

Target

IIT-JAM-2018

Test Series-1

Booklet Code: **A**

Molecular Biology + Recombinant DNA Technology + Taxonomy + Ecology + Physics

Duration: 3:00 Hours

BIOTECHNOLOGY-BT

Date: 02-01-2018

Maximum Marks: 100

Read the following instructions carefully:

1. Attempt all the questions.
2. **Section-A** contains **30** Multiple Choice Questions (MCQ). Each question has 4 choices (a), (b), (c) and (d), for its answer, out of which **ONLY ONE** is correct. From **Q.1 to Q.10** carries 1 Marks and **Q.11 to Q.30** carries 2 Marks each.
3. **Section-B** contains **10** Multiple Select Questions (MSQ). Each question has 4 choices (a), (b), (c) and (d) for its answer, out of which **ONE or MORE than ONE** is/are correct. For each correct answer you will be awarded **2 marks**.
4. **Section-C** contains **20** Numerical Answer Type (NAT) questions. From **Q.41 to Q.50** carries **1 Mark** each and **Q.51 to Q.60** carries **2 Marks** each. For each NAT type question, the value of answer is between 0 to 9.
5. In all sections, questions not attempted will result in zero mark. In Section-A (MCQ), wrong answer will result in negative marks. For all **1 mark** questions, **1/3 marks** will be deducted for each wrong answer. For all **2 marks** questions, **2/3 marks** will be deducted for each wrong answer. In Section-B (MSQ), there is no negative and no partial marking provision. There is no negative marking in Section-C (NAT) as well.

Regn. No.

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SECTION-A

[Multiple Choice Questions (MCQ)]

Q. 1 – Q. 10 carry one mark each.

1. In prokaryotes, AUG encodes for
 - (a) Methionine
 - (b) Formylmethionine
 - (c) Alanine
 - (d) Stop codon
2. The main reason due to which replication of DNA is possible is
 - (a) Hydrogen bonds
 - (b) Sugar-phosphate backbone
 - (c) Complementary base pairing
 - (d) All of the above
3. Which of the following is called the coding strand?
 - (a) The template strand of DNA
 - (b) The non-template or sense strand of DNA
 - (c) mRNA after splicing has taken place
 - (d) When the Okazaki fragments are joined together by DNA ligase
4. The separation of archaeobacteria into a separate domain indicates
 - (a) that these organisms are very different from eubacteria and from eukaryotes
 - (b) that organisms should never be classified according to how they appear (morphological characters)
 - (c) that early taxonomists rushed to classify them without closely examining them
 - (d) that optical viewing techniques have greatly improved so that we can better view these micro-organisms.
5. Systematics deals with
 - (a) Identification of organisms
 - (b) Classification of organism
 - (c) The kinds and diversity of all organisms and the existing relationships amongst themselves
 - (d) Identification, naming and classification of both plants and animals.
6. Match the correct phylum / group of organism

| Series-A | Series-B |
|--|--|
| (A) Dinoflagellates | (i) Euglenophyta |
| (B) Diatoms | (ii) Pyrophyta |
| (C) Euglenoids | (iii) Myxomycete |
| (D) Slime molds | (iv) Chrysophyta |
| (a) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv) | (b) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii) |
| (c) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii) | (d) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii) |
7. A mixture containing protein 1, 2, 3, 4 and 5 with molecular weight 5000, 10000, 25000, 65000 and 100000 respectively, were separated on a sephadex G-50 column (Gel-filtration chromatography). The order of elution of these proteins from the column will be
 - (a) Protein-1, Protein-2, Protein-3, Protein-4, Protein-5
 - (b) Protein-5, Protein-4, Protein-3, Protein-2, Protein-1
 - (c) Protein-1, 2 & 3 elute first, followed by Protein-5 & Protein-4
 - (d) Protein-4 & 5 elute first, followed by Protein-3, 2 & Protein-1

8. Estimation of secondary structures of a protein using _____ is based on the absorption of peptide bond
- (a) X-ray crystallography (b) SEM
(c) CD spectroscopy (d) SPR
9. The technique used to study metalloenzymes oxidation - reduction state of metal in electron transport system is
- (a) ESR (b) NMR
(c) CD (d) Fluorescence microscopy
10. Best resolving power of a light microscope will be at which light
- (a) Violet (b) Blue
(c) Yellow (d) Red

Q. 11 – Q. 30 carry two marks each.

11. Horseradish peroxidase is an enzyme which is used in the ELISA, and it is isolated from Horseradish (perennial plant of Brassicaceae family). What is the scientific name of Horseradish?
- (a) *Vitis vinifera* (b) *Armoracia rusticana*
(c) *Brassica oleracea* (d) *Raphanus sativus*
12. Which one of the following is categorized as a parasite in true sense?
- (a) The cuckoo lays its egg in crow's nest
(b) The female Anopheles bites and sucks blood from humans
(c) Human foetus developing inside the uterus draws nourishment from the mother
(d) Head louse living on the human scalp as well as laying eggs on human hair
13. The abundance of a species population within its habitat is called
- (a) Relative density (b) Regional density
(c) Absolute density (d) Niche density
14. In kingdom Mycota, sexual reproduction is identified and it contains major 4 groups and according to their habitat and morphology they were divided. Please find the correct combination of the following.
- | Match-A | Match-B |
|--|--|
| (A) Club fungi | (i) Phycomycetes |
| (B) Conjugation fungi | (ii) Zygomycetes |
| (C) Sac fungi | (iii) Ascomycetes |
| (D) Algal fungi | (iv) Basidiomycetes |
| (a) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i) | (b) (A)-(iv), (B)-(ii), (C)-(iii), (D)-(i) |
| (c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii) | (d) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii) |
15. Statements regarding kingdom Plantae are correct except
- (i) Naked seeds are present in Gymnosperms
(ii) Mosses and Ferns are included in Bryophytes
(iii) Vascular system is started from Pteridophyta
(iv) Gymnosperms extinct in carboniferous era
- (a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iv) (d) (ii) and (iv)

16. Match the correct larval stages with their given phylum.

Larva

Phylum

- | | |
|--|--|
| (A) Amphiblastula | (i) Aschelminthes |
| (B) Cydippid | (ii) Ctenophora |
| (C) Hexacanth | (iii) Porifera |
| (D) Rhabditiform | (iv) Platyhelminthes |
| (a) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i) | (b) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii) |
| (c) (A)-(i), (B)-(ii), (C)-(iv), (D)-(iii) | (d) (A)-(i), (B)-(iv), (C)-(ii), (D)-(iii) |

17. Zinc containing enzyme used in recombinant DNA technology

- | | |
|-----------------------------|--------------------------|
| (a) Carbonic anhydrase | (b) Alkaline phosphatase |
| (c) S ₁ nuclease | (d) Bam H ₁ |

18. Unifunctional restriction endonuclease which has separate endonuclease and methylase activity

- | | |
|-----------------|-----------------------------|
| (a) Type I RE | (b) Type II RE |
| (c) Type III RE | (d) Type I RE & Type III RE |

19. If there is equal proportion of Auxin and Cytokinin in the medium for plant tissue growth then it will promote.

- | | |
|----------------------|------------------------------|
| (a) Root formation | (b) Shoot formation |
| (c) Callus formation | (d) It not affect the growth |

20. Which of the following partial amino acid sequence from a protein whose gene you wish to clone would be most useful in designing an oligonucleotide probe to screen a cDNA library.

P = Met-Leu-Arg-Leu, Q = Met-Trp-Cys-Trp

- | | |
|----------------|------------|
| (a) Only P | (b) Only Q |
| (c) Both P & Q | (d) None |

21. Genes within an operon:

- Tend to be regulated by a common regulatory mechanism.
- Are generally involved in the same biochemical pathway.
- Are expressed as a polycistronic RNA.
- All of the above

22. The role of the sigma factor in bacterial RNA polymerase is:

- tocatalyse RNA synthesis
- to position RNA polymerase correctly on the template DNA
- to terminate RNA synthesis
- to initiate RNA synthesis

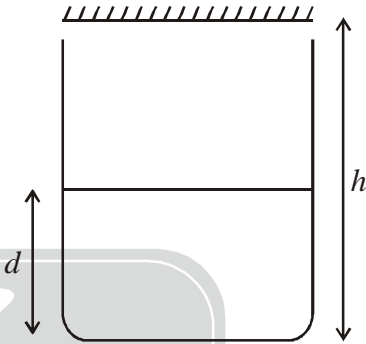
23. Which of the following statements regarding splicing of eukaryotic mRNA transcripts is correct?

- Exons are spliced out and introns are retained in the mature mRNA transcript.
- Several reactions in the splicing process involve hydrolysis of ATP.
- Small nuclear RNAs are retained in the mature mRNA transcript.
- Splicing takes place in the cytosol.

24. Which of the following would you expect to find in an inducible system?

- A repressor protein, which is bound to DNA in absence of any other factor.
- A repressor protein, which is bound to DNA in the presence of a corepressor.
- An activator protein, which is bound to DNA in absence of any other factor.
- An activator protein, which is bound to DNA only in the absence of an inhibitor.



25. Competition is most severe between two
- Distantly related species growing in the same habitat
 - Closely related species growing in the same habitat
 - Closely related species growing in different niches
 - Distantly related species growing in different niches.
26. When faced with danger or competition, some organisms will care only for themselves and ignore the needs of others. Which term best explains this behaviour
- Social group
 - Queen/worker relationship
 - Inclusive fitness
 - Individual fitness
27. A plane mirror is fixed at a height h above the bottom of a beaker containing water (refractive index μ) up to a height d as shown in figure. The image is formed behind the mirror at a distance equal to
- $h + \frac{d}{\mu}$
 - $h - d + \frac{d}{\mu}$
 - $\frac{d}{\mu} - d$
 - $h - d$
- 
28. A ball of mass m hits the floor with a speed v making an angle of incidence θ with the normal. The coefficient of restitution is e . The speed of the reflected ball is
- $ev \tan \theta$
 - ev
 - $v\sqrt{\cos^2 \theta + e^2 \sin^2 \theta}$
 - $v\sqrt{\sin^2 \theta + e^2 \cos^2 \theta}$
29. Two satellites S_1 and S_2 revolve round a planet in coplanar circular orbits in the same sense. Their periods of revolution are 1 hr and 8 hr respectively. The radius of the orbit of S_1 is 10^4 km. When S_2 is closest to S_1 , the speed of S_2 relative to S_1 will be:
- $4\pi \times 10^4 \text{ km h}^{-1}$
 - $2\pi \times 10^4 \text{ km h}^{-1}$
 - $3\pi \times 10^4 \text{ km h}^{-1}$
 - $\pi \times 10^4 \text{ km h}^{-1}$
30. S_1 nuclease is endonuclease used in biotechnological approaches. This enzyme degrades.
- RNA or single stranded DNA
 - only RNA
 - ds-DNA
 - DNA-RNA hybrid

SECTION-B

[Multiple Select Questions (MSQ)]

Q. 31 – Q. 40 carry two marks each.

31. Which of the following does *E. coli* have?
- Inducible operons
 - Repressible operons
 - Semiconservative replication
 - Introns and exons

32. Which of the following statements regarding termination of transcription in prokaryotes is correct?
- In Rho dependent termination the Rho factor moves along the DNA template ahead of the RNA polymerase.
 - Rho factor has topoisomerase activity for relieving supercoiling.
 - Termination often involves a stem-loop structure forming in the RNA transcript.
 - Termination often involves a stem-loop structure forming in the DNA template
33. Read the following sentences carefully and find out the right statement
- Mungbean nuclease is endonuclease specific for ssDNA and RNA
 - S1 is exonuclease purified from *Aspergillus*
 - Isoschizomers are restriction enzymes which are isolated from different organism but recognizes identical base sequences in the DNA and cleave at same cleavage site.
 - Neoschizomers isoschizomers are restriction enzymes which are isolated from different organism but recognizes identical base sequences in the DNA and cleave at same cleavage site.
34. Reporter genes generate a product that can be detected using a simple and often quantitative assay. Find out the false statements
- Lac Z gene, Luciferase, GFP are used as reporter genes
 - GFP discovered by Shimomura
 - GFP is the encoding gene of *Photinus pyralis*
 - Luciferase is encoding gene of *Aquoria victoria*
35. As a practical definition of species, one can say that they are a group of organisms characterized by
- Do not normally interbreed with other species in nature
 - Can be distinguished from other species
 - are in capable of hybridisation with other species
 - remain relatively constant
36. Tick the correct option for pathogen and transmission vector of a protozoan disease.
- | Disease | Pathogen | Transmission Vector |
|--------------------------------|---------------------------|---------------------|
| (a) African sleeping sickness | <i>Trypanosoma brucei</i> | Triatomid bug |
| (b) American sleeping sickness | <i>Trypanosoma cruzi</i> | Tsetse fly |
| (c) Babesiosis | <i>Babesia spp.</i> | Ticks |
| (d) Leishmaniasis | <i>Leishmania gondii</i> | Sand fly |
37. Ex situ conservation includes:
- Zoological Park
 - Wildlife Sanctuaries
 - Germplasm Bank
 - National park
38. A long straight wire carries a current along the Z-axis. One can find two points in the X-Y plane such that
- the magnetic fields are equal
 - the directions of the magnetic fields are the same
 - the magnitudes of the magnetic fields are equal
 - the field at one point is opposite to that at the other point.
39. An AND gate can be prepared by repetitive use of
- NOT gate
 - OR gate
 - NAND gate
 - NOR gate
40. Which of the following quantities do NOT depend on the choice of zero potential or zero potential energy?
- potential at a point
 - potential difference between two points
 - potential energy of a two-charge system
 - charge in potential energy of a two-charge system

SECTION-C

[Numerical Answer Type (NAT)]

Q. 41 – Q. 50 carry one mark each.

41. Calculate the resolving power of a microscope of numerical aperture 0.4 and the wavelength of illuminating light is 550 nm _____
42. You are given three tubes A, B and C which contain one sample of either protein or DNA or RNA. Using UV-Vis absorption spectroscopy, it is confirmed that B tubes contains ds DNA. For this confirmation what should be the value of $\frac{A_{260}}{A_{280}} =$ _____
43. How many cutting sites are present in the following DNA sequence for EcoRI? _____
5' ATGAATTCCACCGAATTCCGAATGA 3'
44. If the codon had doublets instead of triplets, then how many such doublets would be possible with the usual 4 nucleotides? _____
45. Number of subunits in a ribosome are _____
46. The number of amino acids in the polypeptide coded by the following mRNA is _____
AAGAUCGAUGAAACAACGUACGCCUACGUAAAUCG
47. The number of structural genes in lac operon in E. coli is _____
48. Observe the given polypeptide with amino acid sequences. _____
A – P – K – R – Q – S – T – Y – C – D – L – K – M
If this sequence is digested with Trypsin and chymotrypsin, how many peptide bonds will break?
49. Enzymes used for conjugation of antibodies
- | Enzymes | Source |
|------------------------|----------------|
| Peroxidase | Horseradish |
| Alkaline phosphatase | Jack bean |
| β -Galactosidase | Calf intestine |
| Urease | E. Coli |
- How many sources are correctly matched? _____
50. Haemoglobin-A on SDS-PAGE gives how many bonds? _____

Q. 51 – Q. 60 carry two marks each.

51. A double slit experiment is performed with sodium (yellow) light of wavelength 589.3 nm and the interference pattern is observed on a screen 100 cm away. The tenth bright fringe has its center at a distance of 12 mm from the central maximum. The separation between the slits is _____ mm (up to two decimal places)
52. The half life of a radio isotope is 5 years. The fraction of atoms decayed in this isotope in a period of 20 years will be _____ (up to two decimal places).



53. A parallel beam of monochromatic light of wavelength 500 nm is incident normally on a perfectly absorbing surface. The power through any cross section of the beam is 10 W. The force exerted by light beam on the surface is _____ $\times 10^{-8}$ N. (up to two decimal place)
($h = 4.14 \times 10^{-15}$ eV-s, $c = 3 \times 10^8$ m/s, $1 \text{ eV} = 1.6 \times 10^{-19}$ J)

54. A car moving at 40 km/h is to be stopped by applying brakes in the next 4.0 m. If the car weighs 2000 kg, the average force that must be applied on it will be _____ 10^4 N.

Common Statement for Q. No. 55 and 56.

STATEMENT : A certain population A, is experiencing exponential growth. Population size = 50 Births = 10 Death = 4

55. Calculate the individual growth rate (r). This is also known as the per capita reproduction rate. _____
56. Calculate the population growth rate. (Individuals added to the population in one generation.) _____

Common Statement for Q. No. 57, 58 and 59.

STATEMENT : In a population of 600 squirrels, the per capita birth rate in a particular period is 0.06 and the per capita death rate is 0.12.

57. What is the per capita growth rate of the population? Round your answer to the nearest hundredth. _____
58. What is the actual number of squirrels that die during this particular period? Round your answer to the nearest whole number. _____
59. What is the actual number of squirrels that are born during this period? Round your answer to the nearest whole number. _____
60. Suppose that of a cohort of 200 rats in a rat colony born in January, 160 are still alive at the start of March and 120 are still alive at the start of May. What is the survivorship up to the start of March? Round to the nearest hundredth. _____

END OF THE QUESTION PAPER

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IIT-JAM BIOTECHNOLOGY - BT

TEST SERIES - 1

(Molecular Biology + Recombinant DNA Technology + Taxonomy + Ecology + Physics)

Time : 3 Hours

Date : 02-01-2018

M.M. : 100

ANSWER KEY

SECTION-A

[Multiple Choice Questions (MCQ)]

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

SECTION-B

[Multiple Select Questions (MSQ)]

- | | | | |
|---------------|---------------|------------|---------------|
| 31. (a, b, c) | 32. (a, b, d) | 33. (a, c) | 34. (c, d) |
| 35. (a, b, d) | 36. (c, d) | 37. (a, b) | 38. (b, c, d) |
| 39. (c, d) | 40. (b, d) | | |

SECTION-C

[Numerical Answer Type (NAT)]

- | | | | | |
|------------------|-----------------|-----------------|---------------|------------|
| 41. (838 to 840) | 42. (1.8) | 43. (2) | 44. (16) | 45. (2) |
| 46. (7) | 47. (3) | 48. (3) | 49. (1) | 50. (2) |
| 51. (0.48-0.50) | 52. (0.93-0.95) | 53. (3.32-3.34) | 54. (3.0-3.3) | 55. (0.12) |
| 56. (6) | 57. (0.06) | 58. (72) | 59. (36) | 60. (0.80) |

