



51st NATIONAL SCIENCE OLYMPIAD

LIFE SCIENCES

5 MARCH 2015

12:00 – 15:00

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 most 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 – 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.

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. The student number allocated to you can be obtained from your teacher and consists of eight digits e.g. 08149701

Do not fold the answer sheets.

Three hours are allowed to answer the questions

The SAASTA Education Unit wishes you the best of luck

NATIONAL SCIENCE OLYMPIAD

LIFE SCIENCES 2015

1. Which ONE of the following would not be essential in setting up an artificial ecosystem which was self-sufficient in material?
- A. Producers
 - B. Primary consumers
 - C. Decomposers
 - D. An energy source
2. Which structures in a plant cell contain DNA and cellulose respectively?
- | | DNA | Cellulose |
|----|-------------|------------------|
| A. | Cell wall | Cytoplasm |
| B. | Nucleus | Cell wall |
| C. | Chloroplast | Nucleus |
| D. | Cytoplasm | Chloroplast |
3. Which statement is a proper expression of cause and effect?
- A. Water is absorbed by plants to maintain the turgor of cells.
 - B. The need for the protection of the young in mammals has led to the evolution of maternal care.
 - C. The water requirements of plants lead to the growth of roots towards the most suitable regions of soil.
 - D. The incubation of birds' eggs promotes embryonic development.
4. Which one of the following carbohydrate molecules has the most carbon atoms?
- A. Glucose
 - B. Starch
 - C. Sucrose
 - D. Maltose
5. The biological factor which best accounts for stability of a mature ecosystem such as a deciduous forest is the ...
- A. complexity of the food chain.
 - B. rapid adjustment to changes of the environment.
 - C. high rate of production of the producer organisms.
 - D. low rate of release of nutrients by the decomposer organisms.
6. Which ONE of the following homeostatic properties of blood is inherited?
- A. Oxygen carrying capacity.
 - B. Speed of circulation.
 - C. Resistance to infection.
 - D. Capacity for clotting.
7. The pH scale of 1 to 14 uses a mathematical device which expresses hydrogen ion concentrations as ...
- A. a logarithmic decrease.
 - B. a logarithmic increase.
 - C. an arithmetical increase.
 - D. an arithmetical ratio of the concentration of **H** ions to **OH** ions.
8. Haemoglobin is released from red blood cells when they are placed in a solution of sodium chloride which is at a lower concentration than that of the solutes in the interior of cells. This is caused by ...
- A. diffusion of the cell solutes down a concentration gradient.
 - B. exosmosis of substances from the cells.
 - C. endosmosis causing rupture of the cell membranes.

D. increased permeability of the cell membranes caused by sodium chloride.

9. A student carries out tests on a food substance using biuret solution and iodine solution. If the food contains proteins only, what colours will be seen in the test-tubes at the end of each test?

	Biuret Solution	Iodine Solution
A.	Blue	Blue/Black
B.	Purple	Brown/Yellow
C.	Red	Blue
D.	Blue/Black	Milky White

10. The pressure available for effective filtration in the glomeruli of the mammalian kidney is reduced by ...

- A. re-absorption of the filtrate by the tubules.
- B. the size of the protein molecules in the plasma.
- C. the osmotic potential of the plasma protein.
- D. peripheral resistance of the capillaries in the body.

11. A chemical molecule contains sulphur and phosphorus. Which of the following could it be?

- A. A fatty acid
- B. Glycerol
- C. A protein
- D. A carbohydrate

12. A small mammal *P* was given a skin graft from another individual *Q* of the same species. The graft was rejected. Skin grafts from from other individuals *R* and *S* were then tried on *P* with the following results:

Graft from *R*: soon rejected
Graft from *S*: much later rejected

The choice of donor for a graft for *Q* would be:

- A. *R* because it was most readily rejected by *P*.
- B. *S* because it is more likely to be accepted by *Q*.
- C. Neither *R* nor *S* because they are both ultimately rejected by *P*.
- D. Neither *R* nor *S* because the results relate to *P* and not *Q*.

13. Each somatic (body) cell in the human has ...

- A. 23 different chromosomes.
- B. 46 similar chromosomes.
- C. 23 pairs of chromosomes.
- D. 46 pairs of different chromosomes.

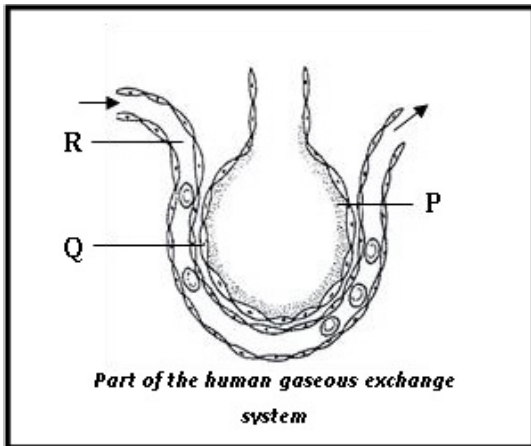
14. The name of the one big mass of land that all the present continents originated from, is ...

- A. Laurasia
- B. Gondwanaland
- C. Antarctica
- D. Pangaea

15. Which is the most likely progression in the development of a relationship between two associated animals?

- A. Commensalism, parasitism, symbiosis.
- B. Symbiosis, commensalism, parasitism.
- C. Symbiosis, tolerant parasitism, parasitism with disease symptoms in the host.
- D. Parasitism, predation, commensalism.

Questions 16 and 17 are based on the accompanying diagram.



16. The cells marked Q, are ...
- columnar epithelial cells.
 - squamous epithelial cells.
 - ciliated epithelial cells.
 - cuboidal epithelial cells
17. The blood vessel labelled R is a branch of the ...
- pulmonary vein.
 - hepatic portal vein.
 - hepatic vein.
 - pulmonary artery.
18. On a very hot day, which of the following would occur?
- Less blood will travel to the brain.
 - More blood would travel to the kidneys.
 - More blood will travel to the skin.
 - More blood will travel to the intestines.
19. Which ONE of the following reactions takes place in the liver of humans?
- Urea \rightarrow amino acids
 - Starch \rightarrow maltose
 - Glycogen \rightarrow glucose
 - Bile \rightarrow haemoglobin
20. Which attribute identifies the molecule of an unsaturated fat?

- The presence of some carbon atoms which do not have valency bonds linked with hydrogen atoms.
- A low proportion of weight of oxygen.
- An ester formed by a fatty acid with an alcohol other than glycerol.
- The incorporation of straight-chain fatty acids of the stearic series.

21. A large amount of fertiliser was added to pot plant. Which row of this table describes the effects of this fertiliser on the water absorbed by the roots and the turgidity of the cells in the leaf?

	Water absorbed by roots	Turgidity of leaf cells
A.	increased	increased
B.	increased	decreased
C.	decreased	increased
D.	decreased	decreased

22. Acquiring an oxygen debt is evidence that...
- lactic acid can be converted into glycogen.
 - oxygen cannot be stored in tissues.
 - anaerobic processes are slower than aerobic processes.
 - aerobic respiration is more complex than glycolysis.
23. Which equation summarizes the dark reactions in photosynthesis?
- $12 \text{H}_2\text{O} + 12\text{NADP} + n\text{P} \rightarrow 12 \text{NADPH}_2 + 6 \text{O}_2 + n\text{ATP}$
 - $6 \text{CO}_2 + 12 \text{NADPH}_2 + n \text{ATP} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 12 \text{NADP} + 6 \text{H}_2\text{O} + n\text{ADP} + n\text{P}$
 - $12 \text{NADPH}_2 + 6\text{O}_2 + n\text{ATP} \rightarrow 12 \text{H}_2\text{O} + 12 \text{NADP} + n\text{ADP} + n\text{P}$
 - $6 \text{CO}_2 + 12 \text{H}_2\text{O} + n\text{ATP} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 + 6 \text{H}_2\text{O} + n\text{ADP} + n\text{P}$
24. Which ONE of the following is not a symptom of iron deficiency in plants?

- A. Reduced rate of respiration.
 B. Reduced root growth.
 C. Long thin internodes.
 D. Little starch present in leaf tissue.
25. In vascular plants, which substance is restricted to one direction of translocation?
 A. Sucrose in sieve tubes.
 B. Auxins in growing tissues.
 C. Reserve amino acids in germinating seedlings.
 D. Gibberelins in growing tissues.
26. Defaecation, sweating, urination and expiration are all ways in which the body loses:
 A. Urea and heat B. Urea and salts
 C. Heat and water D. Salts and water
27. In the deamination of an amino acid in the liver, which could be an initial product?
 A. A keto acid B. Urea
 C. Glucose D. Glycogen
28. Which of the following are decomposers of dead organisms?
- | | Bacteria | Fungi | Viruses |
|----|-----------------|--------------|----------------|
| A. | No | Yes | No |
| B. | Yes | Yes | Yes |
| C. | No | Yes | Yes |
| D. | Yes | Yes | No |
29. Some human saliva was mixed with an equal amount of starch solution. It was left at 70°C for 30 minutes. Several drops of iodine solution were added to it. The contents of the test tube were ...
 A. brown B. orange
 C. colourless D. black
30. In experiments on photosynthesis, the rate is usually measured as the amount of oxygen given off per unit time because oxygen ...
 A. combines easily with most substances.
 B. is an easily measured product.
 C. is an important product of photosynthesis.
 D. is constantly being given off by plants.
31. An experiment was carried out to determine if heat was given off during respiration. Living organisms were put in some vacuum flasks, and these were turned upside down so that the thermometers pointed downwards. The reason for making the thermometers hang down is that ...
 A. hot air rises.
 B. carbon dioxide is lighter than air.
 C. it increases oxygen uptake.
 D. thermometers can be taken out easily.
32. Most of the enzymes that are needed for the Krebs cycle are found in the ...
 A. mitochondria B. ribosomes
 C. cytoplasm D. chloroplasts
33. Which expression is true for all reactions in which oxidation occurs?
 A. Transfer of electrons or protons.
 B. Transfer of electrons only.
 C. Gain in oxygen.
 D. Loss of hydrogen.
34. The actively dividing tissue that produces growth in plants is:
 A. Sclerenchyma B. Meristematic
 C. Chlorenchyma D. Companion cells
35. In which cell of the female mammal does the nucleus undergo reduction division?

- A. Oogonium B. Primary oocyte
C. Secondary oocyte D. First polar body
36. The foramen magnum forms part of the ...
A. lower limbs B. skull
C. spinal column D. upper limbs
37. In coal smoke, the material which has the most harmful effect on growing plants is ...
A. carbon monoxide.
B. carbon particles.
C. sulphur dioxide
D. tarry deposits.
38. The following is a list of compounds found in a cell:
i. Glucose
ii. Proteins
iii. Carbon
iv. Hydrogen
v. Water
vi. Vitamins
- Which of the following combinations are organic compounds found in animal cells?
A. (i), (ii) and (iii)
B. (ii), (iv), (v) and (vi)
C. (i), (ii), (iii) and (v)
D. (i), (ii) and (vi)
39. In which cell structures would multiple layers of electron donors and acceptors be found?
A. The inner folded membranes of mitochondria.
B. Grana of chloroplasts.
C. Muscle fibrils.
D. Non-myelinated axons of neurons.
40. Where is ATP produced in the process of tissue respiration?
A. Krebs' cycle only.
B. Glycolysis only.
C. Krebs' cycle and glycolysis.
D. Krebs' cycle, glycolysis and electron transfer.
41. How many different genotypes could be derived in one generation from a dihybrid cross between two organisms which were heterozygous for both characteristics?
A. 4 B. 8
C. 9 D. 16
42. Diffusion is the movement of molecules from a region of higher concentration to one of lower concentration. This is applicable to ...
A. gases only.
B. liquids only.
C. solutes only.
D. gases, liquids and solutes.
43. The four basic structural parts of most flowers are ...:
A. petals, sepals, pistils and stamens.
B. calyx, corolla, ovules and pollen.
C. stamens, pistils, pollen and seeds.
D. petals, stamens, cotyledons and pistils.
44. A father has blood type A. He has 4 children with the following blood types:
Child 1 – A
Child 2 – O
Child 3 – AB
Child 4 – B
What is the blood type of the mother of the above children?

- A. A B. B
C. O D. AB

45. The following data represents a small section of a sequence of nucleic acid bases taken from an animal cell:

A G C U C G U U

From this data it is reasonable to conclude that ...

- A. this portion of nucleic acid will code for a chain of eight amino acids.
B. the sequence given will be complementary to the sequence CTCGTGCTT.
C. the nucleic acid shown contains the sugar ribose.
D. the nucleic acid shown is DNA.
46. In a situation where a characteristic is expressed more frequently in males than in females in humans, we can conclude that ...
- A. one allele is dominant over the other.
B. the alleles for the characteristic are located on the X chromosomes.
C. the alleles for the characteristic are located on the autosomes.
D. the alleles for the characteristic are located on the Y chromosomes.
47. The list below provides information relating to the replication of DNA:

- 1 Complementary nucleotides bind to each of the two strands.
- 2 Sugar phosphate bonds form between the nucleotides.
- 3 The newly formed DNA molecules are identical to each other.
- 4 After unwinding, the DNA molecule forms two single strands.

The correct order of these events as they occur in DNA replication is ...

- A. 1, 2, 3 and 4 B. 1, 2, 3 and 2
C. 4, 2, 1 and 3 D. 4, 1, 2 and 3

48. Which is the main disadvantage in using *Drosophila* for breeding experiments?

- A. The small size of the imago.
B. Short life cycle.
C. Large number of eggs produced.
D. Occurrence of mating soon after emergence from the pupa.

49. The amount of DNA found in the interphase nucleus of tissues showing active mitosis in animals may be twice or four times the amount found in gametes. This suggests that DNA synthesis occurs during ...

- A. prophase of mitosis.
B. metaphase of mitosis.
C. prophase of meiosis I.
D. Interphase.

50. In *Drosophila*, the male sex is determined by the chromosomes XY and the female by XX. A recessive mutation in the X chromosome of a male was produced by exposure to radium. The effect of this mutation could appear in the phenotype of a ...

- A. female in the F₁ generation.
B. male in the F₁ generation.
C. female in the F₂ generation.
D. male in the F₂ generation.

51. Which would be the smallest combination of the four DNA bases, adenine, thymine, cytosine and guanine to give a sufficient number of codes to represent the range of amino acids necessary for protein synthesis?

- A. The single bases.
B. Bases in pairs.
C. Bases in threes.
D. Bases in fours.

52. In eukaryotes, DNA may be found in ...
- A. nuclei B. mitochondria
C. chloroplasts D. all of the above
57. Meiosis in a diploid cell results in ...

53. Continuous interbreeding in an isolated population leads to ...
- A. increase in variation.
B. decrease in variation.
C. increase in mutation rate.
D. extinction of the population.

54. Which ONE of the following accounts for gametes having a single allele only for a particular characteristic, instead of two?
- A. The chromosome number is halved during Meiosis II.
B. Mendel's principle of segregation.
C. Mendel's principle of independent assortment.
D. The 'law' of dominance.

55. The control centre in the body that will be activated when an athlete is dehydrated is the ...
- A. cerebellum.
B. cerebrum.
C. corpus callosum.
D. pituitary gland.

56. The following are effects of the secretion of different hormones:
- 1 An increase in the blood glucose level.
 - 2 An increase in the heart rate.
 - 3 An increase in the amount of digestive enzymes.
 - 4 An increase in blood flow to the skeletal muscles.

Which ONE of the following combinations of the above effects is due to adrenalin?

- A. 1, 3 and 4 B. 2, 3 and 4
C. 1, 2 and 4 D. 1, 2, 3 and 4
- A. four identical gametes.
B. four haploid gametes.
C. two different diploid gametes.
D. four gametes having the same chromosome number as the parent
58. The list below gives some of the stages involved in gamete and zygote formation.
- 1 Prophase I
 - 2 Prophase II
 - 3 Metaphase I
 - 4 Fertilisation

Which ONE of the following combinations of the above stages contributes to genetic variation?

- A. 1, 2 and 3 B. 1, 3 and 4
C. 2 and 3 D. 3 and 4
59. In a gene pool with equal proportions of a dominant and recessive genotype, the removal of the recessive phenotype in each generation would ...
- A. make no difference to the proportions of the genotypes.
B. decrease the proportion of the recessive phenotypes.
C. lead to the disappearance of the recessive phenotypes.
D. lead to the disappearance of the recessive genotypes.
60. Which one of the substances could be used to find out if transpiration had happened?

- A. Cobalt chloride
B. Potassium hydroxide

- C. Litmus
D. Lime water
61. Which of the following cannot be explained as being due to osmosis?
- A. The shrinking of plant cells when placed in a strong sugar solution.
B. The movement of sugars made by photosynthesis in the phloem.
C. The movement of water from the soil into the cytoplasm of a root hair.
D. A rise in the level of a sugar solution on a potato which has been hollowed out and put in water.
62. A casparian strip can be found in ...
- A. xylem vessels.
B. phloem sieve tubes.
C. endodermal cells.
D. the root pericycle.
63. If a normal mesophytic plant is watered with sea water it will eventually die because ...
- A. the water potential of the root hair cells is higher than that of the soil.
B. the water potential of the root hair cells is lower than that of the soil.
C. the pores of the cell membrane get blocked with salt and close.
D. the pores of the cell membrane become too wide.
64. A species of insect was found to have developed resistance to a commonly used insecticide. Which ONE of the following explanations is most likely?
- A. The insect population was evolving towards resistance to the insecticide.
B. The original gene pool included genes which determined resistance to the insecticide.
C. The insecticide stimulated development of resistance in certain individuals and was inherited.
D. The insecticide caused a mutation which was favourable to resistance and this was inherited.
65. Which factor determines sex in the honey bee?
- A. Queen substance.
B. A chromosome mechanism.
C. Feeding of the larvae.
D. Type of comb cell in which larvae and pupae develop.
66. Which structure in non-flowering plants corresponds to the ovule of a flowering plant?
- A. Scale of a female cone of a gymnosperm.
B. Sporangium of a fern.
C. Archegonium of a bryophyte.
D. Egg cell of a bryophyte.
67. A person who is stranded in a desert is very thirsty. His body will show the following reaction:
- A. Less water will be filtered through Bowman's capsule.
B. More water will be absorbed by the tissue fluid.
C. The hypophysis (pituitary gland) is stimulated to secrete more ADH.
D. The hypophysis (pituitary gland) is stimulated to secrete less ADH.
68. Which ONE of the following would you normally find in blood plasma, glomerular filtrate and the urine?
- A. Plasma proteins B. Amino acids
C. Urea D. Glucose
69. The zone of maximum elongation in a root is characterized by ...

- A. the effect of an osmotic gradient between sea water and the cell sap of the plant.
- B. the physical diffusion of the potassium ions.
- C. control of the movement of the ions by metabolic activity.
- D. a cell sap which is hypertonic to sea water.
81. In actively growing young plants, the best data to use for estimating the rate of photosynthesis would be:
- A. The ratio of oxygen evolved to carbon absorbed.
- B. Increase in fresh weight.
- C. Increase in dry weight.
- D. Increase in carbohydrate.
82. A moist surface is necessary for gas exchange between organisms and the environment because ...
- A. gasses diffuse more rapidly though water than through air.
- B. moist membranes can be kept alive.
- C. gases diffuse through membranes in solution.
- D. living organisms first evolve in water.
83. The most favourable feature for a man lifting a weight which required an energy output of 1 000 joules would be high ...
- A. tidal volume of the lungs.
- B. heart output when at rest.
- C. blood glucose level.
- D. capacity for oxygen debt.
84. A learner did a mark-recapture exercise in a local stream. He first caught 50 crabs and marked them with paint. These crabs were released. 5 days later 100 crabs were caught. 20 of these crabs had paint marks on them, meaning they had also been in the first catch. What is the estimated crab population?
- A. 180
- B. 250
- C. 510
- D. 5 000
85. The ascent of high mountains may cause altitude sickness in a man. Which is the prime cause of this condition?
- A. Excess carbon dioxide in the blood.
- B. Decreased efficiency of haemoglobin.
- C. Decreased partial pressure of oxygen.
- D. Decreased proportion of oxygen in the air.
86. Which substance increases in the blood plasma when there is an uptake of carbon dioxide?
- A. Carbonic acid.
- B. Potassium bicarbonate.
- C. Sodium bicarbonate.
- D. Sodium chloride.
87. When the blood from a donor is incompatible with that of the recipient, agglutination is due to ...
- A. antibodies in the red blood cells attacking antigens.
- B. antigens of red blood cells attacking antibodies of the donor.
- C. antigens of the donor's red blood cells attacking other antibodies.
- D. antibodies of the recipient reacting with antigens of the donor.
88. Which of the following conditions in man is caused by under activity of the thyroid gland in childhood?
- A. Cretinism.
- B. Nervous excitability with enlarged thyroid.
- C. Enlarged thyroid which is underactive.
- D. Myxoedema.
89. In the contraceptive pill, use had been made of progesterone which inhibits the

development of the Graafian follicles in the ovary. Which ONE of the following events would not be a consequence of taking these pills?

- A. Inhibition of LH secretion.
- B. Inhibition of FSH secretion.
- C. Build-up of oestrogen levels in the body.
- D. Prevention of menstruation.

90. The myelin sheath of an axon is formed from ...

- A. Schwann cells.
- B. Nissl's granules.
- C. Nodes of Ranvier.
- D. Deposits of fat.

91. If the tendon of a skeletal muscle is cut, the muscle becomes completely flaccid. This is because ...

- A. muscle stretch receptors (muscle spindles) are no longer stimulated.
- B. sustained isometric contraction is no longer possible.
- C. motor nerves must have been destroyed.
- D. tetanus is no longer possible.

92. Oxygen debt could be most readily removed from a muscle during and immediately after severe exercise by increasing the ...

- A. rate of disposal of pyruvic acid in the muscle.
- B. oxygen supply to the muscle.
- C. the circulation of blood through the muscle.
- D. the supply of phosphate to the muscle.

93. Which of the following is typical of a lumbar vertebra?

- A. A centrum is absent.
- B. The neural spine is absent.

- C. The transverse processes serve as attachment for muscles.
- D. A neural canal is absent.

94. At which trophic level is contamination from persistent agricultural insecticides most likely to accumulate?

- A. Producers
- B. Herbivores
- C. Carnivores
- D. Detritus feeders

95. The only artery in humans that carries deoxygenated blood, is the ...

- A. carotid artery.
- B. pulmonary artery.
- C. aorta.
- D. renal artery.

96. Which of the following constitute the vascular tissue in plants?

- A. Fibres and stone cells.
- B. Root-hairs and root caps.
- C. Collenchyma and sclerenchyma.
- D. Sieve tubes and tracheids.

97. Which ONE of the following is an advantage of the testes being held in the scrotum, outside the body cavity?

- A. More sperm can be stored in the scrotum.
- B. Sperm formation is more efficient at temperatures below the normal body temperature.
- C. The testes are better protected in the scrotum than in the body cavity.
- D. There is more time for prostate secretions to be added to the sperm.

98. In an investigation it was found that 10% of the bases in a molecule of DNA were thymine. What was the ratio of thymine to guanine in the same molecule?

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

99. A ring of DNA (plasmid) is taken from a bacterial cell to produce insulin. The steps which follow are NOT in the correct order below.

- 1 The gene for insulin is removed from a cell of a human pancreas.
- 2 The bacteria make clones of themselves and produce insulin.
- 3 The insulin gene is put into the plasmid and into a new bacterial cell.
- 4 The bacterial plasmid is cut using enzymes.

The CORRECT order of the steps is ...

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

100. When the first child of two parents, without any visible genetic disorder, was born, the child was found to have a serious genetic disorder. The parents were told that a recessive gene had caused the disorder, and that only one pair of genes was involved. If they had a second child this child ...

- A. was certain to have the disorder.
- B. had a 1 in 2 chance of having the disorder.
- C. had a 1 in 4 chance of having the disorder.
- D. had no chance of having the disorder.

The End