

SOUTH AFRICAN AGENCY FOR SCIENCE AND TECHNOLOGY ADVANCEMENT

10th NATURAL SCIENCE OLYMPIAD EXAM

GRADES 7 – 9

2020

INSTRUCTIONS

Please read the instructions carefully before answering the questions

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.

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.

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.**

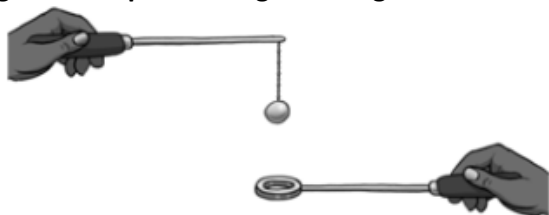
Note that the question numbers 1 to 100 on the answer sheet moves from top to bottom in several columns. Ensure that the number of your selection on the answer sheet corresponds with the number of the question in your examination question paper. Should you make a mistake, please erase the incorrect answer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

Three hours are allowed to answer the questions

1. Which one of the following elements is a liquid at room temperature?

- A bromine
- B oxygen
- C aluminium
- D helium

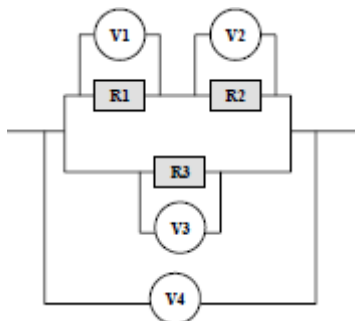
2. The following diagram shows a metal ball and ring apparatus. The ring and ball are both made of brass. At room temperature, the ball is just the right size to pass through the ring.



When the ball is heated, it is unable to pass through the ring. Which of the following is NOT true?

- A The volume of the ball increased.
- B The mass of the ball increased.
- C The speed at which the particles move increased.
- D The spaces between the particles increased.

3. Three identical resistors are connected in a circuit as shown in the following diagram.



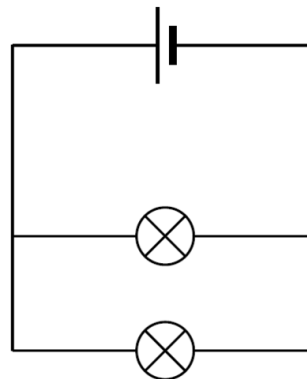
Which one of the following is NOT true?

- A $V_1 + V_2 = V_3$
- B $V_4 = V_1 + V_2 + V_3$
- C $V_1 = V_2$
- D $V_3 = V_4$

4. The boiling point of water at sea level is 100°C. In Gauteng water will boil at ... °C

- A 95
- B 100
- C 105
- D 120

5. Two identical bulbs are connected in parallel as shown in the circuit below.



When one of the bulbs is removed, the other bulb will...

- A glow brighter.
- B glow dimmer.
- C have the same brightness.
- D stop glowing.

6. In order to telecast the 2020 Olympic Games, a satellite will orbit the Earth at a height of 36 000 kilometres. In order to stay directly above China, this satellite will have to travel at an approximate speed of km.h⁻¹.

- A 0
- B 11
- C 110
- D 11 000

7. In 2012, the existence of a new sub-atomic particle (nicknamed the “God Particle”) was confirmed at the CERN laboratory in Switzerland. The particle was named a ...

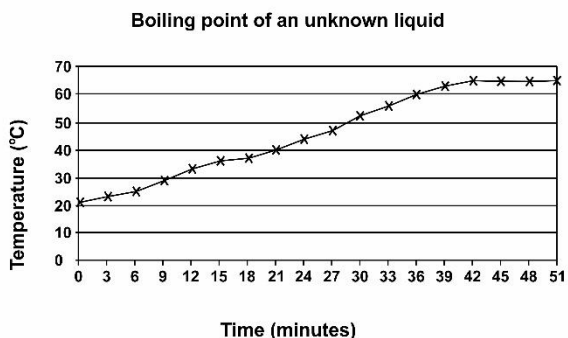
- A Positron
- B Neutrino
- C Muon
- D Higgs boson

8. Which one of the following substances does not react as an acid?

- A CaO
- B HNO₃
- C HCl
- D CH₃COOH

Use the following information to answer questions 9 and 10.

A scientist wants to determine the boiling point of an unknown liquid. She places the unknown liquid in a beaker and carefully heats it on a hot plate. The scientist measures the temperature of the liquid at regular time intervals (every 3 minutes). Afterwards, she draws the following graph:



The scientist suspects that the unknown liquid is one of the substances on the following list.

SUBSTANCE	BOILING POINT (°C)
Acetone	56
Methanol	65
Ethanol	78
Water	100

9. The unknown liquid was ...

- A acetone
- B methanol
- C ethanol
- D water

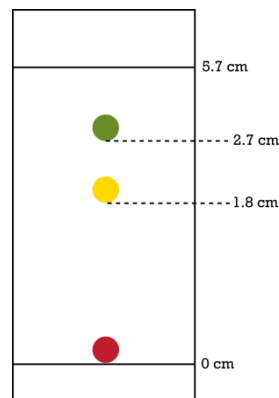
10. After 48 minutes the phase of the substance would be ...

- A liquid
- B gas
- C liquid and gas
- D solid

11. The International Year of the Periodic Table was celebrated in 2019, 150 years after its original design by the scientist ...

- A Albert Einstein
- B Dmitri Mendeleev
- C Sir Isaac Newton
- D James Dalton

12. The following method to separate substances in a mixture is known as ...



- A filtration
- B distillation
- C chromatography
- D evaporation

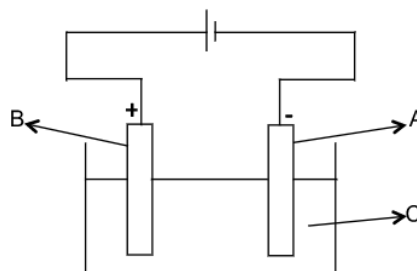
13. The boiling points of four compounds are given below.

COMPOUND	BOILING POINT (°C)
M	0
N	-162
O	-89
P	78

Which one of these compounds will be a liquid at -150°C and a gas at -20°C?

- A M
- B N
- C O
- D P

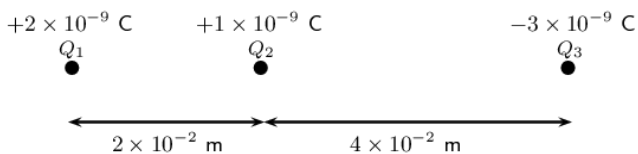
14. The following diagram shows the electrolysis of copper chloride.



Which one of the following statements is correct?

- A electrode B is the anode where Cu is formed.
- B electrode A is the cathode where Cu is formed.
- C electrode B is the cathode where chlorine gas is formed.
- D electrode A is the anode where chlorine gas is formed.

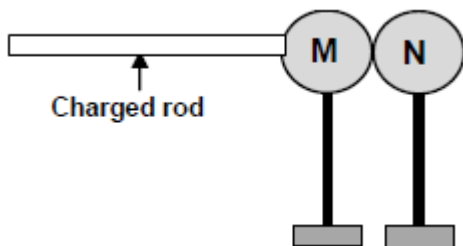
15. Three small charged objects are in a straight line. Their charges as well as the distances between them are given in the diagram below.



Due to static electricity, charge Q_3 will experience a force ...

- A. to the right
- B. to the left
- C. upwards
- D. downwards

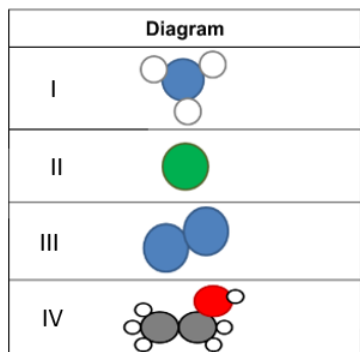
16. Two identical neutral spheres, M and N, are placed on insulating stands. They are brought into contact and a POSITIVELY charged rod is brought in touch with sphere M.



The charges on the objects after being allowed to touch will be:

	ROD	SPHERE M	SPHERE N
A	Positive	Neutral	Neutral
B	Positive	Negative	Neutral
C	Neutral	Positive	Positive
D	Positive	Positive	Positive

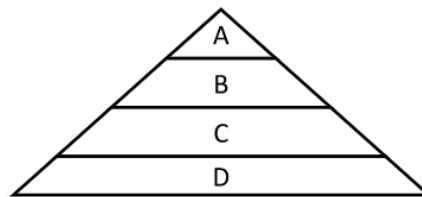
17. Study the following diagrams.



Which of the above diagrams represent an element?

- A. II & III
- B. I & IV
- C. I only
- D. III only

18. The accompanying diagram represents an ecological pyramid of a certain food chain in nature.



Which TWO letters represent carnivores?

- A. A & B
- B. C & D
- C. A & C
- D. B & C

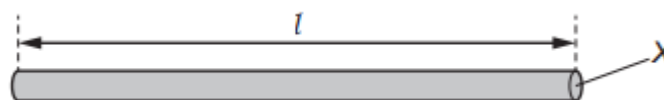
19. Which row shows the unit of force, the unit of mass and the unit of weight?

	Force	Mass	Weight
A	kg	N	kg
B	kg	kg	N
C	N	N	kg
D	N	kg	N

20. A liquid changes into a gas and this causes the temperature of the liquid to change. What is the name of this process, and how does the temperature change?

	Name of process	Temperature change
A	evaporation	increase
B	evaporation	decrease
C	condensation	increase
D	condensation	decrease

21. The diagram shows a wire of length l and cross-sectional area X .



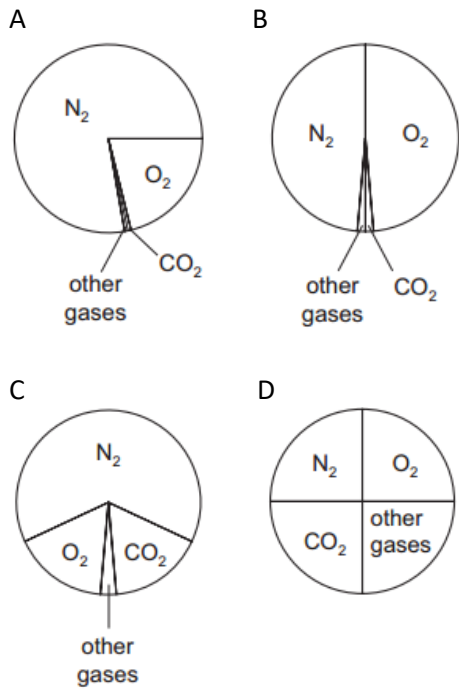
Which two changes will decrease the resistance of the wire?

- A. decrease l and decrease X
- B. decrease l and increase X
- C. increase l and decrease X
- D. increase l and increase X

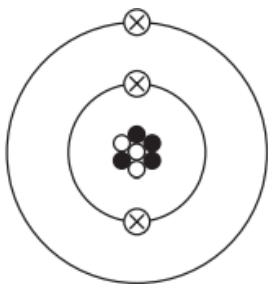
22. Aluminium ions have the formula Al^{3+} . Oxide ions have the formula O^{2-} . What is the formula of aluminium oxide?

- A AlO
- B AlO_2
- C Al_2O_3
- D Al_3O_2

23. Which pie chart shows the proportions of gases in clean air?



24. The diagram represents the structure of a lithium atom.



Which particle below is represented by \otimes ?

- A electron
- B neutron
- C nucleus
- D proton

25. Diagram 1 represents a wave.

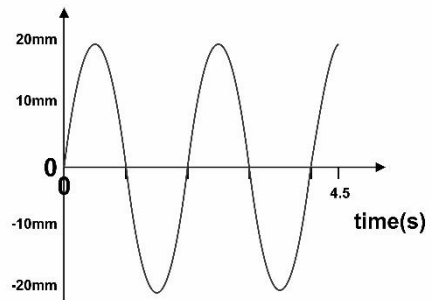
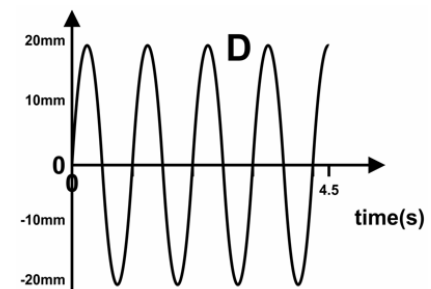
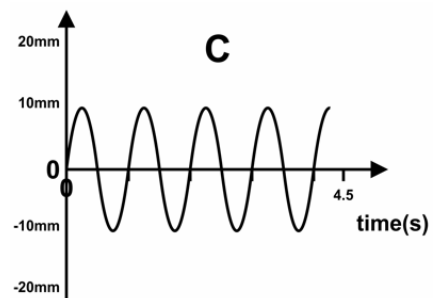
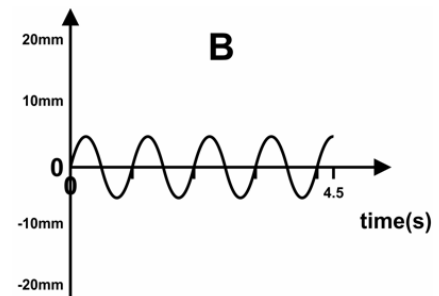
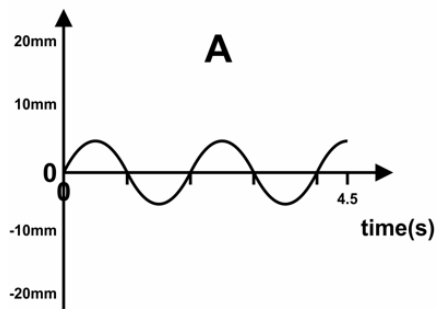
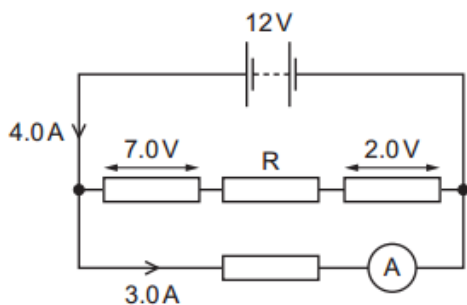


diagram 1

NB. The scales are the same in all the diagrams. All the diagrams show the number of waves moving past a point in 4,5 seconds. Which diagram below represents a wave with double the frequency and half the amplitude of the wave in diagram 1?



26. The diagram shows a circuit containing a battery and four resistors. One resistor is labelled R. Some values of potential difference and current are shown.



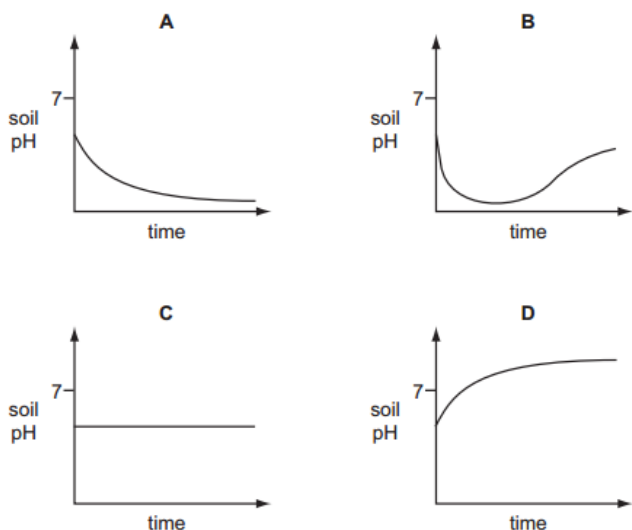
What is the potential difference across resistor R, and what is the current in resistor R?

	Potential difference (V)	Current (A)
A	12.0	1.0
B	12.0	4.0
C	3.0	1.0
D	3.0	4.0

27. Under which conditions will transpiration from a plant be the fastest?

	Temperature	Humidity
A	high	low
B	high	high
C	low	low
D	low	high

28. Which graph shows how the pH of soil changes when lime is added?



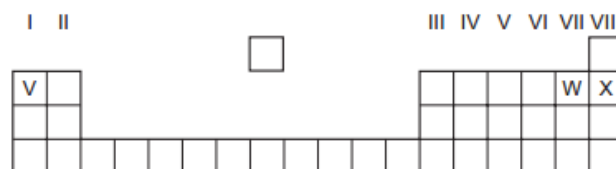
29. Which one of the following statements about the formation of ions is correct?

- A Anions are formed when atoms gain electrons.
- B Anions are formed when atoms lose electrons.
- C Cations are formed when atoms gain protons.
- D Cations are formed when atoms lose protons.

30. Which one of the following compounds is named incorrectly?

	Formula	Name
A	CO	carbon monoxide
B	SO ₂	sulphur dioxide
C	NaCl	sodium chloride
D	MgCl ₂	magnesium dichloride

31. Part of the Periodic Table is shown below.



Which element forms an anion and which element forms a cation respectively?

	Forms anions	Forms cations
A	X	W
B	W	V
C	V	X
D	V	W

32. A vehicle takes 30 minutes to travel a distance of 60 km. Calculate the average speed of the vehicle.

- A 2.0 km/h
- B 30 km/h
- C 120 km/h
- D 1800 km/h

33. Which pair of structures is found in a typical plant cell but not in a typical animal cell?

- A cell membrane and chloroplasts
- B cell membrane and cytoplasm
- C cell wall and chloroplasts
- D cell wall and cytoplasm

34. Which equation represents aerobic respiration?

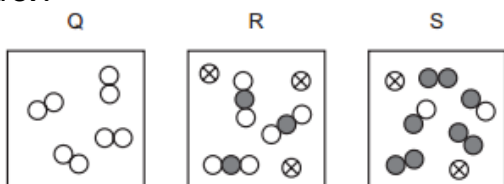
- A carbon dioxide + oxygen → glucose + water
- B carbon dioxide + water → glucose + oxygen
- C glucose + oxygen → carbon dioxide + water
- D glucose + water → carbon dioxide + oxygen

35. Adrenaline is sometimes called the 'fight or flight' hormone.

Which one of the following is an effect of adrenaline that helps prepare the body to fight or to take flight when frightened?

- A It increases blood glucose concentration.
- B It increases the rate of digestion.
- C It maintains a constant body temperature.
- D It slows down the heart rate.

The following diagrams represent containers filled with different gasses. Use the diagrams to answer questions 36 and 37.



36. Which of the following rows could be a correct representation of the gases?

	Q	R	S
A	O ₂	NO ₂ & H ₂	N ₂ , NO & He
B	O ₂	NO ₂ & He	N ₂ , NO & He
C	O ₂	NO ₂ & He	H ₂ , NO & He
D	H ₂	NO ₂ & He	N ₂ , NO & He

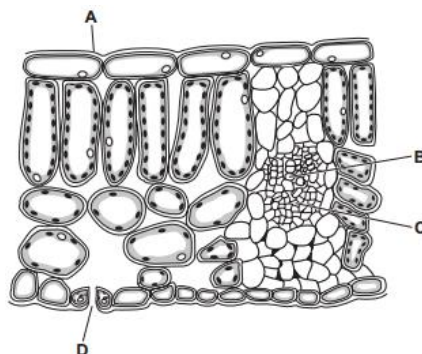
37. Which of the diagram(s) represent(s) the presence of a diatomic gas?

- A Q
- B R
- C S
- D Q and S

38. Infrared waves, microwaves, ultraviolet waves and visible light are all electromagnetic waves. Which one has the shortest wavelength?

- A infrared
- B microwaves
- C ultraviolet
- D visible light

39. The diagram below shows a section through a leaf.



Where does water enter the leaf?

- A A
- B B
- C C
- D D

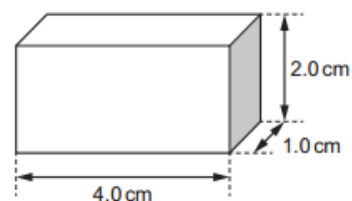
40. Optical fibres are used to transmit telephone conversations. What is transmitted by the optical fibres?

- A light waves with constant amplitude
- B pulses of light waves
- C pulses of sound waves
- D sound waves with constant amplitude

41. Which of the following will colour litmus paper blue?

- A Handy Andy
- B Vinegar
- C Lemon juice
- D Orange juice

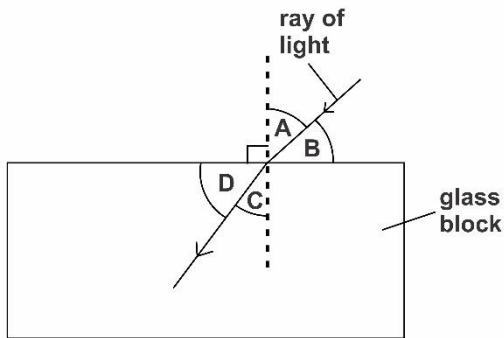
42. The diagram shows a solid block with dimensions as shown. The block is made from a material of density 4.0 g.cm⁻³.



Calculate the mass of the block?

- A 1.0 g
- B 16.0 g
- C 27.0 g
- D 32.0 g

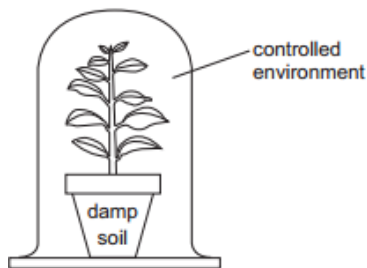
43. The diagram shows a ray of light as it enters a glass block.



Which labelled angle is the angle of refraction?

- A A
- B B
- C C
- D D

44. The diagram shows a plant in a controlled environment.



The list gives three ways in which the environment can be altered.

- 1 humidity increased
- 2 light intensity increased
- 3 temperature increased

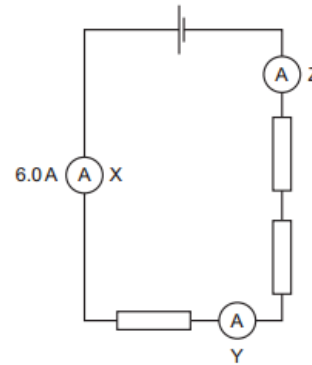
Which changes will cause an increase in the rate of transpiration of the plant?

- A 1 and 2
- B 1 only
- C 3 only
- D 2 and 3

45. Which of the following elements is a non-metal?

- A Calcium
- B Sodium
- C Mercury
- D Sulphur

46. The diagram shows a circuit containing three identical resistors and three ammeters X, Y and Z.



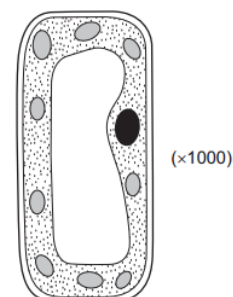
The reading on ammeter X is 6.0 A. What are the readings on ammeters Y and Z?

	Ammeter Y (A)	Ammeter Z (A)
A	2	4
B	3	3
C	4	2
D	6	6

47. Which one of the following rows represents the correct use for each of the elements?

	Copper	Carbon	Iodine	Chlorine
A	antiseptic	purify water	electrical wires	fuel
B	electrical wires	fuel	antiseptic	purify water
C	fuel	electrical wires	antiseptic	purify water
D	electrical wires	fuel	purify water	antiseptic

48. The width of the plant cell in the diagram is 30 mm when it is magnified by a microscope (magnification shown in brackets).



What is the actual width of the cell?

- A 0.003 mm
- B 0.03 mm
- C 0.3 mm
- D 30 mm

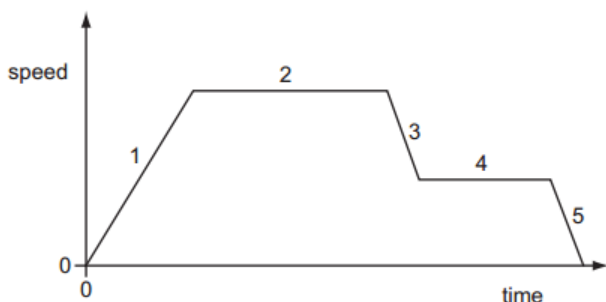
49. An atom of chlorine is represented by the symbol:



Which row represents the correct number of each particle in the atom?

	Protons	Neutrons	Electrons
A	17	18	18
B	17	35	17
C	17	18	17
D	35	17	17

50. The speed-time graph for a car's journey is shown below.



During which two parts of the journey is the car moving at constant speed?

- A 1 and 3
- B 1 and 5
- C 2 and 4
- D 3 and 5

51. The strength of the gravitational field on the Moon is less than the strength of the gravitational field on Earth. An object has mass M and weight W on the Moon.

What is the mass and the weight of the object on Earth?

	Mass	Weight
A	M	more than W
B	M	W
C	more than M	more than W
D	more than M	W

52. Which of the following is a correct, balanced chemical equation for the reaction between magnesium and oxygen?

- A $\text{Mg(s)} + \text{O(g)} \rightarrow \text{MgO(s)}$
- B $\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow \text{MgO}_2\text{(s)}$
- C $2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$
- D $2\text{Mg(s)} + 2\text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$

53. Which row in the table below correctly describes a female gamete compared to a male gamete?

	Size	Number produced	Mobility
A	smaller	fewer	more mobile
B	smaller	greater	less mobile
C	larger	fewer	less mobile
D	larger	greater	more mobile

54. Which row (A-D) in the table below correctly describes the four substances in the top row?

	Air	Brass	Copper	Iron oxide
A	mixture	element	element	compound
B	mixture	element	element	mixture
C	mixture	mixture	element	compound
D	element	mixture	compound	compound

55. An electric heater is labelled 1200 W. The cost of operating the heater for 2 hours if one unit of electricity costs R1.50 is:

- A R 2.16
- B R 3.60
- C R 21.60
- D R 36.00

56. The chemical method used to purify water is:

- A. Filtration
- B. Eutrophication
- C. Chlorination
- D. Bromination

57. The correct set of conditions to liquefy a gas is:

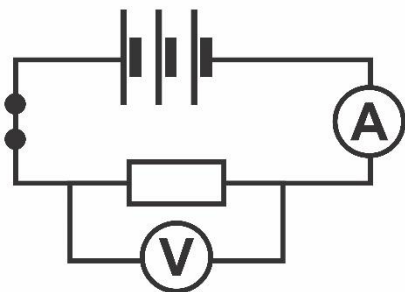
- A. Low temperature, high pressure
- B. High temperature, high pressure
- C. Low temperature, low pressure
- D. High temperature, low pressure

58. Which planet in our solar system is famous for the beautiful rings surrounding it?

- A Mars
- B Mercury
- C Venus
- D Saturn

Use the following information to answer questions 59 to 61.

The diagram below shows the apparatus used to investigate the relationship between the potential difference (voltage) across and the current flow over a certain resistor.



The following procedure is performed:

1. A suitable circuit is built with one cell to determine the potential difference across the resistor and the current through the resistor.
2. The readings on the voltmeter and ammeter are taken.
3. The potential difference is increased by adding another cell in series and the readings on the voltmeter and ammeter are taken.
4. Step 3 is repeated once more until three sets of readings are taken.

The following results were obtained:

Number of cells	Voltmeter reading (V)	Ammeter reading (A)
1	1.5	3
2	3.0	6
3	4.5	9

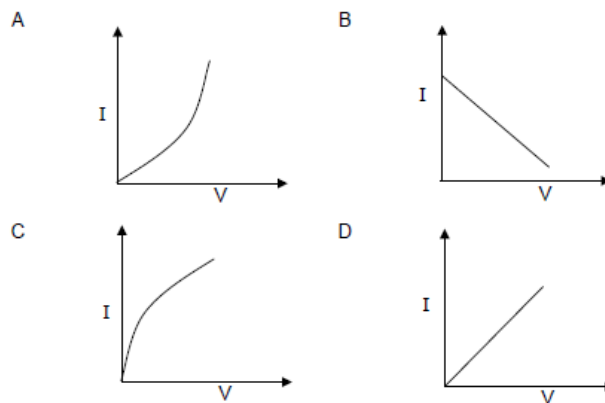
59. In this investigation the independent variable is:

- A. potential difference over the resistor
- B. current through the resistor
- C. temperature of the wires and resistor
- D. resistance of the resistor

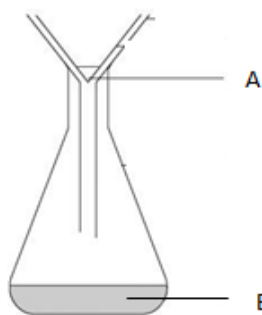
60. In this investigation the dependent variable is:

- A. potential difference over the resistor
- B. current through the resistor
- C. temperature of the wires and resistor
- D. resistance of the resistor

61. Which of the following is the correct graph obtained from the results?



62. The diagram below shows the apparatus for separating soil and water.



What are the parts labelled A and B called respectively?

- A A = residue, B = distillate
- B A = distillate, B = filtrate
- C A = filtrate, B = residue
- D A = residue, B = filtrate

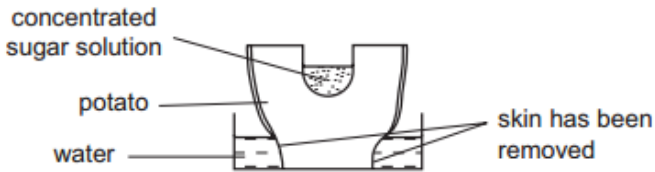
63. As the height of an orbiting satellite above the Earth's surface decreases, the speed of the satellite ...

- A ...increases
- B ...decreases
- C ...remains the same
- D none of the above

64. What is the name of the iron rich component that transports oxygen in the human blood?

- A collagen
- B keratin
- C melanin
- D haemoglobin

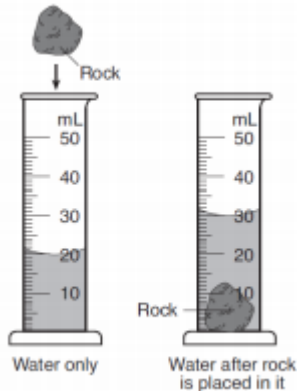
65. The diagram shows an experiment using an uncooked potato. The skin of the potato was removed as shown.



Which diagram below shows the result of the experiment after 24 hours?



66. The diagram below shows a rock being placed in a graduated cylinder containing water.



What is the volume of the rock?

- A 10 ml
- B 15 ml
- C 20 ml
- D 30 ml

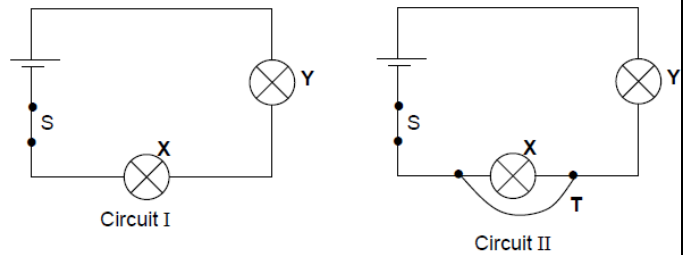
67. Which one of the following elements is a noble gas?

- A. Hydrogen
- B. Nitrogen
- C. Argon
- D. Chlorine

68. Which one of the following materials conducts electricity?

- A Graphite
- B Plastic
- C Glass
- C Wood

69. Circuit I shows two identical lamps X and Y connected to a cell of negligible internal resistance. Switch S is closed



A wire T, of negligible resistance, is now connected across X as shown in Circuit II.

Which ONE of the statements below best describes how the brightness of the lamps have changed after T is connected?

	X	Y
A	Does not light up	Dimmer
B	Brighter	Dimmer
C	Brighter	Brighter
D	Does not light up	Brighter

70. Which of the following products cannot be derived from crude oil?

- A. rubber
- B. natural gas
- C. wax
- D. glass

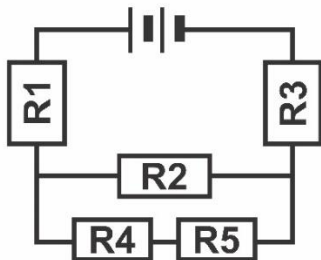
71. Sir Alex Fleming became famous in 1928 when he discovered ...

- A. penicillin
- B. the light bulb
- C. the microscope
- D. the Congo caves

72. Which one of the following substances do not contain carbon?

- A. diamonds
- B. sugar
- C. graphite
- D. table salt

73. Consider the following circuit diagram consisting of a battery and five resistors R_1 to R_5 .



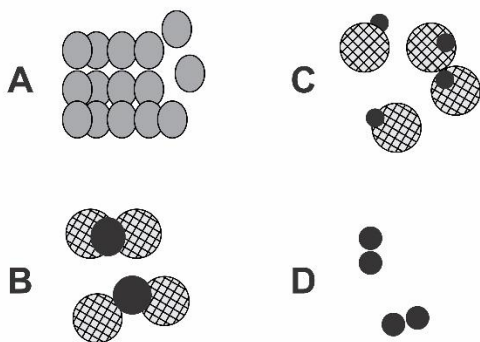
Which one of the following statements is correct?

- A R_1 is connected in series with R_2 .
- B R_4 is connected in parallel with R_5 .
- C R_1 is connected in parallel with R_3 .
- D R_2 is connected in parallel with R_4 and R_5 .

74. The first telescope was made by:

- A. Copernicus
- B. Galilei
- C. Newton
- D. Kepler

75. Which one of the substances in the following diagrams represents a salt?



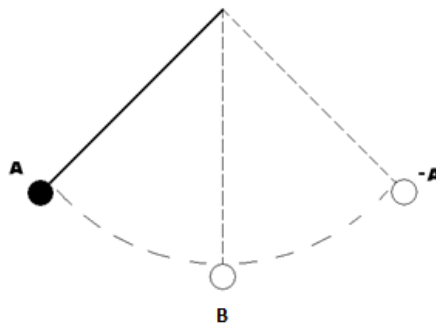
76. In 2016 the latest element named Oganesson was discovered in Russia by professor Yuri Oganessian. How many naturally occurring elements exist on Earth as of 2016?

- A 94
- B 92
- C 114
- D 118

77. The vitamin which is essential for blood clotting is:

- A Vitamin-A
- B Vitamin-B
- C Vitamin-C
- D Vitamin-K

78. The type of energy that a simple pendulum possesses when it is at position B, is....

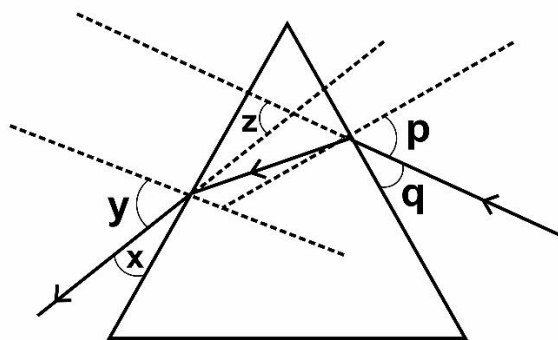


- A kinetic energy
- B potential energy
- C potential and kinetic energy
- D chemical energy

79. Sammy drives his scooter for 80 minutes. For the first 60 minutes, his average speed is 45 km.h^{-1} . For the last 20 minutes, his average speed is 75 km.h^{-1} . The total distance travelled is ...

- A. 4.2 km
- B. 3.9 km
- C. 70 km
- D. 140 km

80. Study the following ray diagram:



In the above diagram, the angle of incidence, the angle of emergence and the angle of deviation is respectively represented by ...

- A. y, p, z
- B. x, q, z
- C. p, y, z
- D. p, z, y

81. Which one of the following has the highest density?

- A. water
- B. ice
- C. oil
- D. alcohol

82. The lightweight metal used to manufacture airplanes is ...

- A. carbon
- B. platinum
- C. aluminium
- D. iron

83. A gas which is so dense that it can be “poured” is...

- A hydrogen
- B oxygen
- C carbon dioxide
- D water vapour

84. Which of the following rows represents the normal body temperature of humans and room temperature?

	Body temperature (°C)	Room temperature (°C)
A	37	30
B	37	25
C	25	25
D	25	30

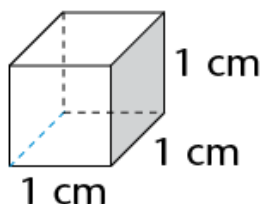
85. Which one of the following materials cannot be recycled?

- A. Steel cans
- B. Glass containers
- C. Computers
- D. Foam cups

86. Which one of the following is not a South African invention?

- A. Vuvuzela
- B. Kreepy Crawley pool cleaner
- C. Telephone
- D. Speedgun that measures the speed of cricket balls

87. The following cube has a volume of ...



- A. 1 dm³
- B. 3 dm³
- C. 1 cm³
- D. 3 cm³

88. A student carried out an experiment by putting weights on the end of a spring. After each weight was added, the length of the spring was carefully measured. The results are summarised below.

Weight added to spring (N)	2	4	6	8	10
Length of spring (cm)	23	27	31	35	39

From the data, what would be the length of the spring if the weight is changed to 15 N?

- A. 47 cm
- B. 49 cm
- C. 51 cm
- D. 53 cm

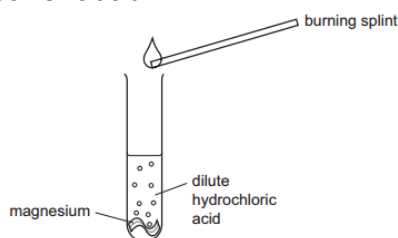
89. You are given the following masses and volumes for various blocks of materials. The mass of 1 cm³ of water is 1 g. Which block of the materials below will sink in water?

- A. material W: mass = 8 g, volume = 10 cm³
- B. material Z: mass = 20 g, volume = 40 cm³
- C. material Y: mass = 27 g, volume = 30 cm³
- D. material X: mass = 30 g, volume = 20 cm³

90. Which electromagnetic waves are found immediately on either side of the visible region of the electromagnetic spectrum?

- A. infrared and ultraviolet
- B. microwaves and infrared
- C. microwaves and X-rays
- D. ultraviolet and X-rays

91. The diagram shows how a student tested the gas given off when magnesium was added to dilute hydrochloric acid.



Which one of the following rows represents the correct name of the gas and the expected observation?

	Name of gas	Observation
A	Hydrogen	popping sound
B	Oxygen	popping sound
C	Hydrogen	splint burns bright
D	Oxygen	splint burns bright

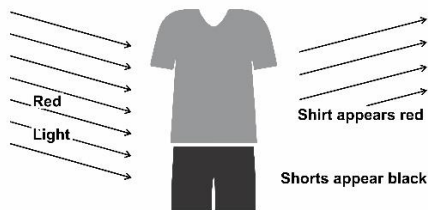
92. Which one of the following may cause a black hole?

- A. Comets
- B. Meteors
- C. Satellites
- D. An exploding star

93. Hexane, C_6H_{14} , burns in an excess of oxygen, forming carbon dioxide and water. Which one of the following is the correct balanced equation for this reaction?

- A. $C_6H_{14} + 9O_2 \rightarrow 6CO_2 + 7H_2O$
- B. $C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$
- C. $2C_6H_{14} + 19O_2 \rightarrow 6CO_2 + 7H_2O$
- D. $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

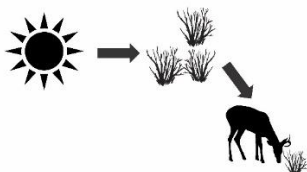
94. Red light shines on a shirt and shorts. The shirt appears red and the shorts appear black.



Which of the following is not possible?

- A. The shirt is white and the shorts are green.
- B. The shirt is red and the shorts are blue.
- C. The shirt is white and the shorts are black.
- D. The shirt is red and the shorts are white.

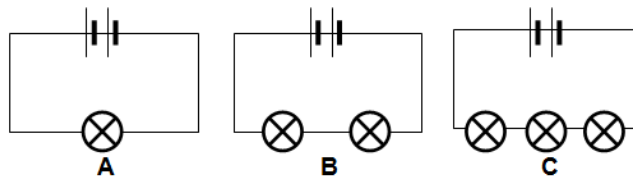
95. Which statement below correctly identifies the processes taking place in the following organisms?



- A. Photosynthesis will take place in the plant and respiration will take place in the animal.
- B. Photosynthesis will take place in the plant and both photosynthesis and respiration will take place in the animal.
- C. Photosynthesis and respiration will take place in the plant and only respiration will take place in the animal.
- D. Both photosynthesis and respiration will take place in the plant and in the animal.

Use the following information to answer questions 96 to 99.

The aim of the following investigation was to determine how the number of bulbs in series affects the brightness of the bulbs. All the cells and bulbs are identical.



96. In this investigation the independent variable is ...

- A. the number of bulbs used
- B. the brightness of the bulbs
- C. the number of cells used
- D. the current in the circuit

97. In this investigation the dependent variable is ...

- A. the number of bulbs used
- B. the brightness of the bulbs
- C. the number of cells used
- D. the current in the circuit.

98. In this investigation a controlled variable is ...

- A. the number of bulbs used
- B. the brightness of the bulbs
- C. the number of cells used
- D. the current in the circuit

99. In which circuit (A, B or C), will the bulb(s) be the brightest?

- A. A
- B. B
- C. C
- D. the brightness will be the same in A, B and C.

100. A balloon is rubbed against a jersey and brought closer to a wall. When the balloon is released, it clings to the wall. Which drawing below best explains why the balloon clings to the wall?

