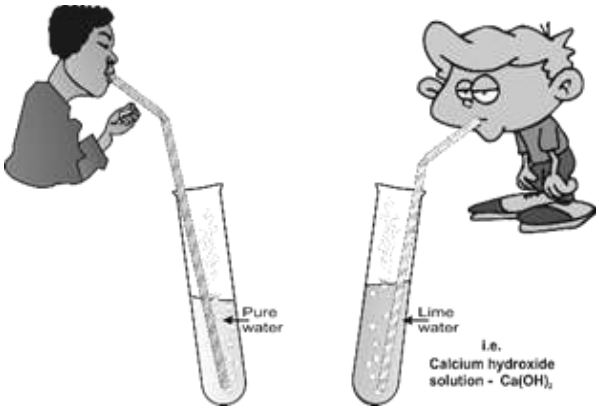
	Primary consumer	Secondary consumer	Tertiary consumer
A	Herbivore Grasshopper	Carnivore Frog	Omnivore Owl
B	Herbivore Grasshopper	Carnivore Frog	Carnivore Owl
C	Herbivore Grasshopper	Carnivore Frog	Omnivore Snake
D	Herbivore Grasshopper	Omnivore Frog	Carnivore Snake

24. Two balls, P and Q, are dropped simultaneously from the same height. Ball P has TWICE the mass of ball Q. Ignore the effects of air friction.

    Just before the balls hit the ground, the kinetic energy of ball P is x. The kinetic energy of ball Q, in terms of x, will be …

    A. ¼ x
    B. ½ x
    C. x
    D. 2x

25. Two students are experimenting to see if the breath we exhale contains carbon dioxide or not. They are each blowing into a straw and observing the results.



    Thabo is blowing bubbles into pure water. Peter is blowing bubbles into lime water.

    What will they observe?

    A. The pure water turns milky but the lime water stays clear.
    B. The pure water stays clear while the lime water turns milky.
    C. Both the pure water and the lime water turn milky.
    D. Neither the pure water nor the lime water turns milky.

26. Sutherland is the main site of South Africa's optical telescopes – including SALT.

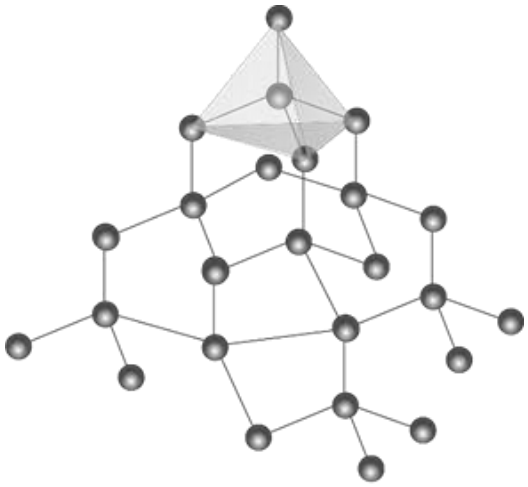
    What do the letters S-A-L-T stand for?

    A. A condiment we add to our food.
    B. South African Load-shedding Telescope.
    C. South African Large Telescope.
    D. South African Long-range Telescope.

27. What are the advantages of using **radio** telescopes like this 26-metre dish at HartRAO to **see** deep into space using radio energy?

    A. Radio waves can be converted by a computer to give a visible image.
    B. Radio waves can also be collected during daylight and can pass through clouds.
    C. Radio waves can penetrate dust clouds in space that block visible light.
    D. All three of these advantages are true.

28. This diagram shows the structure of diamonds.



DIAMOND
A 3D network solid

A. From this it is evident that a diamond is a network of the same element.
B. From this it is evident that a diamond is a compound consisting of different elements.
C. From this it is evident that a diamond is a mixture of elements
D. From this it is evident that a diamond is a solution of elements.

29. Since all four available bonds are occupied, we can conclude that …

A. Diamonds are very hard.
B. Diamonds have extremely high melting points.
C. Diamonds are chemically very stable.
D. All three of these are valid conclusions.

30. The minimum value of the resistance that can be obtained by connecting two 4 Ω resistors is ...

A. 2 Ω.
B. 4 Ω.
C. 6 Ω.
D. 8 Ω.

31. South Africa's MeerKAT radio telescope is made up of 64 dishes, each 13.5m in diameter. The MeerKAT array is distributed across a span of 8km in the remote area of Carnarvon in the Northern Cape. The 64 MeerKAT antennae are standing in the Karoo. Currently it is the largest Radio Telescope Array in the world, but it will soon become part of the giant Square Kilometre Array consisting of 197 dishes as the SKA develops over the next few years.

Why has the SKA been positioned in the remote Karoo?

A. The dry desert air stops the telescope dishes from rusting.
B. The area is a “radio quiet” zone with no normal cell phone coverage.
C. There are no clouds to block the incoming radio signals.
D. There are very few people to disturb the work of the scientists.

32. Which among the following diseases is not caused by a virus?

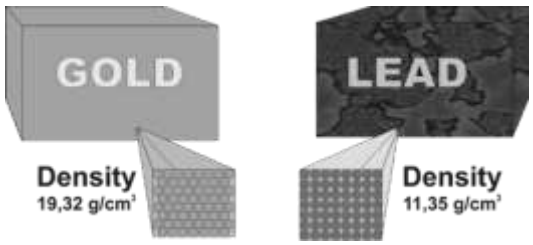
A. Covid - 19
B. Ebola
C. HIV-AIDS
D. Tuberculosis

33. The Johannesburg Observatory was once the main centre for Astronomy in South Africa.

Most of the telescopes have been moved to Sutherland in the Karoo mainly because…

A. Johannesburg has too much traffic noise.
B. People living near the observatory vandalised the valuable equipment.
C. Smoke from houses and factories dirtied the lenses and mirrors of the telescopes.
D. Light pollution from street lights, houses, office buildings and vehicle headlights made it difficult to see the stars.

34. This diagram represents two heavy elements: Gold and Lead. Gold has an atomic number of 79 and a mass number of 197 u, while Lead has an atomic number of 82 and a mass number of 207 u.

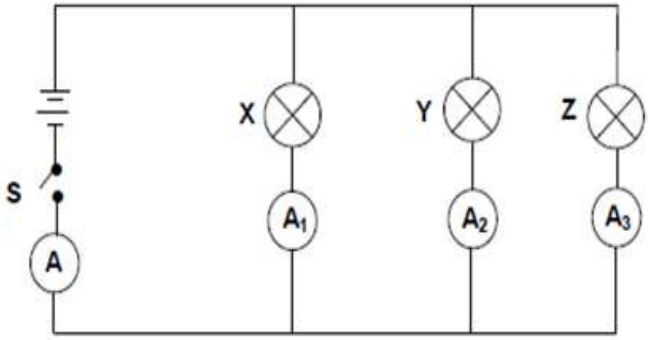


How is it possible that a Gold bar is heavier than an equal-sized bar of Lead?

A. The statement is incorrect – a bar of Lead must be heavier than a bar of Gold.
B. Gold atoms are packed more densely than Lead atoms.
C. Gold is a pure “noble” metal, while the lead may be contaminated.
D. Gold has a higher melting point (1064ºC) than Lead (327.5ºC).

35. Three light bulbs, X, Y and Z with resistances R, 2R and R respectively, are connected in a circuit as shown below. The battery has negligible internal resistance.

When switch S is closed, all the bulbs light up. The reading on ammeter A is 2,5 A.



Which ONE of the following correctly describes the readings on the ammeters (in amperes) when bulb Z burns out?

	A_1	A_2	A_3	A
A	1,25	1,25	0	2,5
B	1,6	0,8	0,1	2,5
C	0,75	0,75	0	1,5
D	1	0,5	0	1,5

36. Diagram A and diagram B below represent the same part of the same human eye under different conditions.

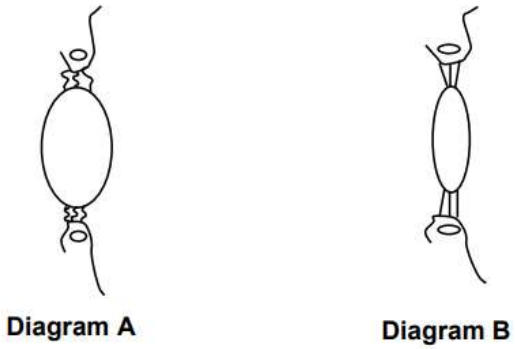
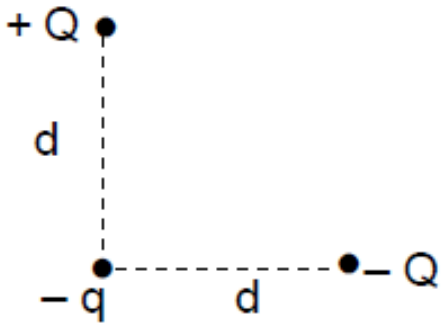


Diagram A **Diagram B**

Which diagram, with a corresponding reason, represents a person looking at an object 10 metres away?

A. Diagram B because the suspensory ligaments are tight and the lens is less convex.
B. Diagram B because the lens is more convex and the suspensory ligaments are slack.
C. Diagram A because the lens is more convex and the suspensory ligaments are slack.
D. Diagram A because the suspensory ligaments are tight and the lens is less convex.

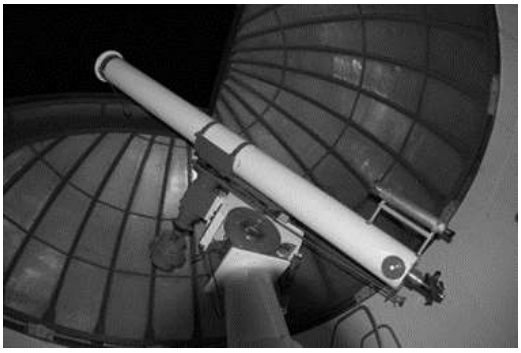
37. Two charges, + Q and – Q, are placed a distance d from a negative charge – q. The charges, + Q and – Q, are located along lines that are perpendicular to each other as shown in the diagram below.



Which ONE of the following arrows CORRECTLY shows the direction of the net force acting on charge – q due to the presence of charges + Q and – Q?

A.	
B.	
C.	
D.	

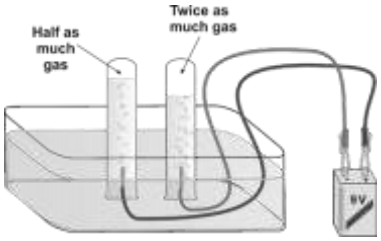
38. This is the Reunert Telescope which was used in 1928 to measure the distance to the closest star to our Solar System (other than the Sun).



This star is known as Proxima Centauri and it is…

A. 4,2 Light years away from us.
B. 42 Light years away from us.
C. 42 000 km away from us.
D. 150 million km away from us.

39. In the experiment illustrated here, gas bubbles rise into the test tubes above the electrodes. Twice as many gas bubbles form above the negative terminal than those that form above the positive terminal.



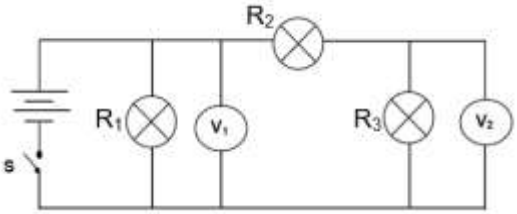
What does this simple experiment tell us about the chemical make-up of water molecules?

A. Liquid water is made up equally of two elements.
B. The elements that make up water have a ratio of 2:1.
C. Water is a mixture of two elements.
D. If water is “electrified” it disintegrates immediately.

40. If we perform simple tests on the above gases, we should make the following observations:

A. The larger quantity of gas will ignite with a popping sound typical of hydrogen.
B. The smaller quantity of gas will cause a glowing splint to burst into flame.
C. Both A and B are correct and tell us that the two gases are hydrogen and oxygen.
D. The larger quantity of gas is H2S and has a foul smell like that of rotting eggs.

41. Three identical light bulbs R_1, R_2 and R_3 are connected in a circuit as shown below. The resistances of the battery and connecting wires can be ignored.



Which ONE of the following statements is CORRECT when switch S is closed?

The reading on V_1 is …

A. half that on V_2.
B. equal to that on V_2.
C. twice that on V_2.
D. three times that on V_2.

42. The Moon produces no light, and yet it shines at night. Why does the Moon shine?

A. The Moon reflects the light from the Sun.
B. The Moon rotates at very high speed.
C. The Moon is covered with a thin layer of ice.
D. The Moon has many craters.

43. Which of these processes occur in the leaf of a green plant during the day?

    A. Photosynthesis, transpiration and respiration
    B. Photosynthesis and respiration only
    C. Photosynthesis and transpiration only
    D. Photosynthesis only

44. Two identical positively charged spheres, which are free to move, are placed near each other on a frictionless surface.

    Which ONE of the following CORRECTLY describes the motion of the two spheres?

    A. They move away from each other with increasing acceleration.
    B. They move away from each other with decreasing acceleration.
    C. They move away from each other with constant acceleration.
    D. They move away from each other with zero acceleration.

45. What are the advantages of placing our optical telescopes near a remote small town in the semi-desert of the Karoo?

    A. The dry desert air seldom has clouds to interfere with astronomical observations.
    B. There is no light pollution from city lights to interfere with observations.
    C. The high altitude of the Sutherland mountains means that there is less atmosphere above the telescopes that could interfere with observations.
    D. All three of these advantages are true.

46. Mpho has lost her party balloon. It is filled with Helium and is floating away, higher and higher.

    What will probably happen to her balloon?

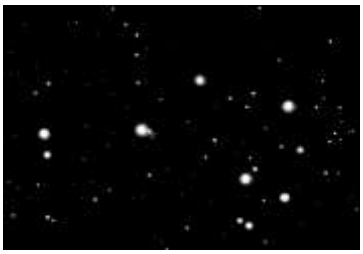
    A. As the balloon rises the pressure of the air around it decreases, and the balloon expands until it bursts.
    B. The balloon will rise higher and higher until it reaches the Thermosphere where it will be incinerated by the heat.
    C. The balloon will rise into the stratosphere where the cold will cause it to shrink and sink back to Earth.
    D. It will rise no more than 20 metres and then stay at that altitude.

47. P, Q and R are three charged spheres. When P and Q are brought near each other, they experience an attractive force. When Q and R are brought near each other, they experience a repulsive force.

    Which ONE of the following is TRUE?

    A. P and R have charges with the same sign.
    B. P and R have charges with opposite signs.
    C. P, Q and R have charges with the same sign.
    D. P, Q and R have equal charges.

48. This is a photograph of the star group known as the Pleiades or Seven Sisters or Selimela (Xhosa) or Selemela (Sotho/Tswana) or IsiLimela (Zulu).



This star group has strong cultural significance for many African peoples, because…

A. Their appearance signals the start of traditional "coming of age" schools.
B. They signal the start of the rainy season.
C. They indicate the arrival of winter.
D. They indicate the end of winter.

49. Which of the following correctly indicates the type of adaptation of animals to survive in their environment?

	Structural	Functional	Behavioural
A	Thick winter fur	Using fat as energy source	Migration
B	Thick winter fur	Migration	Using fat as energy source
C	Migration	Thick winter fur	Using fat as energy source
D	Using fat as energy source	Thick winter fur	Migration

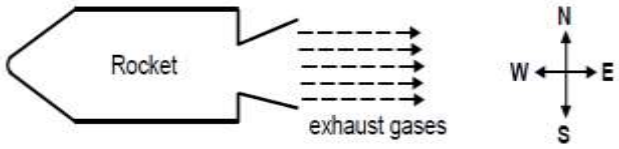
50. Consider the following list of chemical substances:

I) Water
II) Glucose
III) Chlorophyll
IV) Oxygen
V) Carbon dioxide

The combination from the list that indicates the requirements for photosynthesis is …

A. I and III
B. I, III and IV
C. I, III and V
D. II, III and IV

51. The simplified diagram below shows a rocket that has been fired horizontally, accelerating to the west.



Which ONE of the statements below best explains why the rocket accelerates?

A. The speed of the exhaust gases is smaller than the speed of the rocket.
B. The pressure of the atmosphere at the back of the rocket is less than at the front.
C. The air outside the rocket exerts a greater force on the back of the rocket than at the front.
D. The rocket pushes the exhaust gases to the east and the exhaust gases push the rocket to the west.

USE THE FOLLOWING DIAGRAM TO ANSWER QUESTIONS 52 TO 53.

52. The experiment illustrated in this diagram shows potassium permanganate being heated in a porcelain bowl. An invisible gas is given off which is identified when a glowing splint bursts into flame. The invisible gas is…

A. Carbon dioxide.
B. Hydrogen
C. Steam.
D. Oxygen.

53. This type of chemical reaction is called…

    A. Decomposition.
    B. Combustion.
    C. Synthesis.
    D. Melting.

54. Some learners decided to build a small electrical generator in the laboratory. They then used this generator to investigate how the magnitude of the induced emf would change as the magnetic field strength changed.

    Which ONE of the following is CORRECT regarding the variables for the investigation?

	Dependent Variable	Independent Variable	Control Variable
A	Magnitude of induced emf	Number of turns of coil of generator	Magnetic field strength
B	Number of turns of coil of generator	Magnitude of induced emf	Magnetic field strength
C	Magnitude of induced emf	Magnetic field strength	Number of turns of coil of generator
D	Magnetic field strength	Number of turns of coil of generator	Magnitude of induced emf

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 55 TO 56.

Consider the following process that occur in living cells.

Gas X + Y → Energy + Water + Z

55. This process occurs in the … of cells.

    A. Chloroplasts
    B. Mitochondria
    C. Nucleus
    D. Vacuole

56. The substance Y is …

    A. Carbon dioxide
    B. Oxygen
    C. Glucose
    D. Chlorophyll

57. This photograph is an 8 minute-long "time exposure" of the night sky. The light of the stars has been stretched into "star trails."

What does this tell us about the Earth and beyond?

    A. The Earth is spinning on its axis.
    B. The stars are moving at great speed.
    C. The camera was being moved in a circle.
    D. Our eyes take time to adapt to night vision.

58. The Earth can be considered as having a series of 'spheres' starting from the CORE and continuing outward to the edge of SPACE.

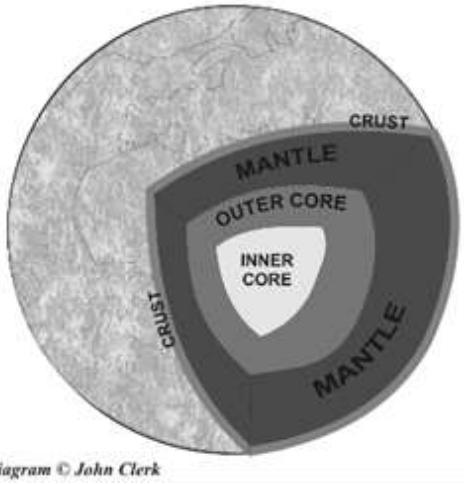
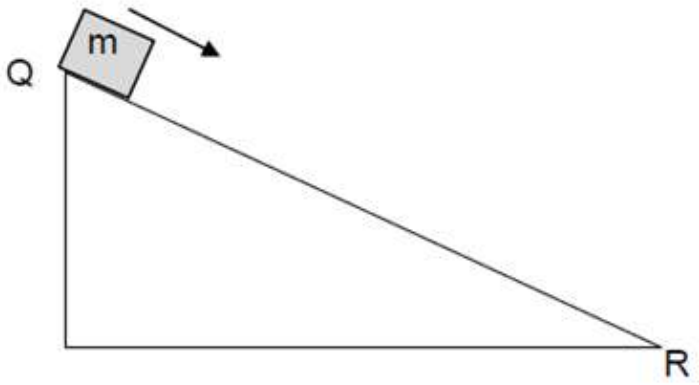


Diagram © John Clerk

The core density has been measured using seismic waves and this leads us to believe that Earth's core consists mainly of…

    A. Solid hydrogen gas
    B. Gold and lead
    C. Iron and nickel
    D. There is no way to know this.

59. A block of mass m is released from rest from the top of a frictionless inclined plane QR, as shown below.



The total mechanical energy of the block is EQ at point Q and ER at point R.
The kinetic energy of the block at points Q and R is KQ and KR respectively.

Which ONE of the statements regarding the total mechanical energy and the kinetic energy of the block at points **Q** and **R** respectively is CORRECT?

	Total Mechanical Energy (E)	**Kinetic Energy (K)**
A	EQ > ER	KQ = KR
B	EQ = ER	KQ < KR
C	EQ = ER	KQ = KR
D	EQ < ER	KQ > KR

60. Which of the following can be treated with an antibiotic?

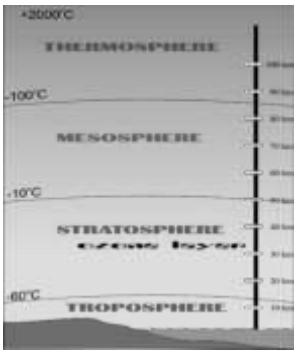
A. Viruses
B. Bacteria
C. Fungi
D. Protists

61. The diagram shows two main processes – one is happening in the old shoe polish tin, and another in the candle flame below the tin.

Which one of the following correctly describes what is happening?

A. Above is a physical process, below is a chemical process.
B. Above is a chemical process, below is a physical process.
C. Both are chemical processes.
D. Both are physical processes.

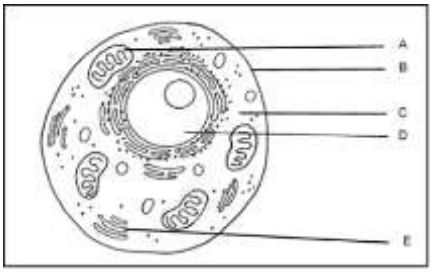
62. The outer spheres of Earth form the atmosphere. Notice that the fourth layer, the "Thermosphere" has very high temperatures. Rockets and satellites are made mainly of aluminium – which melts at 660°C.



How is it possible that satellites can pass through the 2000°C thermosphere without melting?

A. Scientists have lied to us – space travel is clearly impossible.
B. The "hot" air molecules are so far apart that there is actually very little **heat** up there.
C. The "thermosphere" is **wrong** – air gets colder as you go higher.
D. Satellites are surrounded by gold heat shields.

63. Study the following diagram of a cell.



The labels A, B and D represents …

	A	B	D
A	Chloroplast	Cell wall	Vacuole
B	Chloroplast	Cell wall	Nucleus
C	Mitochondrion	Cell membrane	Vacuole
D	Mitochondrion	Cell membrane	Nucleus

64. Looking at an object through a **red transparent** glass window, the object appears red. Which of the following is possible?

	Red glass	Object
A	Allows only red light through	Absorbs all colours of white light
B	Allows only red light through	Reflects all colours of white light
C	Reflects only red light	Reflects only red light
D	Reflects only red light	Absorbs all colours of white light

65. When you use a propane gas burner in a closed room, you may observe the build-up of misty liquid droplets on the windows.

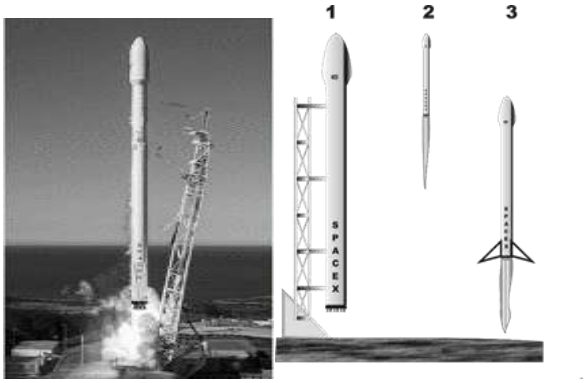
Here is ***part*** of the reaction with *one key item omitted*.

Look at the incomplete reaction and decide what the missing item is.

A. Carbon dioxide.
B. Water
C. Methane.
D. Oxygen.

66. SpaceX is a very innovative company owned by South African-born Elon Musk. They make and fly the Falcon-9 series of reusable rockets which can take off vertically and then land again vertically. This photo shows the rocket launching into space carrying a South African-made satellite.

The diagram shows the rocket [1] waiting to launch, [2] on the way up, [3] coming down to land again.



In which of the three positions does **gravity** act on the rocket?

A. [3] only
B. [1] and [2] only
C. [2] and [3] only
D. [1], [2] and [3]

67. The table below compares the rate of extinction of mammal species over two different time periods.

TIME PERIOD (YEARS)	RATE OF EXTINCTION (PER 100 YEARS)
1500 – 1900	4,5
1900 - 2000	90

What is the ratio between the rate of extinction from 1500 to 1900 compared to the rate of extinction from 1900 to 2000?

A. 1 : 20
B. 1 : 2
C. 2 : 1
D. 20 : 1

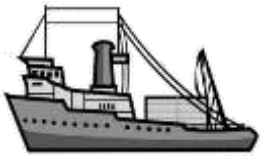
68. Which of the following is a characteristic feature of consumers?

A. Autotroph
B. Heterotroph
C. Saprophyte
D. Parasite

69. Why do mountain climbers use oxygen equipment at the top of the world's highest mountains?

A. There is less oxygen in the air at great heights.
B. There is very little nitrogen at great heights.
C. There is a hole in the ozone layer.
D. There is no air at the top of very high mountains.

70. Fishing trawlers are in danger of rusting. The crew have to maintain the ship in good condition by painting the iron surface to prevent it from rusting.

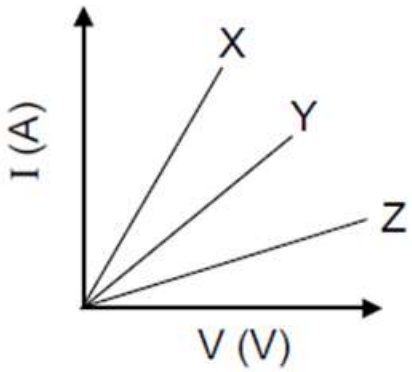


Which ONE of the following provides the BEST reason to explain how this works?

A. A layer of paint prevents water from coming in contact with iron
B. A layer of paint prevents oxygen and moisture from coming in contact with the iron.
C. A layer of paint prevents carbon dioxide from coming in contact with the iron.
D. A layer of paint prevents nitrogen from coming in contact with the iron.

71. Learners investigate the relationship between current (I) and potential difference (V) at a constant temperature for three different resistors, X, Y and Z. The three resistors are made from the same material, have the same length but differs only in diameter (thickness of the wire).

They obtain the graphs shown below.

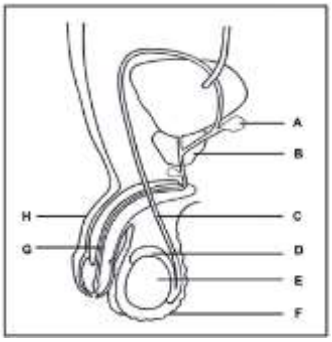


As the resistance of a resistor increases, the current through it will decrease. Which ONE of the following conclusions regarding the resistors is CORRECT?

A. X has the smallest diameter and the biggest resistance
B. X has the biggest diameter and the biggest resistance
C. X has the smallest diameter and the smallest resistance
D. X has the biggest diameter and the smallest resistance

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 72 TO 73.

The diagram below shows the parts of the male reproductive system.



72. Which of the following is the correct labels for **C**, and **F**?

	C	F
A	Urethra	Scrotum
B	Sperm duct	Scrotum
C	Urethra	Testis
D	Sperm duct	Testis

73. The part that produces testosterone is labelled …

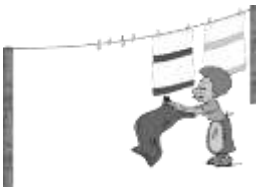
A. A
B. B
C. D
D. E

74. The outer crust of the Earth consists of about 20 tectonic plates which move very slowly. How can fossil shells of marine life be transported to the tops of very high mountains?

A. An oceanic plate has been crumpled up in the path of a moving continental plate.
B. An oceanic plate has been subducted down into the mantle below a continental plate.
C. A volcano arose and lifted the fossil shells with it.
D. This is not true – you cannot find seashells on top of high mountains.

75. It is laundry day, and you are helping mom (or dad) hang out the washing to dry in the Sun. Which physical process occurs to make this happen?

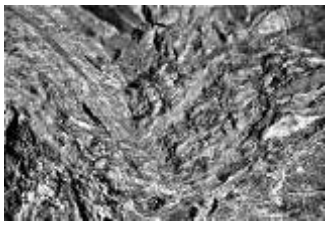
A. Condensation
B. Boiling
C. Melting
D. Evaporation



76. Heating is a process in which energy is transferred from a hotter body to cooler body. Which one of the following represents the energy transfer processes represented by 1, 2 and 3.

	1	2	3
A	Conduction	Radiation	Convection
B	Conduction	Convection	Radiation
C	Convection	Conduction	Radiation
D	Radiation	Convection	Conduction

77. This is a picture of rich iron ore called “Banded Ironstone.” It contains iron chemically bonded to oxygen.



In order to extract the iron from the ore people have to…

A. Crush the rock and dissolve the oxygen in acid.
B. Crush the rock and melt it – the oxygen evaporates.
C. Crush the rock, melt it and add carbon which will react with the oxygen and go up into the air as carbon dioxide.
D. Crush the rock and blow very hot carbon dioxide over it.

78. There are 92 natural elements in the Periodic Table. They form in the stars. Hydrogen nuclei fuse to form Helium in sun-like stars. Bigger stars form Carbon, Nitrogen and Oxygen as they age. Even bigger stars form the elements up to iron as they die.

    Where do the heaviest elements like Uranium, Platinum, Lead, Gold and Silver form?

    A. They come from space, but we do not know how they form.
    B. They form when a Red Giant Star shrinks to form a sun-like star.
    C. They form when aliens on exoplanets wage thermonuclear war against each other.
    D. They form when supernovae explode or when neutron stars collide.

79. A learner conducted an investigation to determine the effect of caffeine on reaction time. The procedure was done as follows:

    - 50 male volunteers of the same age participated.
    - Their reaction times were measured using a computer program.
    - They were all given 200 mℓ of an energy drink that contained caffeine.
    - Their reaction times were measured again every 10 minutes for 2 hours.

    Which ONE of the following reduced the effect of errors in the results obtained?

    A. Gender of the volunteers
    B. Age of the volunteers
    C. 50 volunteers used
    D. Type of caffeine used

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 80 TO 81.

A liquid boils when its “vapour pressure” equals the atmospheric pressure. As the temperature of a liquid rises, the evaporation rate increases and so does its vapour pressure. When the vapour pressure matches the atmospheric pressure, the liquid boils.

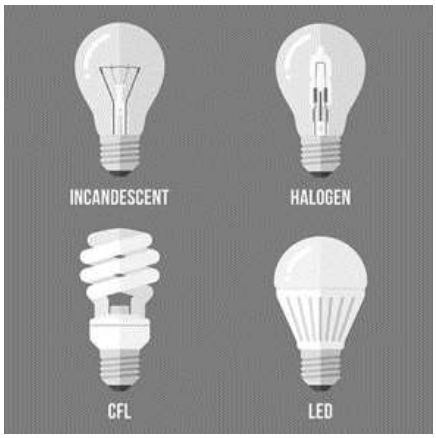
80. Which of the following statements is correct in terms of the above principle?

    A. Water evaporates more easily than cooking oil, so oil must have the lower Boiling Point.
    B. Alcohol evaporates more easily than water, so alcohol must have the higher Boiling Point.
    C. Petrol evaporate more easily than water, so water must have the higher Boiling Point.
    D. Ether evaporates more easily than alcohol, so alcohol must have the higher Boiling Point.

81. A mountain climber makes his way to the top of a very high mountain. It is bitterly cold and he looks forward to making a nice hot cup of soup when he reaches the top. He boils the water, makes the soup – but he is disappointed – the soup is not very hot. Why not?

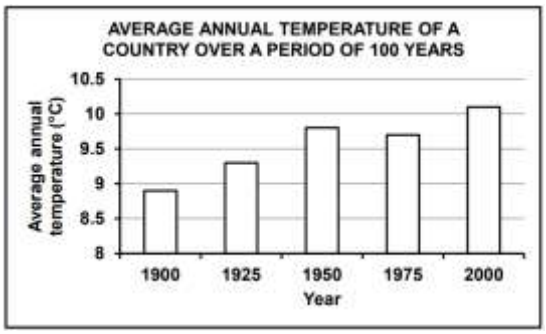
    A. The flame of his gas burner was not hot at high altitude.
    B. The boiling point of the water was a lot lower at the top.
    C. The boiling point of the water was a lot higher at the top
    D. This is nonsense – he was fussy because he was tired and cold.

82. Which of the four light bulbs below are the most energy efficient?



A. Incandescent (tungsten) bulbs
B. Halogen bulbs
C. CFL (fluorescent) bulbs
D. LED (light emitting diode) bulbs

83. The annual average temperature of a country was recorded over the past 100 years. The information is represented in the graph below.



Which ONE of the following is a possible conclusion that can be made from the information in the graph?

A. Global warming has caused habitat destruction.
B. Ozone depletion has occurred.
C. Carbon dioxide levels in the atmosphere are increasing.
D. Desertification has occurred as a result of global warming.

84. One of the main causes of acid rain is…

A. Waste from nuclear power plants.
B. Toxic waste from chemical manufacturing plants.
C. Gases from burning fossil fuels.
D. Gases from recycling plastics.

85. The cost of using a fridge with power rating of 350 W for 1 day (24 hours) if the cost of electricity is R 2,95 per kWh is …

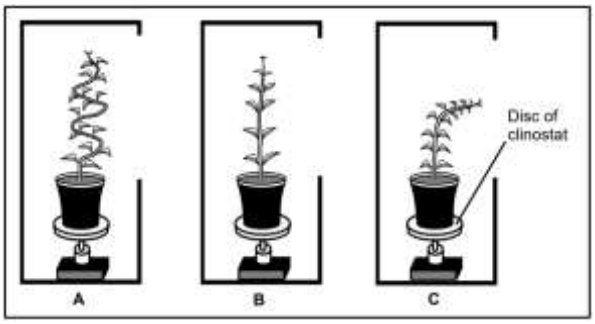
A. R 4,30
B. R 10,33
C. R 24,78
D. R 89,20

86. A clinostat is a device used to investigate plant growth responses. It has a disc that rotates very slowly when the clinostat is switched on.

During an investigation on plant responses to light, the procedure below was followed:

- Three pot plants of the same species were used.
- Each pot plant was placed on one of three identical clinostats.
- Each set of apparatus, A, B and C, was placed in a box with a single opening.
- Each clinostat was treated in a different way over a period of five weeks.

The results of the investigation are represented in the diagrams below.



In which apparatus (A, B or C) was the clinostat switched off, but manually rotated through 180° once a week?

A. A
B. B
C. C
D. A and C

87. Here are two chemical reactions:

$$C + O_2 \Rightarrow CO_2 \quad \textbf{AND} \quad S + O_2 \Rightarrow SO_2$$

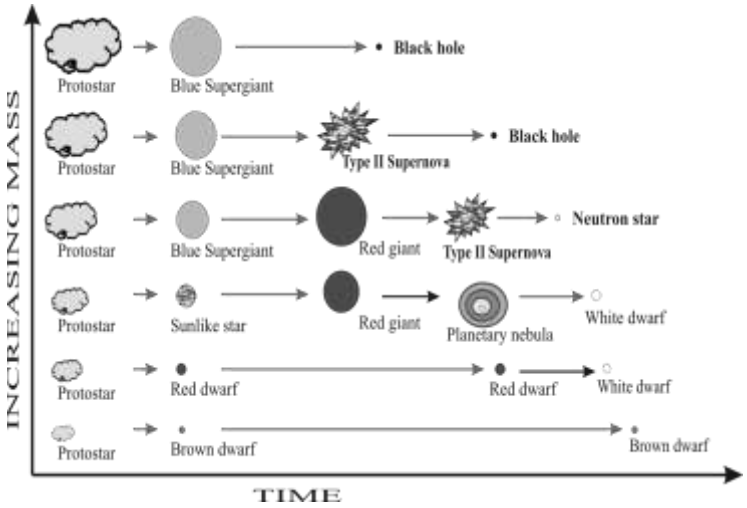
Look at the following statements:

P: Both reactions are oxidation reactions.
Q: Both reactions are exothermic reactions.
R: Both reactions involve a metal reacting with oxygen.
S: Both reactions needed *activation energy* to get started.

A. ALL of the statements are true.
B. P & Q are true, but R & S are false.
C. P & Q & R are true, but S is false.
D. P & Q & S are true, but R is false.

USE THE FOLLOWING DIAGRAM TO ANSWER QUESTIONS 88 TO 90.

Live Fast and Die Young – Star Evolution



88. The “Birth of Stars”: From the graph, deduce which statement best completes the following sentence: Stars of various types and sizes form when…

A. Black holes evaporate.
B. Enormous clouds of gases and dust collapse to form stars of different sizes.
C. Red Giants collapse to form Planetary nebulae only.
D. Brown dwarfs grow to become Red Dwarfs before becoming Sun-like stars.

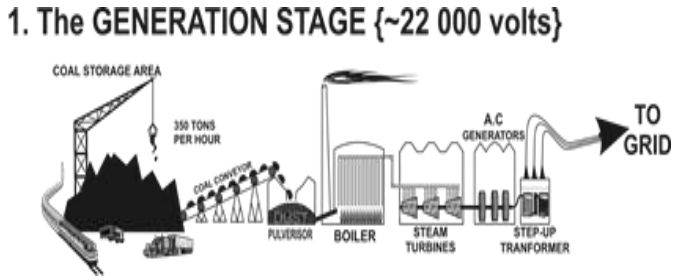
89. The “Life of Stars”: From the graph, which ONE of the following statements is true with regard to the lifespan of the stars.

    A. The largest stars burn through their fuel relatively quickly before turning into a black hole.
    B. When our Star (The Sun) comes to an end it will be a neutron star.
    C. All types of Stars turn into Black Holes when they die.
    D. Brown dwarfs are the most massive and live the longest

90. The “Death of Stars”: From the graph, which ONE of the following statements is true with regard to the death of the stars.

    A. All stars become Black Holes when they run out of fuel.
    B. All Blue Giant stars become Supernovae before they lose all of their energy.
    C. The Sun will become a Red Giant before throwing off its outer shells and ending up as a White Dwarf.
    D. Brown Dwarfs have the shortest lifespan.

91. At a coal-fired power station (like Kusile, Medupi and Matla) coal is delivered by trucks. The coal is typically lumps about the size of a fist. Before being fed into the boiler, the lumps of coal are pulverised down to a fine powder. 350 tonnes of coal dust is blown into the flames of the boiler per hour.



.

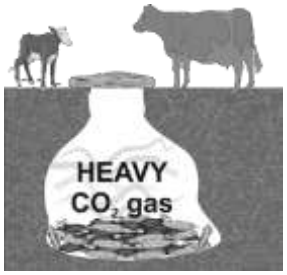
Why is the coal pulverised to a powder?

    A. To speed up the reaction rate and increase the energy released to make steam.
    B. To ensure that all the coal is burnt without leaving any lumps.
    C. To allow the reactants (carbon and oxygen) to mix within the dust cloud.
    D. All of these are valid reasons.

92. White light consists of a spectrum (range) of different frequencies and wavelengths. When comparing red light with blue light, the red light will have a …

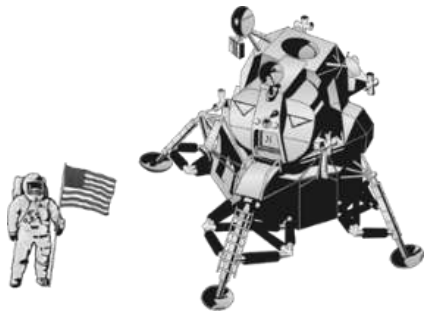
    A. Higher frequency and longer wavelength
    B. Higher frequency and shorter wavelength
    C. Lower frequency and shorter wavelength
    D. Lower frequency and longer wavelength

93. This diagram shows an Nguni grain pit for storing mielies and sorghum safely for extended periods. The Carbon dioxide gas forms naturally when grain contacts the moist clay walls of the pit which traditionally is situated inside the cattle kraal.



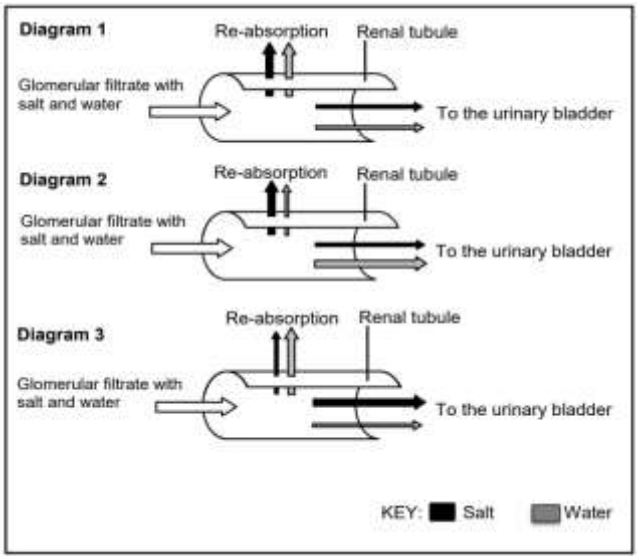
A. The CO_2 prevents the grain from fermenting and rotting.
B. The CO_2 kills any insects and microbes that enter the pit.
C. The CO_2 will suffocate any mice or rats that enter the pit.
D. All of these are valid reasons.

94. The Moon is 384 000 km from Earth on average. When Apollo 11 landed on the Moon on 20 July 1969, Neil Armstrong sent a radio message back to Earth saying “The Eagle has landed.” The message, travelling at the speed of light, arrived _?_ seconds after he spoke those words.



A. 1,28 seconds
B. 12,8 seconds
C. 384 seconds
D. The message never arrived because sound cannot travel through the vacuum of space.

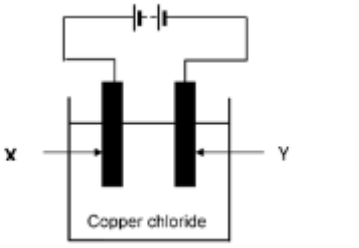
95. The diagrams below show the re-absorption of salt and water through the tubules of a nephron in the kidney under three different conditions. The width of the arrows represents the amounts of salt and water.



Which diagram would represent a person who had eaten salty chips on a hot day without any intake of water?

A. Diagram 1
B. Diagram 2
C. Diagram 3
D. Diagram 2 and 3

96. Copper (II) chloride solution can be broken down to copper metal and chlorine gas in a process is called electrolysis as illustrated below. X and Y are carbon electrodes.



Which of the following is correct?

	X	Y
A	Anode where Cu forms	Cathode where chlorine gas forms
B	Cathode where chlorine gas forms	Anode where Cu forms
C	Anode where chlorine gas forms	Cathode where copper forms
D	Cathode where copper forms	Anode where chlorine gas forms

97. During an investigation a man was placed in an airtight room. Sensors were used to monitor his breathing rate. The investigators were able to change the environmental conditions in the room. After 30 minutes the man's breathing rate had increased.

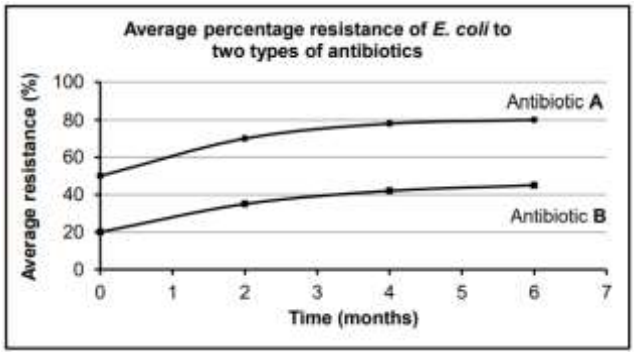
    The investigators changed the environmental conditions in the room by …

    A. decreasing the light intensity.
    B. increasing the amount of carbon dioxide in the air.
    C. decreasing the humidity.
    D. increasing the amount of oxygen in the air.

USE THE FOLLOWING INFORMATION TO ANSWER QUESTIONS 98 TO 99.

The *E. coli* bacterium lives in the intestines of pigs where they reproduce rapidly. Certain strains of *E. coli* cause diarrhea in young pigs (piglets). Scientists carried out an investigation using 100 piglets to determine the resistance of *E. coli* to two antibiotics, A and B over a period of six months.

The results are shown in the graph below.



98. The independent variable in this investigation is the …

    A. average resistance (%) of *E. coli*
    B. time (in months)
    C. type of antibiotic
    D. number of piglets used for the investigation

99. The results show that …

    A. antibiotic A is more effective than antibiotic B.
    B. antibiotic B is more effective than antibiotic A.
    C. Both antibiotic A and B were ineffective after 6 months.
    D. It took 6 months for the antibiotics to become effective.

100. A renewable energy source using heat within the earth that has not yet been utilized in South Africa to generate electricity, is …

    A. Solar
    B. Hydropower
    C. Geothermal
    D. Biomass

The end

[Intentionally Left Blank]