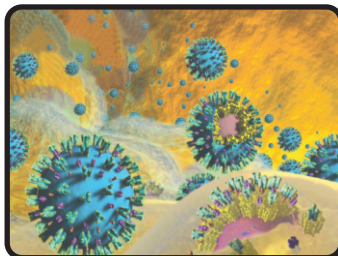


EtG

OLYMPIAD EXPLORER BIOTECHNOLOGY

EduHeal Foundation
Nationwide Biotechnology Olympiad
and other
National/International Biotechnology Olympiads/Talent Search Exams.



Class- 11

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SYLLABUS GUIDELINES*

Based on CBSE, ICSE & GCSE Syllabus & NCF guidelines devised by NCERT

Key Topics in Mathematics for Class XI and XII

- I. ALGEBRA
Sets, Relations and Functions, Complex Numbers, Matrices and Determinants ,
Quadratic Equations, Permutation and Combination, Binomial Theorem and its
Applications, Sequences and Series
- II. CALCULUS
Differential Calculus, Integral Calculus, Differential Equations
- III. TWO AND THREE DIMENSIONAL GEOMETRY
Two dimensional Geometry, The straight line and pair of straight lines,
Circles and system of Circles, Conic Section, Three dimensional Geometry
- IV. VECTORS
Vector Algebra
- V. STATISTICS
Measures of Central Tendency and Dispersion, Probability
- VI. TRIGONOMETRY
- VII. STATICS AND DYNAMICS
Statics, Dynamics

Key Topics in Physics for Class XI and XII

1. Units and Measurement
2. Description of Motion in one dimension
3. Description of Motion in Two and Three dimensions
4. Laws of Motion
5. Work, Energy and Power
6. Rotational Motion and Moment of Inertia
7. Gravitation
8. Properties of Matter
9. Oscillations
10. Waves
11. Heat and Thermodynamics
12. Transference of heat
13. Electrostatics
14. Current Electricity
15. Thermal and Chemical Effects of currents
16. Magnetic Effects of Currents
17. Magnetostatics
18. Electromagnetic Induction and Alternating Currents
19. Ray Optics
20. Wave Optics
21. Electromagnetic waves
22. Electrons and Photons
23. Atoms, Molecules and Nuclei
24. Solids and Semi-Conductor Devices

Class - 11

v

Key Topics in Chemistry for Class XI and XII

1. Atoms, Molecules and Chemical Arithmetic
2. Elements, their Occurrence and extraction
3. States of Matter Gaseous state
4. Atomic Structures Constituents of the atom
5. Chemical Families – Periodic Properties
6. Chemical Bonding and Molecular structure
7. The Solid State
The Gaseous state
8. Solutions
9. Chemical Energetics and Thermodynamics
10. Chemical Equilibrium
11. Redox Reactions and Electrochemistry
12. Rates of Chemical Reactions and Chemical Kinetics
13. Chemistry of Hydrocarbons
14. Purification and Characterisation of Organic Compounds
15. Organic Chemistry Based on Functional Group
16. Organic Chemistry Based on Functional Group II
17. Organic Chemistry Based on Functional Group-II
18. Chemistry of Non-metals
19. Chemistry of Non-metals – II
20. Chemistry of lighter Metals
21. Heavy Metals
22. Chemistry of Representative Elements
23. Transition Metals including Lanthanides
24. Coordination Chemistry and Organo Metallics
25. Nuclear Chemistry
26. Synthetic and Natural Polymers
27. Surface Chemistry
28. Bio Molecules and Biological Processes
29. Chemistry in Action

Key Topics in Biology for Class XI and XII

1. General Biology
2. Systematics and Classification
3. Animal Kingdom
4. Plant Kingdom
5. Cell Biology
6. Genetics
7. Human Biology
8. Angiosperm Botany
9. Ecology and Environment
10. Application of Biology
11. Evolution



For Maths, Physics & Chemistry please refer to Maths and Science Workbooks.

International Biology Olympiad **INTERVIEW with** 
IBO **INTERNATIONAL BIOLOGY OLYMPIAD MEDALISTS**
 Saskatoon Canada 2007
MAKING INDIA PROUD

Edusys : *How did you prepare for the International Biology Olympiad? Is any special preparation required for it?*

Anurag Shahi : For the International round of the exam, we were prepared by the teachers at HBCSE. They guided us and provided us books to study. The training camp was excellent and exhaustive and one can really learn a lot of things which help him even in further studies. As the questions are quite different from the one usually asked in other exams such as PMT, some special preparation is required. One should solve previous years



(L - R) Devanshu Bansal (Silver medalist), Anurag Chahal (Silver medalist), Kalyani Kansal (Gold medalist) and Anurag Shahi (Silver medalist).

papers to know the pattern of questioning and study accordingly. Practicals are very-very important part and hence it is an area to concentrate.

Devanshu Bansal : Concept clearing and application of the basic knowledge and logic is important. Practical component has quite a large weightage, hence equal stress on practicals and theory is required. Training camp gives good practice.

Anurag Chahal : There is no special preparation required for the International Biology Olympiad. While studying, you should keep in mind that you have to clear your concepts. Whatever you read, you should be 100% clear about the concepts.

Kalyani Kansal : Initially we had an Orientation-cum-selection camp at Mumbai from 3 June to 11 June. After that we had a Pre-Departure Camp in July, which was for 14 days. During these camps, we were oriented with the lab practices, we did dissections, general slide preparations, biochemical and genetics experiments etc. And besides that we did old theory papers of Indian National Biology Olympiad (INBO) and IBO. So that was the preparation we did. As such, Olympiad is not something for which you can prepare really. Its what all

you have gathered during the past 2 years. There is no specific “pattern” for which one can prepare. One has just to be clear about the different ideas, the very basic facts (Eg. the direction of DNA replication etc.) and keep one’s mind open as he/she goes to take the exam.

Edusys : *What books you referred to?*

A.S. : ‘Campbell’ is a must for the International part. It is the *bible* for IBO. Other useful books are Guyton, Biological Sciences (Cambridge University Press), and Lehninger. (These books are used as physiology & biochemistry text books in 1st year MBBS)

D.B. : Among books, Campbell is the most recommended. It gives good practise.

A.C. : You should go through Biology by Campbell & Reece if you really want to score good in IBO. Probably I did not get a gold medal because I did not go through this book. NCERT books are required only to clear the first round but 2nd round onwards only Campbell helps and so does Biological Sciences - Cambridge University Press by Soper *et al.* Lehninger is also good book for biochemistry.

K.K. : Neil A. Campbell’s Biology.

Edusys : *What was your experience when you wrote the International Biology Olympiad?*

A.S. : While writing any exam my mind just goes blank, I mean blank to everything except the questions and options. I felt nervous & tensed just before the exam started. Once the exam started, I just felt like answering the questions. At that time there is no room for nervousness, any sort of doubt or anything else. You just have to concentrate hard on the questions, shut your mind to all other thoughts and give your best shot.

D.B. : The IBO exam was very good. The practicals were skilfully designed and it required practice to do them properly. But after the training camp, they did not seem that difficult. The theory paper was quite easy.

A.C. : I was quite excited & a bit nervous as I was representing India at the International level and all the eyes were set on me and the medal and glory I was going to get for my country depended on my performance in those few hours.

K.K. : Obviously it was the experience of a lifetime. I mean, think about it. With a mere Rs 50 you are trained with the best teachers of the country, meet new people, live in luxury, go abroad etc. As for the exam, it didn’t throw any surprises as such, except for the fact that it was a rather simple one as compared to INBOs and some other IBOs.

Edusys : *What was the pattern of exam and what was the question paper like? Can you recall any question which appeared in the exam?*

A.S. : The pattern was different from the usual exams. It was mostly applied but stress was laid on little details which sometimes skip notice. If you have gone through the text thoroughly with understanding, it is easy. There were questions like filling tables, matching columns etc. These look easy but you need good solid basics and thinking ability to get through.

D.B. : The exam had 2 parts - theory and practical. The practical part had 4 topics - Genetics, Biochemistry, Plant Sciences and Animal Sciences with 1½ hrs. for each topic. The theory included all the different aspects of biology (like Cytology, Ethology, Ecology, Genetics and Evolution, Botany, Zoology, Systematics). The theory exam had 2 parts, one with MCQs and the other with match the following, fill in the blank type.

For example, in Genetics practicals, there was DNA extraction, in Biochemistry, there was colorimetry & sectioning in Botany.

A.C. The pattern of the exam was as if they wanted to test your basic knowledge. They did not expect you to know details of each organism or each unique phenomenon, but they wanted that you to know the basic concepts regarding very elementary processes like glycolysis. But you should be clear enough about what you know. Question paper seemed quite easy but was tricky which would include some hidden hints which had to be seen before final attempt.

K.K. : As for the theory exam, there are objective questions mainly (except a few related to cladograms), most of them are multiple choice, others are matches (hardly any factual matches) etc. As per the IBO, the exam shouldn't have more than 25% factual questions. The practicals are like, we are given a detailed set of instructions, and we have to follow these and be patient and accurate. One has to have plenty of presence of mind for the practicals. Then in the follow-up questions we are asked to interpret the results and predict results in case of any change in the experimental setup.

Edusys : Students who appeared in the previous International Biology Olympiad said that ethology is an important chapter for International Biology Olympiad. What do you say?

A.S. : Yes, Ethology is very very important.

D.B. : Yes, Ethology can have questions which require logic and application of the basic knowledge about the patterns of behaviour of the various animals.

A.C. : Yes, ethology is indeed an important part of Ecology as per IBO syllabus. In Biology by Campbell, the details given are enough and this book demarcates the syllabus for International Biology Olympiad.

K.K. : Yes it is. But it's not a big deal. Once you get acquainted with some basic terms like habituation, altruism etc., it's all about having some presence of mind. But sometimes there are certain important examples which might be asked about, so in that case, one ought to refer to Campbell.

Edusys : Which topics are important for International Biology Olympiad?

A.S. : The topics which are generally neglected for PMT's and some entirely new topics like Ethology, Ecology, Biostatistics, Biosystematics, Probability analysis, Genetics are important.

D.B. : Topics like genetics and evolution, Biostatistics are quite important for International Biology Olympiad.

A.C. : Biostatistics, Genetics- in a little detail and evolution, Biosystematics, Behavioural Ecology and Ethology are important topics for International Biology Olympiad.

K.K. : Genetics, Plant (especially growth of plants: effects of light etc.) and Animal Physiology, Systematics, Ecology and Ethology are important. For the botany practicals, plant anatomy and systematics are very important.

Edusys : What would you suggest to those aspiring to write Olympiad exams at both National and International levels?

A.S. : I would advise them to have faith in themselves and their teachers. They shouldn't follow the crowd but seek their own path. Everyone is different and what suits one isn't necessarily suitable for everyone else. So just work hard and don't lose heart.

D.B. : The Olympiad is an excellent opportunity for getting to improve your concepts about the various aspects of biology as well as meeting with the students from other countries. Those who plan to presume a research career get an excellent opportunity by participating in International Biology Olympiad.

A.C. : I would suggest that students should have faith in their ability and should work hard and should be determined enough together through PMTS as well as Olympiads. Clear your concepts well and don't cram. They should not indulge in many activities which is oriented towards their ultimate goal at least for these two crucial career-making years.

K.K. : Read from good books. And read not because you want to crack a certain exam, but because you really care about the subject.



(L - R) Anurag Shahi, Anurag Chahal, Devanshu Bansal and Venkatraman (Ex-IBO gold medalist) with Dr. Sandeep Ahlawat (second from right)

EXERCISE - 1

1. Mesosomes - a cell wall associated structures in bacteria are concerned with the process of
 - (a) Septum formation
 - (b) Respiration
 - (c) Digestion
 - (d) Both (b) and (c)
2. In bacteria, besides a cell wall there is a capsule surrounding cell wall commonly made up of
 - (a) Polypeptides
 - (b) Polysaccharides
 - (c) Monosaccharides
 - (d) Polyglycogens
3. Gram positive bacteria retain Gram's stain owing to the high percentage of than Gram negative bacteria.
 - (a) Peptidoglycan
 - (b) Lipopolysaccharides
 - (c) Lipoproteins
 - (d) Proteins
4. Species can be defined as a
 - (a) Group of bacteria similar in characters and essentially fertile self-breeders.
 - (b) Group of bacteria forming similar types of colonies.
 - (c) Group of similar bacteria
 - (d) Group of bacteria that coexists together and form colony.
5. One of the following is a Gram negative bacteria, it is
 - (a) Spirilla
 - (b) *Erysiphilothrix*
 - (c) *Corynebacteria*
 - (d) *Lactobacilli*
6. Which of the following is not cocci bacteria ?
 - (a) *Streptomyces*
 - (b) *Streptococcus*
 - (c) *Strephylococcus*
 - (d) *Sarcina*
7. In which of the following group chain of conidia grows on aerial hyphae
 - (a) Streptomyces
 - (b) Nocardia
 - (c) Actinomyces
 - (d) All of the above
8. The basic difference between Actinomyces and Nicardia group of bacteria is that
 - (a) Former is filamentous bacteria while latter is spiral.
 - (b) Former is a anaerobic while latter is aerobic.
 - (c) Former is Gram negative while latter is Gram positive.
 - (d) Former is aerobic while latter is anaerobic
9. Actinomyces, a subgroup of filamentous bacteria is
 - (a) Gram positive
 - (b) Gram negative

- (c) Fuelgen positive (d) Fuelgen negative
10. The cells of gram positive bacteria have
 (a) Multiple layers containing high amount of peptidoglycan
 (b) Periplasmic space
 (c) Large amounts of teichoic acids
 (d) Layers having less amount of peptidoglycan
11. Which of the following is true for photoorganotrophs
 (a) $\text{NH}_2 + 3/2\text{O}_2 \xrightarrow{\text{Nitrosomonas}} \text{NO}_2 + \text{H}^+ + \text{H}_2\text{O}$
 (b) $2\text{H}_2\text{S} + \text{CO}_2 \xrightarrow{\text{Light}} \text{CH}_2\text{O} + \text{H}_2\text{O} + 2\text{S}$
 (c) $2\text{CH}_3\text{CHOHCH}_3 + \text{CO}_2 \xrightarrow{\text{Light}} \text{CH}_2\text{O} + 2\text{CH}_3\text{CCH}_3 + \text{H}_2\text{O}$
 (d) $2\text{HNO}_2 + \text{O}_2 \xrightarrow{\text{Nitrosomonas}} 2\text{HNO}_3 + \text{Energy}$
12. The amount of oxygen required by organic matter in a sample of water for its oxidation by a strong chemical oxidant is called as
 (a) BMR (b) CD
 (c) BOD (d) COD
13. Enterobacter helps in production of from pyruvic acid.
 (a) Acetone (b) Butanediol
 (c) Ethanol (d) Propanol
14. Lactic acid is produced from pyruvic acid at industrial level by the help of
 (a) *Staphylococcus* (b) *Lactococcus*
 (c) *Streptococcus* (d) All of the above.
15. Which of following bacteria are responsible for conversion of pyruvic acid to propionic acid through oxaloacetic acid formation
 (a) *Enterobacter* (b) *Propionobacterium*
 (c) *Lactobacillus* (d) *Clostridium*
16. Thermophiles are bacteria which can grow in places of high temperature. Which one is a thermophile ?
 (a) *Pseudomonas spp.* (b) *Rhizobium spp.*
 (c) *Chlostridium spp.* (d) *Thermophilus aquaticus*
17. Which one of the following bacteria oxidizes molecular hydrogen in order to form water in soil ?
 (a) *Bacillus pentotrophus* (b) *Rhizobium noduliformis*
 (c) *Albugo candida* (d) All of the above
18. One of the following bacteria oxidizes ferrous compounds into ferric compounds find it out
 (a) *Rhizobium* (b) *Bacillus pentotrophus*
 (c) *Leptothrix ochracea* (d) *Bacillus thermophilus*
19. Growth may be defined in simple words as a/an

- (a) Reversible change in shape and size
 (b) Irreversible change in mass and volume
 (c) Reversible change in mass and volume
 (d) Irreversible change in few systems only.
20. Polymetaphosphate, a storage granule acts as a source of
 (a) Phosphate (b) Sulphate
 (c) Sulphur (d) Phosphoric acid
21. The bacteria, *Bacillus mesenterius* is used for the production of & enzymes.
 (a) Pectinase, cellulase (b) Amylase, protease
 (c) Polymerase, invertase. (d) Cellulase oxide, carboxylase
22. In alcoholic fermentation, there are two species responsible for top and bottom fermentation. They are
 (a) *S. cerevisal* and *S. saccharum*
 (b) *S. carlsbergensis* and *S. cerevisal*
 (c) *Saccharomyces cerevisiae* and *S. carlsbergensis*
 (d) *S. carlsbergensis* and *S. saccharum*
23. Fuel oil, a fermentation product is the mixture of
 (a) Isoamyl + Methanol (b) Methanol + Butanol
 (c) Ethanol + Methanol (d) Isoamyl Alcohol + Butyl Alcohol
24. Bacterial conjugation a mean of transferring genetic material from one cell to other was first described by
 (a) Watson and Crick
 (b) Leaderberg and Tautum (c) Leaderberg
 (d) Tautum
25. The most common type of reproduction in bacteria is
 (a) Budding (b) Binary fusion
 (c) Binary fission (d) Sexual reproduction
26. The microorganism responsible for major alcoholic fermentation are
 (a) *Pseudomonas spp.* (b) *Lactobacillus spp.*
 (c) *Saccharomyces spp.* (d) All of the above
27. *Clostridium spp.* are good fermenter responsible for the formation of
 (a) n-butanol (b) Formic acid
 (c) Acetic acid (d) Ethanol
28. Which of the following microorganism is a true homolactic fermentor ?
 (a) *Propionobacterium* (b) *Staphylococcus*
 (c) *Streptococcus* (d) *Clostridium*
29. Nitrogen fixation *i.e.* conversion of ammonia into nitrite and then to nitrate is carried out by
 (a) *Nitrosomonas* and *Nitrobacter*

- (b) *Nitrosomonas* (c) *Nitrobacter*
 (d) *Thiobacillus* and *Azotobacter*
30. Which of the following are aerobic bacteria ?
 (a) *Thiobacillus* (b) *Nitrobacter*
 (c) *Nitrosomonas* (d) All of the above.
31. Common out breaks of food poisoning are called by
 (a) *Salmonella typhimurium* (b) *Pseudomonas fragi*
 (c) *Clostridium nigrificans* (d) All of the above
32. Which of the following microorganisms are recently used for soil fertility improvement?
 (a) *Scytonema* (b) *Anabaena*
 (c) Both (a) and (b) (d) None of the above
33. *Clostridium tetanomorphum* is known to produce
 (a) Vitamin C (b) Vitamin B
 (c) Vitamin A (d) Vitamin K
34. 'Illudin', an antibiotic is produced by
 (a) *Clitocbe illudens* (b) *Penicillium illudens*
 (c) *Fusarium oxysporium* (d) *Ustilago illudens*
35. Penicillin, an antibiotic is produced by
 (a) *P. patulum* (b) *P. glaucum*
 (c) *Penicillium chrysogenum* (d) *P. griseofulvin*
36. Neomycin and nystalin, the two antibiotics are produced by which two species of *Streptomyces* ?
 (a) *S. rimosus*, *S. nodosus* (b) *S. fradiae*, *S. noursei*
 (c) *S. venezuelae*, *S. nodosus* (d) *S. auerofaciens*, *S. erythraeus*
37. 'Enniatin - B' an antibiotic is produced by
 (a) *Penicillium notatum* (b) *Bacillus subtilis*
 (c) *Alternaria solani* (d) *Fusarium orthoceras*
38. The bacterium responsible for common souring and curding of milk is
 (a) *Lactobacillus* (b) *Aspergillus*
 (c) *Streptococcus lactis* (d) *Clostridium*
39. Which of the following bacterium is responsible for curing of tobacco and tea?
 (a) *Penicillium glaucum* (b) *Micrococcus candisans*
 (c) *Aspergillus sydowi* (d) *Mycoderma acti*
40. Retting of jute, flex and hemp fibre is also enhanced by bacteria, which one is responsible for retting ?
 (a) *Aspergillus nidulans* (b) *Penicillium notatum*
 (c) *Clostridium butyrium* (d) *Micrococcus candisans*

41. Most of the eukaryotic organisms (except molds and yeasts) are
 (a) Gram neutral (b) Gram negative
 (c) Gram positive (d) None of the above
42. A toxoid is a
 (a) Toxin that loses its activity (b) Impotent toxin
 (c) Potent toxin (d) Toxin producing gland
43. Endotoxins are toxic chemicals secreted by pathogens inside the host cells, chemically they are
 (a) Lipids (b) Lipopolysaccharides
 (c) Proteins (d) Phospholipids
44. Lecithinase-causes lysis of RBC and other lipid containing tissues is produce by
 (a) *Clostridium perfringenes* (b) *S. pyogenes*
 (c) *Streptococcus aureus* (d) All of the above
45. The major difference between parasite and pathogen is that
 (a) One obtains his food only while other causes disease to the host
 (b) One causes disease and other fails to do so
 (c) Former is weaker where as latter is stronger in power
 (d) One lives inside while other lies outside the body
46. Virulence can be defined as
 (a) Ability of an organism to produce toxins
 (b) Toxicity caused by a parasite
 (c) Capacity of pathogen to cause disease
 (d) Ability of an organism to cause latent symptoms
47. *Pseudomonas citri* causes disease
 (a) Blight (b) Gall formation
 (c) Black spot (d) Citrus canker
48. 'White rust' disease of crucifer is caused by
 (a) *Xanthomonas compestris* (b) *Ustilago spp*
 (c) *Albugo candida* (d) All of the above
49. Sulfited spoilage of strawberry is caused by
 (a) *Rhizopus stolonifer* (b) *R. sexualis*
 (c) Both (a) and (b) (d) None of the above
50. *Aspergillus candidus*, *A. nidulus* and *A. niger* are known to cause damage even to
 (a) Hardware of computer (b) Glassware
 (c) Optical instruments (d) All of these
51. Penicillin a potent antibiotic acts by destroying other microorganisms. It hinders
 (a) Protein synthesis (b) Cell wall formation
 (c) DNA formation (d) RAN synthesis system

52. Iodine is used as a sterilant, because it is a strong..... agent and destroys microorganisms
 (a) Redox (b) Reducing
 (c) Oxidizing (d) All of these
53. Which of the following growth curve is represented by bacterial cultures?
 (a) J-shaped (b) V-shaped
 (c) S-shaped (d) Linear shaped

☺☺☺

1. (d) 2. (b) 3. (a) 4. (a) 5. (a) 6. (a) 7. (a) 8. (b)
 9. (c) 10. (d) 11. (c) 12. (d) 13. (b) 14. (c) 15. (b) 16. (d)
 17. (a) 18. (c) 19. (b) 20. (a) 21. (b) 22. (c) 23. (d) 24. (b)
 25. (c) 26. (c) 27. (a) 28. (c) 29. (a) 30. (e) 31. (a) 32. (a)
 33. (b) 34. (a) 35. (c) 36. (b) 37. (d) 38. (a) 39. (b) 40. (c)
 41. (b) 42. (a) 43. (b) 44. (a) 45. (a) 46. (c) 47. (d) 48. (c)
 49. (a) 50. (a) 51. (b) 52. (c) 53. (a)

☺☺☺

EXERCISE - 2

- Mitochondria of the eukaryotes can be compared to
 (a) Flagellum of prokaryotes (b) Mesosomes of prokaryotes
 (c) Cell wall of prokaryotes (d) Chromatophores of prokaryotes
- The most abundant element found in living organisms is
 (a) Carbon (b) Water
 (c) Hydrogen (d) Nitrogen
- Which of the following governs the size of the cell ?
 (a) Nucleocytoplasmic ratio (b) Physiological status
 (c) Both (a) and (b) (d) None of the above
- The shape of cell may not be fixed (*i.e.* it changes) in
 (a) *Amoeba* (b) *Chlamydomonas*
 (c) *Lactobacillus* (d) *Spirocheates*
- Which of the following eukaryotic cell lacks nucleus
 (a) Platelets (b) WBC
 (c) RBC (d) Nerve cell
- Which of the following represents the smallest living organism ?
 (a) Qb (b) Amoeba
 (c) Bacteriophage (d) PPLO
- The major sterol found in eukaryotic microorganism cell membrane is
 (a) Phytosterols (b) Cholesterol
 (c) Ergosterol (d) Stigmasterol
- Cephalin is a
 (a) Phospholipid of bacteria
 (b) Phospholipid found in cell membranes
 (c) Phospholipid found in all cell walls
 (d) Glycolipid of bacterial cell membrane
- One of the following is a binucleate cell
 (a) Cartilage cells
 (b) Liver cells and cartilage cells
 (c) Liver cells
 (d) Parenchymatous cells
- Which of the following organelles are not present in prokaryotes?
 (a) Chromosomes (b) DNA
 (c) Ribosomes (d) Endoplasmic reticulum
- Thin, elastic, selectively permeable membrane is
 (a) Nuclear membrane (b) Cell wall

- (c) Cell membrane (d) All of these
12. A membrane found in both plants and animals is
 (a) Plasmodesmatal membrane
 (b) Cell wall
 (c) Cell membrane (Plasma membrane)
 (d) Pit membrane
13. Cuticularization of cell wall helps to reduce
 (a) Growth rate (b) Transpiration rate
 (c) Respiration rate (d) Infection rate
14. The most important function of cell wall is
 (a) Elasticity (b) Semipermeability
 (c) Shape and mechanical strength
 (d) Protection
15. Cell wall is made up of
 (a) Cellulose, hemicellulose and fatty substances
 (b) Cellulose and hemicellulose
 (c) Cellulose
 (d) Cellulose, hemicellulose, fatty substances and minerals
16. Cell wall is
 (a) Thin, permeable and living (b) Thin, permeable and nonliving
 (c) Thick, permeable and nonliving
 (d) Thick, elastic, semipermeable and nonliving
17. Centrosome, lysosome and microvilli are characteristics of
 (a) Prokaryotic cells (b) Animal cells
 (c) Plant cells (d) Eukaryotic cell
18. Exocytosis and endocytosis is absent in
 (a) *Mycoplasma* (b) *Euglena*
 (c) *Amoeba* (d) Algae
19. Histone as well as non-histone proteins are present in
 (a) Prokaryotic nucleus (b) Eukaryotic cytoplasm
 (c) Eukaryotic nucleus (d) Prokaryotic cytoplasm
20. Nuclear membrane is well organized in
 (a) *Nostoc* (b) *Lactobacillus*
 (c) *Plasmodium* (d) HIV
21. So far the highest number of mitochondria are found in
 (a) Liver hepatocyte (b) Bacterial cell
 (c) Yeast cell (d) Chaos chaos (Protozoa)
22. Mitochondria could be specifically stained in a living cell by
 (a) Janus green - B (b) Acetocarmine
 (c) Fast green (d) Safranin

23. The term bioblast was used for mitochondria, by
 (a) Altman (b) Benda
 (c) A. Koliker (d) Porter
24. Mitochondria was first observed by
 (a) Altman [1892] (b) Benda [1898]
 (c) A. Koliker [1850] (d) Porter and Kallman
25. Smooth ER can be found in
 (a) Sarcoplasmic reticulum (b) Myeloid body (in retina of frog)
 (c) Both of the above (d) None of the above
26. Endoplasmic reticulum is absent in
 (a) Prokaryotes (b) Mature erythrocytes
 (c) Both of the above (d) None of these
27. Glycosylation of proteins occurs in
 (a) Endoplasmic reticulum (b) Mitochondria
 (c) Golgi body (d) All of the aese
28. Golgi body was first studied by Camello Golgi in
 (a) Cambial cells (b) Pus cells
 (c) Nerve cells of Brown owl (d) Muscle cells
29. Cardiopin is a membrane lipid, can be seen in
 (a) Bacteria (b) Chloroplast
 (c) Mitochondria (d) All of these
30. Cell membrane is made up of
 (i) Phospholipids (ii) Proteins
 (iii) Glycolipids (iv) Sterols
 (v) Cellulose
 Choose the correct answer.
 (a) i, ii, iii, iv (b) i, iii, v
 (c) i, iii, iv, v (d) ii, iii, v
31. Photophosphorylation occurs in
 (a) Golgi body (b) Chloroplast
 (c) Mitochondria (d) Cell membrane
32. ATP synthetase, PS-I, PS-II and glutamase dehydrogenase are characteristic of
 (a) Matrix (b) Thylakoid
 (c) Outer membrane (d) Inner membrane
33. Photo systems (PS-I and PS-II) are found in
 (a) Stroma (b) Thylakoid membrane
 (c) Outer membrane (d) Inner membrane
34. Synthesis of starch, sugars and fatty acid occurs in

- (a) Granum (b) Inner chloroplast membrane
(c) Thylakoid membrane (d) Stroma
35. The term 'plastid' was first used by
(a) Schimper (b) Hoffman
(c) Menke (d) Altman
36. Mitochondria is known as 'power house of cell', because
(a) It liberates heat (b) It stores energy
(c) It is hot (d) It produces ATPs
37. Cytochrome oxidase and cytochrome deficiency in mitochondria causes
(a) Kearns-Says syndrome
(b) Kearns-Says syndrome and Menke's disease respectively.
(c) Menke's disease
(d) Leber's optic neuropathy
38. Citrate synthetase, succinate dehydrogenase, fatty acyl coA synthetase are common enzymes of
(a) Matrix
(b) Inner mitochondrial membrane
(c) Outer mitochondrial membrane
(d) Perimitochondrial space
39. Inner mitochondrial membrane is rich in
(a) Choline phosphotransferase
(b) Sulphite oxidase
(c) Cation translocases/fatty acyl transferases
(d) Citrate synthetase



1. (b) 2. (a) 3. (a) 4. (a) 5. (c) 6. (d) 7. (c) 8. (a)
9. (b) 10. (d) 11. (c) 12. (c) 13. (b) 14. (c) 15. (d) 16. (c)
17. (b) 18. (a) 19. (c) 20. (c) 21. (d) 22. (a) 23. (a) 24. (c)
25. (a) 26. (a) 27. (c) 28. (c) 29. (d) 30. (a) 31. (b) 32. (b)
33. (b) 34. (d) 35. (a) 36. (d) 37. (b) 38. (a) 39. (c)



EXERCISE - 3

- The most common temperature at which assays are performed are
(a) 37°C (b) 30°C
(c) 25°C (d) All of these
- A heterolytic fission of enzyme bonds results in the formation by
(a) Carbanion and Carbonium ion
(b) Carbonium ion
(c) Carbanion (d) Free radical
- A homolytic fission of enzyme bonds results in the formation of
(a) Carbonium ion (b) Free radical
(c) Carbanion (d) Cations
- The inhibitor and the enzyme usually bind by
(a) Covalent bond (b) Tandsons force
(c) Electrostatic (d) Vander waal force
- The region which contains the binding and catalytic sites is termed as
(a) Active region (b) Active centre
(c) Active site (d) All of these
- Enzymes are
(a) Globular proteins (b) Glycoproteins
(c) Fibrous proteins (d) Lipoproteins
- Enzymes lower the activation energy of reaction by using
(a) Binding energy (b) GTP
(c) ATP (d) None
- Enzymes affect
(a) Reaction rates & reaction mode
(b) Reaction rates and equilibria
(c) Reaction rates
(d) Substrate and product concentration
- Lyases catalyzes reaction around
(a) Co-ordinate bond (b) Double bond
(c) Single bond (d) All of these
- If a complex organic or metallo organic group is attached to an enzyme it is called as
(a) Apoprotein (b) Coenzyme
(c) Cofactor (d) Prosthetic group
- Which of the following statements is wrong ?

- (a) Some DNA molecules have catalytic activities.
 (b) Few RNA molecules behave like enzyme
 (c) Some RNA molecules may have catalytic activities
 (d) Enzymes are the largest and most specialized class of protein molecules
12. Which of the following statement is false ?
 (a) All enzymes are proteins
 (b) Stability of the immobilized and free enzymes are the same
 (c) Properties of immobilized enzyme changes when is in free solution
 (d) Enzymes change the activation energy
13. Antibody that behaves as enzymes in catalyzing reactions are called
 (a) Lipozymes (b) Holozymes
 (c) Isozymes (d) Abzymes
14. Abzymes are
 (a) Antibody (b) Antigen
 (c) Hydrolases (d) Proteases
15. Enzymes obtained commercially from microbial fermentation is usually
 (a) Intracellular (b) Intercellular
 (c) Extracellular (d) Acellular
16. Extracellular enzymes are those that are present
 (a) Outside the cell (b) Periplasmic space
 (c) In between two cells (d) Inside the cell
17. Coenzymes are preferably stored a
 (a) In sodium sulphate (b) As liquid
 (c) As solid (d) In liquid nitrogen
18. In general enzymes are stored at
 (a) 20°C (b) 120°C
 (c) 60°C (d) 40°C
19. Enzyme-catalyzed reactions are suitable for analytical purpose because
 (a) They proceed under relatively mild conditions
 (b) They are easily available
 (c) They are resistant to high and low temperature
 (d) They proceed with a great speed
20. Enzyme activity in terms of total protein is termed as
 (a) Molar activity (b) Specific activity
 (c) Molar catalytic activity (d) Site specific activity
21. Out of the total enzymes present in the cell, mitochondria alone has
 (a) 4 % (b) 70 %
 (c) 95 % (d) No enzyme

22. Which enzyme is needed to digest the food reserve in castor seeds ?
 (a) Lipase (b) Diastase
 (c) Amylase (d) Proteases
23. Enzymes differ from inorganic catalysts in
 (a) Not being used up in reaction
 (b) Working at high temperature
 (c) Having high diffusion rate (d) Being protein in nature
24. Which of the following enzymes is active at acidic pH ?
 (a) Pepsin (b) Amylase
 (c) Ptyalin (d) Chymotrypsin
25. The most complex multi-enzyme systems are associated with
 (a) Ribosomes (b) Biological membrane
 (c) Both of the above (d) None of these
26. Zymogen are stored in the
 (a) Nucleus (b) Intracellular space
 (c) Intercellular space (d) Nucleolus.
27. are the inactive forms of enzymes.
 (a) Mesozymes (b) Isoenzymes
 (c) Zymogens (d) Neoenzymes
28. Most of the enzymes secreted by cells are
 (a) Mesozymes (b) Stored
 (c) Rich in lipoproteins (d) Neoenzymes
29. Enzyme substrate complex [ES] at the active site was postulated by
 (a) Michaelis and Menten (b) Sutton
 (c) Wilkins (d) Franklin
30. The active sites on an enzyme can be
 (a) Several (b) Double
 (c) Single (d) Half of the total active site
31. Lysozyme is an enzyme found in
 (a) Egg white (b) Human vacuole
 (c) Pigs stomach (d) Lysosome
32. Enzyme kinetic is based on
 (a) Law of mass action (b) Gibbs free energy
 (c) Law of equilibrium (d) Order of reaction
33. Which of the following enzymes are not monomeric enzymes ?
 (a) Pepsin (b) Chymotrypsin
 (c) Trypsin (d) Lactose synthetase
34. Monomeric enzymes are those that are made up of

- (a) Straight chain polypeptides (b) Single polypeptide chain
(c) Single type of amino acid (d) All of these
35. Peptide linkage occurs between
(a) Sucrose (b) Glucose
(c) Amino acids (d) Glycogen
36. Which is not an attribute of enzyme
(a) They are specific in nature
(b) They speed up rate of biochemical reaction
(c) They are used up in reaction
(d) All of the above
37. NADP is
(a) A coenzyme (b) A part of s-RNA
(c) An enzyme (d) A part of t-RNA
38. Dry seeds can endure higher temperature than soaked germinating seeds because
(a) Dry seeds have more reserved food
(b) Seedlings are tender (c) Dry seeds are hard
(d) Hydration makes the enzyme sensitive to temperature
39. Diastase enzyme digests
(a) Fat (b) Proteins
(c) Starch (d) Cellulose
40. Esterase belongs to
(a) Hydrolytic enzyme (b) Carboxylating enzyme
(c) Oxidation reduction enzyme
(d) Transferases



1. (a) 2. (a) 3. (b) 4. (a) 5. (a) 6. (a) 7. (a) 8. (a)
9. (b) 10. (b) 11. (a) 12. (b) 13. (d) 14. (a) 15. (c) 16. (a)
17. (c) 18. (d) 19. (a) 20. (b) 21. (b) 22. (a) 23. (d) 24. (a)
25. (a) 26. (b) 27. (a) 28. (d) 29. (a) 30. (a) 31. (d) 32. (a)
33. (a) 34. (b) 35. (c) 36. (c) 37. (a) 38. (d) 39. (c) 40. (a)



EXERCISE - 4

- Membrane proteins are
(a) Aligned diagonally (b) Asymmetrically placed
(c) Symmetrically placed (d) Arranged in a zig zag manner
- Which of the following protein traverses the bilayer as β helix ?
(a) Glycophorin (b) Porin
(c) Spectrin (d) None of these
- Spectrin is attached to the membrane through
(a) Hydrogen bond (b) Ankyrin
(c) Phosphodiester bond (d) Covalent bond
- Glycophorin extends the Red blood cell lipid bilayer as
(a) Single α helix (b) Double β helix
(c) Single β helix (d) Triple α helix
- Glycophorin is a
(a) Cytosolic protein (b) Peripheral protein
(c) Transmembrane protein (d) Triple α - helix
- Carbohydrate chain is attached to glycophorin at
(a) 16 residues (b) 17 residues
(c) Varies between 16-17 (d) 26 residues
- The proteins in the membrane exhibit
(a) Rotational movement (b) Lateral movement
(c) Transverse movement (d) No movement
- In transmembrane protein the conformation is always an- helical because
(a) Hydrogen bonds between peptide bonds are maximum in case of α - helix
(b) α - helix is a stabler structure than any other conformation of protein
(c) α - helical takes less space
(d) All of the above
- Backbone of majority of phospholipids are made up of :
(a) Alcohol (b) Fatty acid
(c) Glycerol (d) Sphingosine
- The lipid molecules and proteins in membranes are held together by
(a) Non covalent bond (b) Any covalent bond
(c) Hydrogen bond (d) Electrostatic force
- An ATPase pump that does not take place in eukaryotes is
(a) K^+ pump (b) Ca^{2+} pump
(c) Na^+-K^+ pump (d) None

12. In case of bacteria the carrier proteins pump variety of nutrients by using
 (a) Both (b) ATPase only
 (c) H⁺ gradient only (d) None
13. Ion channels always remain
 (a) Fluctuate between open and closed state
 (b) Open (c) Closed
 (d) Some are always closed and some are always open
14. Channel proteins that allow ions and small molecules to flow between communicating cells are
 (a) Gap junctions (b) Ca²⁺ pump
 (c) Na⁺-K⁺ pump (d) All of these
15. Which of the following ions bind strongly to valinomycin ?
 (a) Al (b) Na⁺
 (c) K⁺ (d) Ca
16. Ionophores are
 (a) Neutral molecules (b) Hydrophobic molecules
 (c) Hydrophilic molecules (d) Positively charged
17. The transport by channel proteins is
 (a) Active (b) Passive
 (c) Both (d) None
18. The transport by carrier proteins is
 (a) Active (b) Passive
 (c) Both (d) None
19. Active transport is mediated by
 (a) Both depending on the concentration of the ion
 (b) Carrier protein
 (c) Channel protein
 (d) Both depending on the size of the ion
20. The ions traverse through the membrane faster through
 (a) G-protein (b) Carrier protein
 (c) Channel protein (d) Free lipid bilayer
21. Ras proteins contain subfamilies. The one which is not a part of it are
 (a) Rab proteins (b) Rac proteins
 (c) Rho proteins (d) SH₂ proteins
22. Which of the following receptor used cGMP as intracellular mediator ?
 (a) G-protein (b) Guanylyl cyclases
 (c) Both (d) None
23. Which of the following is not an enzyme linked receptor?
 (a) Receptor tyrosine phosphatases
 (b) Receptor tyrosine kinases

- (c) Receptor guanylyl cyclases (d) None of the above
24. In case of vertebrate vision the cyclic nucleotide involved is
 (a) cCMP (b) cGMP
 (c) cAMP (d) cTMP
25. In a cell of vertebrate vision the cyclic nucleotide involved is
 (a) 24 connexin (b) 12 connexin
 (c) 10 connexin (d) 14 connexin
26. Which of the following is not an energy source in active transport ?
 (a) Sodium motive force (b) Proton motive force
 (c) ATP & Phosphoenol pyruvate
 (d) All of the above
27. Vitamin D is derived from
 (a) Mevalonate (b) Light
 (c) Cholesterol (d) HMG CoA
28. The basic structural unit of sphingolipids is
 (a) Palmitoyl CoA (b) Sphingosine
 (c) Ceramide (d) Dehydrosphinganine
29. A phospholipid which is formed from dihydroxy acetone phosphate (DAP) is
 (a) Choline phospholipid (b) Ether phospholipids
 (c) Glycolipids (d) Phospholipid
30. G-Protein is
 (a) Trimeric (b) Bimeric
 (c) Unimeric (d) Tetrameric

☺☺☺

1. (c) 2. (a) 3. (b) 4. (b) 5. (a) 6. (b) 7. (c) 8. (a)
 9. (c) 10. (a) 11. (d) 12. (a) 13. (a) 14. (a) 15. (c) 16. (b)
 17. (b) 18. (b) 19. (a) 20. (b) 21. (d) 22. (b) 23. (a) 24. (b)
 25. (b) 26. (d) 27. (c) 28. (c) 29. (c) 30. (a)

☺☺☺

**NATIONWIDE BIOTECHNOLOGY
OLYMPIAD (NBTO)
SAMPLE PAPER**

Total duration : 60 Minutes

Total Marks : 50

SECTION A : GENERAL KNOWLEDGE

1. How many years does it take glass to decompose?
(a) 100 years or less (b) 100 to 500 years
(c) 500 to 1000 years (d) Over 1 million years
2. Select the appropriate SEQUENCE.
(a) Global warming → melting snow → rising sea level floods
(b) Volcanic dust → traps carbon dioxide → global warming
(c) Greenhouse effect → carbon dioxide traps heat → melting snow
(d) All of the above
3. What human activities cause ozone depletion?
(a) Industrial halocarbons (b) Smog from vehicles
(c) Cigarettes (d) Cooking
4. “Close the loop on recycling” is becoming a popular catchphrase in the world of waste management. What does it refer to?
(a) Buying recycled products
(b) Dropping off recycled materials at a certified recycling center
(c) Living an environmental lifestyle besides just recycling
(d) Tying up your recyclables securely
5. What recyclable commodity is most valuable?
(a) Paper (b) Plastic (c) Glass (d) Aluminum
6. The major threats to biodiversity worldwide can be categorized using the HIPPO dilemma. HIPPO stands for:
(a) Hippopotamuses
(b) Habitat Loss, Introduced Species, Pollution, Population, Over-consumption
(c) Hunting, Isolation, People, Propaganda, Opulence
(d) Harmful ultraviolet rays, International trade, Politics, Power production, Oxygen deprivation
7. Speaking of the ozone layer, what harmful product does this part of the atmosphere filter?
(a) Greenhouse Effect (b) Acid Rain
(c) UV light (d) Sewage
8. What gas has been continuously highlighted as being the main contributor to global warming?
(a) Carbon monoxide (b) Sulphur dioxide
(c) Methane gas (d) Carbon dioxide
9. What do scientists believe global warming is caused from?
(a) The earth getting older (b) Human activity
(c) Changes in animals (d) The rainforest

10. Scientists are worried that if the Greenland ice cap melts rapidly, it will deliver a surge of freshwater into the North Atlantic Ocean. This will cause what to happen?
- Icy climates will occur in that region.
 - This freshwater will shutdown the ocean conveyor in this region.
 - The warmth that is delivered to Europe via the Gulf Stream leg of the conveyor will cease in activity.
 - All of the above.

SECTION B : PHYSICS & CHEMISTRY

11. Two masses $m_1 = 5$ kg and $m_2 = 4.8$ kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when lift is free to move? ($g = 9.8$ m/s²)

- 0.2 m/s²
- 9.8 m/s²
- 5 m/s²
- 4.8 m/s²



12. If g is the acceleration due to gravity on the earth's surface, the gain in the potential energy of an object of mass m raised from the surface of the earth to a height equal to the radius R of the earth, is

- $2mgR$
- $\frac{1}{2}mgR$
- $\frac{1}{4}mgR$
- mgR

13. A wire fixed at the upper end stretches by length l by applying a force F . The work done in stretching is

- $\frac{F}{2l}$
- $F l$
- $2F l$
- $\frac{Fl}{2}$

14. In an LCR series ac circuit, the voltage across each of the components. L , C and R is 50 V. The voltage across the LC combination will be

- 50 V
- $50\sqrt{2}V$
- 100 V
- 0 (zero)

15. An α -particle of energy 5 MeV is scattered through 180° by a fixed uranium nucleus. The distance of the closest approach is of the order of

- 1Å
- 10^{-10} cm
- 10^{-12} cm
- 10^{-15} cm

16. When the velocity of electron increases, its specific charge

- decreases
- increases
- remain unaffected
- none

17. In the reaction
 $\text{KMnO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{C}_2\text{O}_4 \longrightarrow \text{product}$
 Mn^{2+} ions act as

- positive catalyst
- negative catalyst
- autocatalyst
- enzyme catalyst.

18. Which of the following compounds on boiling with alkaline KMnO_4 and subsequent acidification will not give benzoic acid?

- anisole
- benzyl alcohol
- toluene
- acetophenone

19. The benzyl phenyl ether on reaction with HI gives

- benzyl iodide
- benzyl alcohol
- benzyl iodide & phenol
- benzyl alcohol & iodobenzene.

20. Which one is not a graphical representation of Boyle's law?

- P vs V (hyperbolic curve)
- P vs V^{-1} (straight line)
- $\log P$ vs $\log V$ (straight line)
- P vs $1/V$ (straight line)

SECTION C : MATHEMATICS

21. $\lim_{x \rightarrow \infty} \frac{(x+1)^{10} + (x+2)^{10} + \dots + (x+100)^{10}}{x^{10} + 10^{10}}$ is equal to

- 0
- 1
- 100
- 10

22. $\lim_{n \rightarrow \infty} \left[\frac{n}{1+n^2} + \frac{n}{4+n^2} + \frac{n}{9+n^2} + \dots + \frac{1}{2n} \right]$ is equal to

- $\frac{\pi}{2}$
- $\frac{\pi}{4}$
- 1
- none of these

23. If $\vec{A} = i + 2j + 3k$, $\vec{B} = -i + 2j + k$ and $\vec{C} = 3i + j$, then the value of t such that $\vec{A} + t\vec{B}$ is at right angle to vector \vec{C} , is

- 2
- 4
- 6
- 5

24. The principal value of $\sin^{-1} \left(\sin \frac{5\pi}{3} \right)$ is

- $\frac{5\pi}{3}$
- $-\frac{\pi}{3}$
- $-\frac{5\pi}{3}$
- $\frac{4\pi}{3}$

25. If the lines represented by the equation $2x^2 - 3xy + y^2 = 0$ make angles α and β with x -axis, then $\cot^2 \alpha + \cot^2 \beta =$

- 0
- $\frac{3}{2}$
- $\frac{5}{4}$
- $\frac{7}{4}$

26. Range of the function $\frac{1}{2 - \sin 3x}$ is

- [1, 3]
- $\left(\frac{1}{3}, 1 \right)$
- (1, 3)
- $\left[\frac{1}{3}, 1 \right]$

27. If a, b, c, d are positive real numbers, then $\lim_{n \rightarrow \infty} \left(1 + \frac{1}{a+bn}\right)^{c+dn}$ is equal to
 (a) $\frac{d}{e^b}$ (b) $\frac{c}{e^a}$ (c) $e^{\frac{c+d}{a+b}}$ (d) e
28. If $\int_{\sin x}^1 t^2 f(t) dt = (1 - \sin x)$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is equal to
 (a) $\frac{1}{3}$ (b) 3 (c) $\frac{1}{\sqrt{3}}$ (d) $\sqrt{3}$
29. $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \pi$, then $\frac{1}{xy} + \frac{1}{yz} + \frac{1}{zx}$ is equal to
 (a) xyz (b) $\frac{1}{xyz}$ (c) 1 (d) 0
30. If for any complex number z , $|z-4| < |z-2|$, then
 (a) $\operatorname{Re}(z) > 0$ (b) $\operatorname{Re}(z) < 0$
 (c) $\operatorname{Re}(z) > 3$ (d) $\operatorname{Re}(z) > 2$
31. If $(1 + \omega)^7 = A + B\omega$, then A, B are
 (a) 0, 1 (b) 1, 1 (c) 1, 0 (d) -1, 1
32. The roots of $|x-2|^2 + |x-2| - 6 = 0$ are
 (a) 0, 4 (b) -1, 3 (c) 4, 2 (d) 5, 1
33. If two sets A and B are having 99 elements in common, then the number of elements common to each of the sets $A \times B$ and $B \times A$ are
 (a) 99^2 (b) 2^{99} (c) 100 (d) 18
34. The order and degree of the differential equation representing family of curves $y^2 = 2k(x + \sqrt{k})$ (where k is a positive parameter) are
 (a) 1, 2 (b) 1, 3 (c) 1, 4 (d) 2, 4
35. The integrating factor of the differential equation $\frac{dy}{dx}(x \log x) + y = 2 \log x$ is
 (a) x (b) e^x (c) $\log(\log x)$ (d) $\log x$
36. The system of equations $x + y + z = 2$, $2x + y - z = 3$, $3x + 2y + kz = 4$ has unique solution if
 (a) $k = 0$ (b) $-2 < k < 2$ (c) $-1 < k < 1$ (d) $k \neq 0$
37. If $A = \begin{bmatrix} 2 & -3 \\ 1 & -1 \end{bmatrix}$, then $|A^{1003} - 5A^{1002}|$ is equal to
 (a) 1 (b) 18 (c) 21 (d) -5
38. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \dots + C_r x^r + \dots + C_{n-r}x^{n-r} + C_n$, then $C_0 C_r + C_1 C_{r+1} + C_2 C_{r+2} + \dots + C_{n-r} C_n$ is equal to

- (a) $\frac{(2n)!}{(n-r)!(n+r)!}$ (b) $\frac{(2n)!}{n!(n+r)!}$
 (c) $\frac{(2n)!}{n!(n-r)!}$ (d) $\frac{(2n)!}{(n-1)!(n+1)!}$
39. $\tan 1^\circ \tan 2^\circ \tan 3^\circ \dots \tan 89^\circ$ is equal to
 (a) 0 (b) 1 (c) ∞ (d) none of these
40. If $x^2 + \alpha y^2 + 2\beta y = a^2$ represents a pair of perpendicular straight lines, then
 (a) $\alpha = -1, \beta = \pm a$ (b) $\alpha = 1, \beta = a$
 (c) $\alpha = -1, \beta = 0$ (d) None of these

SECTION C : BIOTECHNOLOGY

21. Diagrams, tables, and graphs are used by scientists mainly to
 (a) design a research plan for an experiment
 (b) test a hypothesis
 (c) organize data
 (d) predict the independent variable
22. What happens to certain nutrient molecules after they pass into muscle cells?
 (a) They are replicated in the nucleus.
 (b) They are acted on by enzymes and release the energy they contain.
 (c) They are changed into tissues and organs in the cytoplasm.
 (d) None of these
23. A medical test indicates that a patient has a defective protein. This condition is most likely due to a change in the directions coded in the
 (a) number of hydrogen atoms in starch molecules
 (b) sequence of inorganic molecules
 (c) number of carbon atoms in sugar molecules
 (d) sequence of subunits in DNA
24. If a human system fails to function properly, what is the most likely result?
 (a) a stable rate of metabolism
 (b) a disturbance in homeostasis
 (c) a change in the method of cellular respiration
 (d) a change in the function of DNA
25. Which statement regarding the functioning of the cell membrane of all organisms is *not* correct?

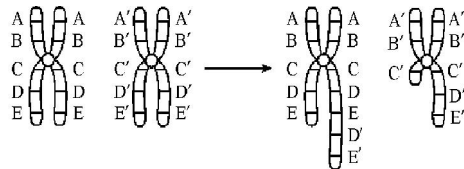
- (a) The cell membrane forms a boundary that separates the cellular contents from the outside environment.
 (b) The cell membrane is capable of receiving and recognizing chemical signals.
 (c) The cell membrane forms a barrier that keeps all substances that might harm the cell from entering the cell.
 (d) The cell membrane controls the movement of molecules into and out of the cell.
26. In multicellular organisms, cells must be able to communicate with each other. Structures that enable most cells to communicate with each other are known as
 (a) pathogenic agents (b) chloroplasts
 (c) antibiotics (d) receptor molecules
27. Every single-celled organism is able to survive because it carries out
 (a) metabolic activities (b) autotrophic nutrition
 (c) heterotrophic nutrition (d) sexual reproduction
28. The shape of a protein molecule is influenced by
 (a) whether it is organic or inorganic
 (b) the sequence of amino acids in it
 (c) the number of genes found in the nucleus
 (d) the number of chromosomes in the cell
29. A small amount of DNA was taken from a fossil of a mammoth found frozen in glacial ice. Genetic technology can be used to produce a large quantity of identical DNA from this mammoth's DNA. In this technology, the original DNA sample is used to
 (a) stimulate differentiation in other mammoth cells
 (b) provide fragments to replace certain human body chemicals
 (c) act as a template for repeated replication
 (d) trigger mitosis to obtain new base sequences
30. Many diabetics are now using insulin that was made by certain bacteria. The ability of these bacteria to produce insulin was most likely the result of
 (a) deleting many DNA segments from bacterial DNA
 (b) genetic mapping of bacterial DNA to activate the gene for insulin production
 (c) inserting a portion of human DNA into the ring-shaped DNA of bacteria
 (d) using radiation to trigger mutations
31. Which situation would most directly affect future generations naturally produced by a mango tree?
 (a) Ultraviolet radiation changes the DNA sequence within some leaves of the tree.

- (b) Ultraviolet radiation changes the DNA sequence within the gametes of some flowers of the tree.
 (c) An increase in temperature reduces the number of cell divisions in the roots.
 (d) Rapidly growing cells just under the bark are exposed to radiation, causing changes in genetic material.
32. Which statement is best supported by fossil records?
 (a) Many organisms that lived in the past are now extinct.
 (b) Species occupying the same habitat have identical environmental needs.
 (c) The struggle for existence between organisms results in changes in populations.
 (d) Structures such as leg bones and wing bones can originate from the same type of tissue found in embryos.
33. One explanation for the variety of organisms present on Earth today is that over time
 (a) new species have adapted to fill available niches in the environment
 (b) evolution has caused the appearance of organisms that are similar to each other
 (c) each niche has changed to support a certain variety of organism
 (d) the environment has remained unchanged, causing rapid evolution
34. Within which structure in the human body does specialization of parts of the developing baby take place?
 (a) ovary (b) uterus (c) testis (d) pancreas
35. Which statement best explains the significance of meiosis in the process of evolution within a species?
 (a) The gametes produced by meiosis ensure the continuation of any particular species by asexual reproduction.
 (b) Equal numbers of eggs and sperm are produced by meiosis.
 (c) Meiosis produces eggs and sperm that are alike.
 (d) Meiosis provides for variation in the gametes produced by an organism.
36. Which phrase best describes cellular respiration, a process that occurs continuously in the cells of organisms?
 (a) removal of oxygen from the cells of an organism
 (b) conversion of light energy into the chemical bond energy of organic molecules
 (c) transport of materials within cells and throughout the bodies of multicellular organisms
 (d) changing of stored chemical energy in food molecules to a form usable by organisms

37. Which statement does *not* identify a characteristic of antibodies?
- They are produced by the body in response to the presence of foreign substances.
 - They may be produced in response to an antigen.
 - They are nonspecific, acting against any foreign substance in the body.
 - They may be produced by white blood cells.
38. An increase in the level of insulin in the blood would most directly result in
- a decrease in the amount of glucose in the blood
 - a decrease in the amount of protein in the blood
 - an increase in the amount of fat in cells
 - an increase in the amount of carbon dioxide in cells
39. Compared to a natural forest, the wheat field of a farmer *lacks*
- heterotrophs
 - significant biodiversity
 - autotrophs
 - stored energy
40. A new type of fuel gives off excessive amounts of smoke. Before this type of fuel is widely used, an ecologist would most likely want to know
- what effect the smoke will have on the environment
 - how much it will cost to produce the fuel
 - how long it will take to produce the fuel
 - if the fuel will be widely accepted by consumers

SECTION D : INTERACTIVE QUESTIONS

41. The diagram below represents a change that occurred in a pair of chromosomes during the formation of an egg cell. The letters represent genes on the pair of chromosomes.



The alteration that occurred will most likely

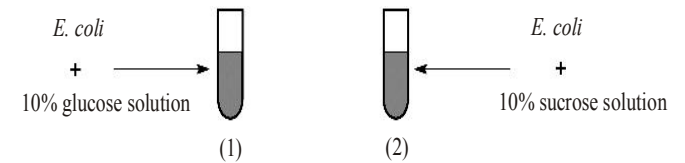
- be passed on to every cell that develops from the egg cell
 - change the chromosome number of the body cells that develop from the egg cell
 - convert sex cells into body cells
 - trigger the production of pathogens
42. The diagram below represents chromosomes in a zygote.



Which diagrams best illustrate the daughter cells that result from normal mitotic cell division of this zygote?

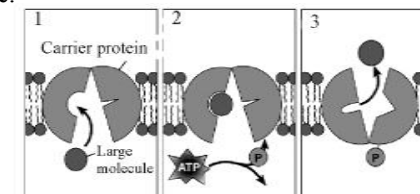


43. The diagram below shows two setups that were used to study bacterial growth. Each setup initially contained an equal number of the bacterium *E. coli* in different carbohydrate solutions. After one hour, a 1-milliliter sample was drawn from each tube and analyzed. The number of bacteria found in the sample from test tube 1 was higher than the number in test tube 2.



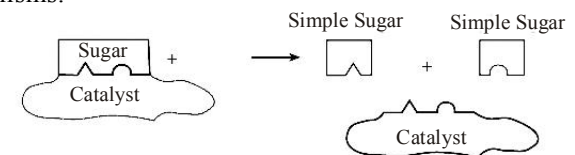
Which conclusion regarding this investigation is *not* valid?

- All bacteria grow best in a solution of glucose.
 - E. coli* grows better in a 10% solution of glucose than in a 10% solution of sucrose.
 - The type of sugar solution will make a difference in the rate of growth of *E. coli*.
 - The rate of growth of *E. coli* depends on the type of carbohydrate present.
44. The diagram below represents movement of a large molecule across a membrane.



Which process is best represented in this diagram?

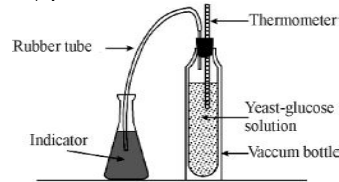
- active transport
 - diffusion
 - protein building
 - gene manipulation
45. The diagram below illustrates a biochemical process that occurs in organisms.



The substance labeled “catalyst” is also known as

- (a) a hormone (b) an antibody
(c) an enzyme (d) an inorganic compound

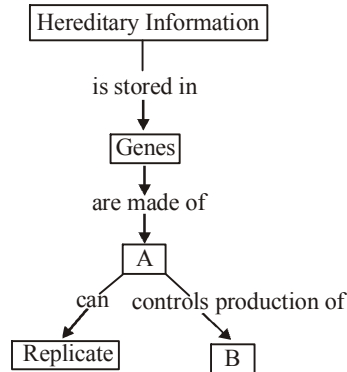
46. A student placed a solution of glucose and yeast in a vacuum bottle and sealed it with a two-hole stopper as shown in the diagram below. The temperature of the yeast glucose solution increased gradually with time, and the colour of the indicator was observed and recorded throughout a 2-day period.



The purpose of the investigation was most likely to

- (a) study the relationship between temperature and pressure
(b) demonstrate the release of energy by a chemical process
(c) show that proteins are produced by yeast
(d) study autotrophic nutrition in yeast

Base your answers to questions 47 and 48 on the diagram below, which provides information related to heredity.



47. The type of molecule in box *A* serves as a template. This means
- (a) It serve as complete genome
(b) It serve as a pattern
(c) It serve as sugar molecule
(d) None of these
48. Which molecules are represented by box *B*?
- (a) bases (b) proteins
(c) amino acids (d) simple sugars

Base your answers to questions 49 and 50 on the information below.

A student completed a series of experiments and found that a protein digesting enzyme (intestinal protease) functions best when the pH is 8.0 and the temperature is 37°C. During an experiment, the student used some of the procedures listed below.

Procedures

- (A) Adding more protease
(B) Adding more protein
(C) Decreasing the pH to 6.0
(D) Increasing the temperature to 45°C
(E) Decreasing the amount of light

49. Which procedure would have the *least* effect on the rate of protein digestion?
- (a) *A* (b) *E* (c) *C* (d) *D*
50. Which two procedures would most likely cause a *decrease* in the rate of protein digestion?
- (a) *A* and *D* (b) *B* and *C* (c) *C* and *D* (d) *A* and *E*

☺ END OF THE EXAM ☺

ANSWERS

- | | | | | |
|---------|---------|---------|---------|---------|
| 1. (d) | 2. (a) | 3. (a) | 4. (a) | 5. (d) |
| 6. (b) | 7. (c) | 8. (d) | 9. (b) | 10. (d) |
| 11. (a) | 12. (b) | 13. (d) | 14. (d) | 15. (c) |
| 16. (a) | 17. (c) | 18. (a) | 19. (c) | 20. (b) |
| 21. (c) | 22. (b) | 23. (d) | 24. (b) | 25. (c) |
| 26. (d) | 27. (a) | 28. (b) | 29. (c) | 30. (c) |
| 31. (b) | 32. (a) | 33. (a) | 34. (d) | 35. (d) |
| 36. (d) | 37. (c) | 38. (a) | 39. (b) | 40. (a) |
| 41. (a) | 42. (b) | 43. (a) | 44. (a) | 45. (c) |
| 46. (b) | 47. (b) | 48. (b) | 49. (b) | 50. (c) |

☺☺☺