

PART-A

1. Helium and argon gases in two separate containers are at same temperature and so have different root mean square (r.m.s) velocities. The two are mixed in a third container keeping the same temperature. The rms velocity of the helium atoms in mixture is
 (1) more than what it was before mixing
 (2) less than what it was before mixing
 (3) equal to what it was before mixing
 (4) equal to that of argon atoms in the mixture

2. 100 g of inorganic compound $X \cdot 5H_2O$ containing a volatile impurity was kept in an oven at $150^\circ C$ for 60 minutes. The weight of residue after heating is 8 g. The percentage of impurities in X was
 (1) 10 % (2) 8 %
 (3) 20 % (4) 80 %

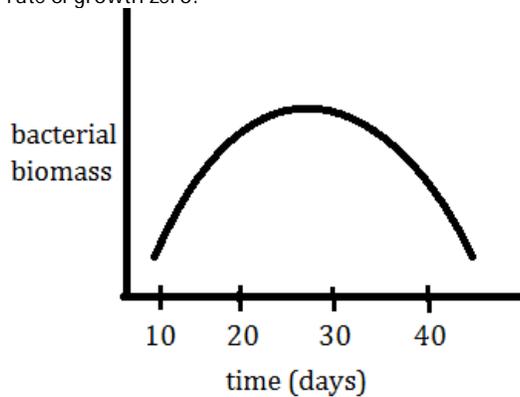
3. Two moles each of oxygen (O_2) and hydrogen (H_2) are in two separate containers, each of volume V_0 and at temperature $150^\circ C$ and 1 Atmospheric pressure. The two were allowed to react in third container to form water vapors until hydrogen is exhausted. When the temperature of the mixture in the third container was restored $150^\circ C$, its pressure become 1 atmospheric. The volume of container must be
 (1) V_0 (2) $5V_0/4$
 (3) $3V_0/2$ (4) $2V_0$

4. The mineral talc is used in the manufacture of soap because
 A. gives bulk to product
 B. Kills bacteria
 C. Gives fragrance
 D. is soft and does not scratch the skin

Which of the following is correct reason?
 (1) D only (2) A and C
 (3) A and B (4) A and D

5. On a certain night the moon in its waning phase was half moon. At midnight the moon will be
 (1) on Eastern horizon
 (2) at 45° angular height above the eastern horizon
 (3) at the zenith
 (4) on western horizon

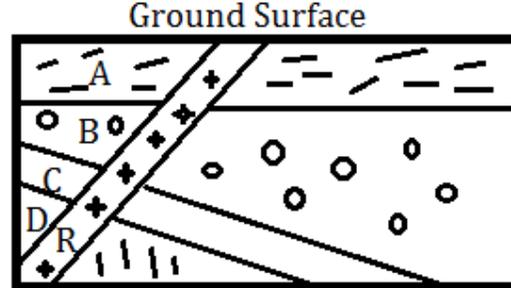
6. Growth of an organism was monitored at regular intervals of times and shown in the graph below. Around what time is the rate of growth zero?



- The zero growth rate will be observed during
 (1) close to day 10
 (2) on the 20th day
 (3) between 20 and 30 days
 (4) between 30 and 40 days

7. The ends of rope are fixed to two pegs such that rope remains slack. A pencil is placed against rope and moved, such that the rope always remains taut. The shape of the curve traced by pencil would be a part of
 (1) a circle (2) an ellipse
 (3) a square (4) a triangle

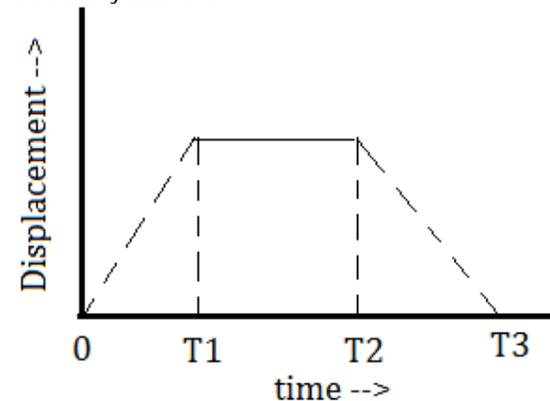
8. Four sedimentary rocks A, B, C and D are intruded by igneous rock R as shown in cross section diagram.



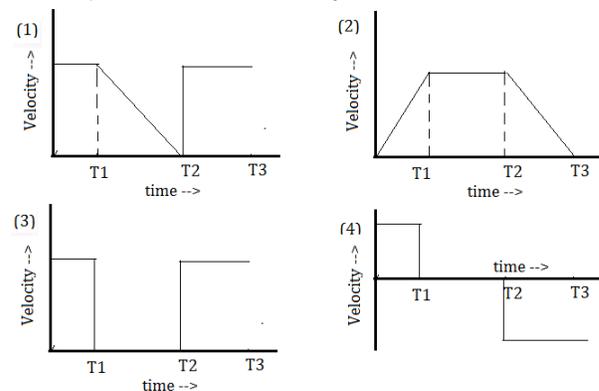
- Which of the following is correct about their ages?
 (1) A is youngest followed by B, C, D and R
 (2) R is youngest followed by A, B, C and D
 (3) D is youngest followed by R, A, B and C
 (4) A is youngest followed by R, B, C and D

9. A gemstone is irradiated in a nuclear reactor for 5 days. Ten days after irradiation, the activity of the chromium isotope in gemstone is 600 disintegration per hour. What is the activity of chromium isotope 5 days after irradiation if its half life of is 5 days?
 (1) 300 (2) 150
 (3) 2400 (4) 1200

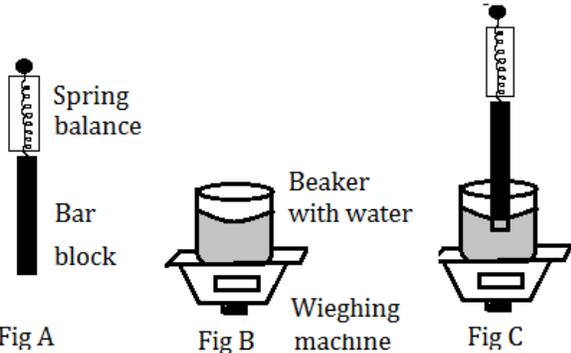
10. Displacement versus time curve for a body is shown in the figure. Select the graph that correctly shows the variation of the velocity with time



Which of the following is correct representation of velocity with respect to time for same body?



11. The spring balance in figure A reads 0.5 kg and the pan balance in figure B reads 3.0 Kg. If iron block is suspended from spring balance is partially immersed in water in the beaker (Figure C). The spring balance now reads 0.4 kg. The reading on the pan balance in figure C is



- Fig A
 (1) 3.0 kg
 (3) 3.1 kg
- Fig B
 (2) 2.9 kg
 (4) 3.5 kg

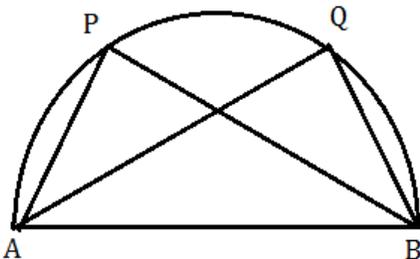
12. The angles of a right angled triangle shaped garden are in arithmetic progression and the smallest side is 10.00 m. The total length of the fencing of the garden in m is

(1) 60.00 m
 (2) 47.32 m
 (3) 12.68 m
 (4) 22.68 m

13. The rabbit population in community A increases by 25 % per year while in community B increases at 50 % per year respectively. If the present populations of A and B are equal, the ratio of the number of rabbits in B to A after two years will be?

(1) 1.44
 (2) 1.72
 (3) 1.90
 (4) 1.25

14. AB is diameter of semicircle as shown in diagram. If $AQ=2AP$ then which of the following is correct



- (1) angle APB = 1/2 of angle AQB
 (2) angle APB = twice of angle AQB
 (3) angle APB= angle AQB
 (4) angle APB =1/4 of angle AQB

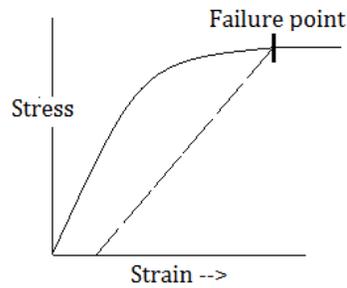
15. A Tall plant with Red seeds (both dominant traits) was crossed with a dwarf plant with white seeds. If the segregating progeny produced equal number of tall red and dwarf white plants, what would be the genotype of the parents?

(1) $TtRr \times TtRR$
 (2) $TtRr \times ttrr$
 (3) $TTRR \times ttrr$
 (4) $TTRR \times TtRr$

16. During ice skating the blades of the ice skater's shoe exerts pressure on the ice. Ice skater can efficiently skate on ice because

(1) ice gets converted to water as the pressure exerted on it increases
 (2) ice gets converted into water as the pressure exerted on it decreases
 (3) the density of ice in contact with the blades decreases
 (4) blades do not penetrate into ice

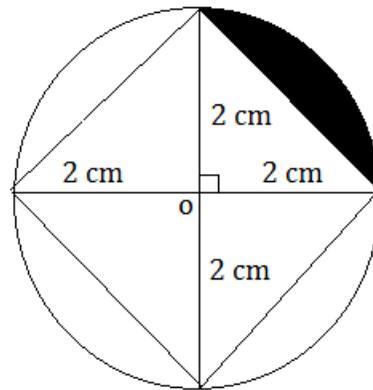
17. The strain in a solid subjected to continuous stress is plotted.



Which of the following statement is true?

(1) The solid deforms elastically till the point of failure
 (2) The solid deforms plastically till the point of failure
 (3) The solid comes back to original shape and size on failure
 (4) The solid is permanently deformed on failure

18. The area of shaded region in cm^2



- (1) $(\pi-\sqrt{2})$
 (2) $(\pi-2)$
 (3) $(\pi/4-\sqrt{2}/2)$
 (4) $(\pi+2)$

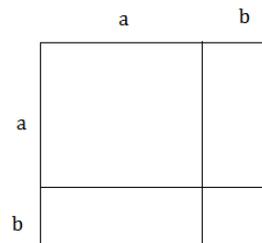
19. Three sunflower plants were placed in conditions as indicated below

- Plant A: Still air
 Plant B: moderately turbulent air
 Plant C: Still air in dark

Which of the following statement is correct?

(1) Transpiration rate of plant B>that of plant A
 (2) Transpiration rate of plant A> that of plant B
 (3) Transpiration rate of plant C=that of A
 (4) Transpiration rate of plant C>that of plant A>that of plant B

20. Which of the following is indicated by the accompanying diagram?



- (1) $a+ab+ab^2+\dots=a[1-b \text{ for } |b|<1$
 (2) $a>b \text{ implies } a^3 > b^3$
 (3) $(a + b)^2 = a^2 + 2ab + b^2$
 (4) $a>b \text{ implies } -a < -b$

PART-B

21. Which nitrogen of adenosine gets protonated if pH of nucleoside is lowered from 7 to 3?

- (1) N₁ (2) N₃
(3) N₇ (4) N₉

22. Phosphotidyl serine, an important component of biological membrane, is located in

- (1) the outer leaflet but flip flop to inner
(2) both leaflets of plasma membrane
(3) middle of the bilayer
(4) the inner leaflet but flip flops to outer leaflets under specific conditions

23. The oligopeptide, with F-A-R-P-M-T-S-R-P-G-F is treated with trypsin, chymotrypsin and carboxypeptidase-B. Apart from original, the number of fragments obtained will be

- (1) 4 (2) 3
(3) 2 (4) 0

24. The word "fermentation" is used in biochemistry and Microbial technology to denote different phenomenon. If the former is called C and latter is called T. Which of the following statement is true?

- (1) All C is T but all T is not C
(2) All T is C but C is not T
(3) T is always a product of genetic engineering while C is not
(4) C is always an aerobic process, while T can be aerobic or anaerobic

25. All cytosolic proteins have nuclear export signals that allows them to be removed from nucleus when it reassembles after

- (1) meiosis (2) Mitosis
(3) both mitosis and meiosis
(4) DNA replication

26. ATP- binding cassette (ABC) transporters

- (1) all are P-glycoprotein
(2) found only in eukaryotes
(3) are both membrane spanning transporter domain that recognizes substrate and ATP-binding domain
(4) affect translocation by forming channels

27. Which one of the following interactions plays a major role in stabilizing B-DNA?

- (1) Hydrogen bond
(2) Hydrophobic interactions
(3) Van der Waals interactions
(4) Ionic interactions

28. Which of the following statement is NOT true about small interfering RNA (siRNA)?

- (1) siRNA has 21-25 nucleotide sequence with 2 nucleotide overhang at 3' end
(2) siRNA is processed by RNA protein complex RISC
(3) siRNA is often induced by viruses
(4) siRNA does not generally act at the level of transcription.

29. Regulatory elements for expression of ribosomal RNA genes resides in the

- (1) transcribed spacer region
(2) non-transcribed spacer region
(3) 5' flanking region of individual ribosomal genes
(4) internal regions within the genes

30. Presence of an internal ribosomal entry site (IRES) in mRNA

- (1) Inhibit its translation
(2) promotes its post transcriptional processing
(3) has no impact on its translation
(4) promotes its translation under adverse conditions

31. *Mycobacterium tuberculosis* is an intra-cellular bacterium. It prefers to infect

- (1) Macrophages (2) B-cells
(3) T-cells (4) neutrophils

32. Integrin molecule link extracellular matrix (ECM) to the actin cytoskeleton of cell. Integrin binds to which of the following ECM macromolecules?

- (1) Laminin (2) Collagen
(3) Fibronectin (4) Vitronectin

33. Major stimulus for spore formation in bacteria is

- (1) Nutrient limitation (2) heat stress
(3) Cold stress (4) pH stress

34. Which of the following matches of oncogene-protein product is NOT correct?

- (1) *erbA* → Thyroid hormone receptor
(2) *erbB* → Epidermal Growth Factor receptor
(3) *ras* → Guanine nucleotide binding protein with GTPase activity
(4) *fos* → Platelet derived growth factor receptor

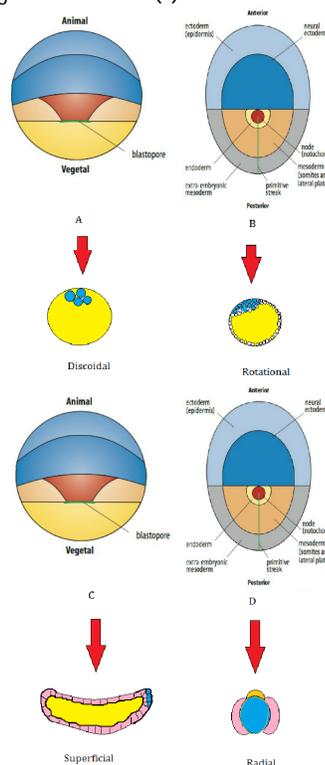
35. Which of the following statement is INCORRECT in relation to treatment of pre-B cell with phorbol ester?

- (1) Phorbol esters activates NF-κB for translocation into nucleus
(2) Phorbol esters activate protein kinase C
(3) Phorbol ester leads to phosphorylates of NF-κB
(4) Phorbol ester remove the inhibitor from inactive NF-κB complex in the cytoplasm

36. CD 19 is a marker for

- (1) B-cells (2) T-cells
(3) Macrophage (4) Natural Killer cells

37. Given below are fate map of two organisms and the pattern by which embryos undergo cleavage. Which of the following is/are the right combination(s)?



- (1) B only (2) B and A
(3) A and C (4) B and D

38. Ced-9 gene appears to be a binary switch that regulates cell survival and apoptosis in nematodes. Considering that CED-9 protein can bind to and inactivate CED-4, which of the following would lead to apoptosis?

- (1) Activation of *Ced-9* gene
- (2) Loss of function of CED-3
- (3) Loss of function of *Ced-9* gene
- (4) Loss of function of CED-4

39. In case of is *Xenopus levis* which cells make up the Knewkoop center and Spemann's organizer?

- (1) endodermal and mesodermal, respectively
- (2) mesodermal and endodermal, respectively
- (3) endodermal and ectodermal, respectively
- (4) ectodermal and endodermal, respectively

40. Photosystem II functions as a light dependent water plastoquinone oxidoreductase. What are the names of two reaction center protein that bind electron transfer prosthetic group, such as P680, pheophytin and plastoquinone?

- (1) CP43 and CP47
- (2) D1 and D2
- (3) 33 kDa and 23 kDa
- (4) F_A and F_B

41. Which one of the following combinations of secondary metabolite biosynthetic pathway result in the biosynthesis of terpenes?

- (1) Mevalonic acid and MEP pathways
- (2) Malonic acid and MEP pathways
- (3) Shikimic acid and Malonic acid pathway
- (4) Shikimic acid and Mevalonic acid pathways

42. Symbiotic biological nitrogen fixation takes place with the association between a plant and a nitrogen fixing prokaryote as shown in the following table:

List of plants	Nitrogen fixing
A. Soyabean	1. <i>Frankia</i>
B. <i>Casurina</i>	2. <i>Bradyrhizobium</i>
C. <i>Guneria</i>	3. <i>Anabena</i>
D. <i>Azolla</i>	4. <i>Nostoc</i>

The correct combination is:

- (1) A-1, B-2, C-3, D-4
- (2) A-2, B-1, C-4, D-3
- (3) A-3, B-2, C-1, D-4
- (4) A-4, B-3, C-2, D-1

43. Plants have evolved with multiple photoreceptors, which can perceive specific wavelength of light. Which of the following statement is correct about photoreceptors?

- (1) Phytochrome A can receive both far-red and blue light
- (2) Phytochrome C can receive far-red light
- (3) Cryptochrome I and phytochrome B are for perceiving blue light
- (4) Phytochrome B can predominantly perceive far red light

44. Which of the following statement describes the process of phloem loading?

- (1) Triose phosphate is transported from chloroplast to cytosol
- (2) Sugars are transported into sieve elements and companion cells.
- (3) Sugars are transported from producing cells in mesophyll in the vicinity of sieve element
- (4) Solute are transported from roots to the shoots

45. Which of the following is responsible for initiation of maternal behaviour in first time pregnant rats after parturition?

- (1) high prolactin levels in blood
- (2) Stimulation of sensory receptors during delivery
- (3) changes in uterine volume
- (4) Presence of male rats

46. Which one of the following changes will occur in the cell membrane of nodal tissue of heart, which results in an increased heart rate due to stimulation of sympathetic nerves?

- (1) Opening of sodium channels is facilitated
- (2) Potassium conductance is increased
- (3) Opening of L-calcium are facilitated
- (4) 'h' channels are inhibited

47. A person takes 1.0 ml of insulin injection daily at 8:00 AM. His son gave 1.5 ml of insulin at 8:00 AM considering the father will go to party and eat more during lunch. The father also avoided breakfast, as he planned to eat more during lunch. Which one of the following events will occur?

- (1) father will be normo-glycemic
- (2) father will be in hypoglycemic condition before lunch
- (3) father will be in hyperglycemic condition before lunch
- (4) blood glucose of father will be low after taking lunch

48. A gene encoding t-RNA undergoes a mutational event in its anticodon region that enables it to recognize a mutant nonsense codon and permit completion of translation. Such a mutation is known as

- (1) silent mutation
- (2) neutral mutation
- (3) reversion
- (4) Non sense suppressor

49. Mutation at two different loci of the same gene X results in altered functions. These two mutated versions of gene X are called

- (1) alleles
- (2) complementation group
- (3) interrupted genes
- (4) linkage group

50. Spermatogonial stem cell undergoes extensive metamorphosis to become a spermatozoan. Meiosis leads to the formation of spermatid containing 22 autosomes and one sex chromosome. A male mouse was found in a colony which always produced only female puff upon matting. Which one pf following is a possible reason

- (1) Spermiogenesis was defective
- (2) All spermgonial stem cells contained only X and no Y chromosomes
- (3) Activation of Y-chromosome linked post meiotic death related gene may lead to such a situation
- (4) Activation of X-chromosome linked post meiotic death related gene may lead to such a situation

51. Two pure line of corn have mean cob length of 9 cm and 3 cm, respectively. The polygenes involved in this trait exhibit additive gene action. Crossing these two lines is expected to produce a progeny population with mean cob length of

- (1) 12.0 cm
- (2) 7.5 cm
- (3) 6.0 cm
- (4) 2.75 cm

52. How many genetically different gametes can be made by an individual of genotype AaBbccDDEe?

- (1) 3
- (2) 5
- (3) 8
- (4) 32

53. A paraphyletic group

- (1) contains unrelated organisms
- (2) includes the most recent common ancestors but not all of its decedents
- (3) includes all the representatives of a clade but not the most recent common ancestor
- (4) contains all the representative of a clade and most recent common ancestor

54. Which of the following organism is widely used as a biocontrol in organic farming?

- (1) *Rhizobium tropicii*
- (2) *Trichoderma viridisi*
- (3) *Fusarium oxysporum*
- (4) *Nostoc muscorum*

55. Which of the following is NOT an adaptive modification in a xerophytic plant?

- (1) strongly developed Sclerenchyma
- (2) Sunken stomata
- (3) Sparse stomata
- (4) Presence of Lacunar tissues

56. If the milk is left open, lactose is fermented first to produce acid. This is followed by proteolytic bacteria which increases the pH. Ultimately milk fats are degraded to produce rancidity. This is an example of

- (1) ecological succession
- (2) Antagonism
- (3) interference competition
- (4) Microevolution

57. Based on per molecule, which of the following gas has the most powerful greenhouse effect?

- (1) CO₂
- (2) CH₄
- (3) N₂O
- (4) CFCs

58. The Hardy-Wienberg principle comes from considering what happens when Medelian genes act on population. The model predicts that there will be no change in allele frequencies when

- (1) Migration into the population occurs at a steady rate
- (2) The population suffers a bottle neck
- (3) a rare new mutation is associated with a sharp increase in fitness
- (4) no evolutionary process is at work

59. Among the following events in history of life

- a. prokaryotic cell
- b. eukaryotic cell
- c. natural selection
- d. organic molecules
- e. self replicating molecule

Which is the correct chronological order?

- (1) d→e→c→a→b
- (2) d→e→a→b→c
- (3) e→d→a→c→b
- (4) d→e→a→c→b

60. Sexual selection results in variation in the reproductive success of males, often due to female choice with particular phenotypes. This type of sexual selection is because

- (1) Males cannot compete with other males
- (2) cost of breeding is higher for females as compared to males
- (3) inappropriate mating results in a similar reduction in fitness of females and males
- (4) males are a limiting resource for females

61. Which is best method for checking mycoplasma contamination in a mammalian cell line?

- (1) Southern Hybridization
- (2) ELISA
- (3) PCR
- (4) Western Hybridization

62. Major disadvantage of using liposome as targeted drug delivery vehicle is that

- (1) It get internalized by phagocytosis inside lysosome
- (2) It is very unstable and has low shelf life
- (3) It get intercalated in cell membrane
- (4) Its drug entrapment efficiency is very low

63. If 'r' denotes correlation coefficient and 'm' denotes slope of regression line, interchanging X and Y axes would

- (1) change 'm' but not 'r'
- (2) change 'r' but not 'm'
- (3) changes both 'r' and 'm'
- (4) nor change 'r' or 'm'

64. Which of the following statement is NOT true during infection of plant cell by *Agrobacterium*?

- (1) The protein products of virulence genes *Vir A* and *VirG* perceives acetosyringone
- (2) The *VirB* protein forms a connection between *Agrobacterium* and the plant cell and facilitates T-DNA transfer into the plant
- (3) The T-DNA is excised and bound to *VirD2* protein
- (4) The T-DNA, after becoming coated with *VirF* binds to phosphorylated *VIP1*, which allows the complex to enter the plant's nucleus

65. Which of the following does not represents strategy for phytoremediation?

- (1) Phytodegradation
- (2) Phytomining
- (3) Continuous removal through hyper accumulators
- (4) Chelate mediated extraction of pollutants

66. Among existing technologies, which of the following vector system would you prefer to use for generating a library for 140 kb eukaryotic genomic DNA fragments, while giving due consideration to size as well as stability of insert?

- (1) Phage
- (2) Cosmid
- (3) BAC
- (4) YAC

67. The use of biotinylated secondary antibody in ELISA?

- (1) increase the sensitivity of assay but compromises the specificity
- (2) increases the sensitivity of assay without compromising the specificity
- (3) does not alter either sensitivity or specificity
- (4) decreases both sensitivity and specificity

68. Secondary sewage treatment involves

- (1) Physical removal of solids from polluted water by filtration and sedimentation
- (2) removal of chemical remains by precipitation
- (3) removal of dissolved organic compounds by activated sludge or trickling filter
- (4) Removal of microbial pathogens by chlorination or ozonization

69. Site specific recombination results in precise DNA rearrangements, which is limited to specific sequences. The enzymes that are important to carry out the process are

- (1) Restriction endonuclease and DNA Polymerase
- (2) nuclease and ligase
- (3) DNA polymerase and ligase
- (4) DNA polymerase and DNA gyrase

70. To replace animal use in testing hepatic toxicity of a drug on trial, which one of the following would be used *in vitro* to be closest to the *in vivo* scenario?

- (1) Liver cells
- (2) Hepatic cell lines
- (3) Liver slices
- (4) Co-culture of liver parenchymal cells and kupfer cells

PART-C

71. A plot of $V/[S]$ versus V is generated for an enzyme catalyzed reaction, and a straight line is obtained. Indicate the information that can be obtained from the plot.
 (1) V_{max} and turnover number K_m can be obtained only from a plot of $1/V$ versus $1/[S]$.
 (2) K_m/V_{max} from the slope
 (3) V_{max} , K_m and turnover number
 (4) only K_m and turnover number.

72. Phosphorylation of ADP to ATP occurs through energy metabolism, comprising oxidative phosphorylation or substrate level phosphorylation or photo-phosphorylation (in plants). ATP can also be formed from ADP through the action of adenylate kinase. Crystal structure determination of adenylate kinase shows that the C-terminal region has the sequence -val-asp-asp-val-phe-ser-gln-val-cys-thr-his-leu-asp-thr-leu-lys.

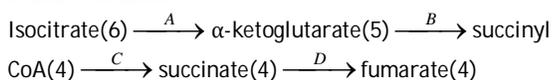
What can be a possible conformation of the sequence?
 (1) A helix that is not amphipathic
 (2) Amphipathic helix
 (3) Leucine zipper helix
 (4) Beta helix

73. Consider a 51-residue long protein containing only 100 bonds about which rotation can occur. Assume that 3 orientations per bond are possible. Based on these assumptions, how many conformations will be possible for this protein?
 (1) 3^{100} (2) 100^3
 (3) 3^{51} (4) $51 \times 100 \times 3$

74. Phosphogluconolactone is added to 0.1 M glucose-1-phosphate (G-6-P). The standard free energy change of the reaction, $G-6-P \rightleftharpoons G-1-P$ is 1.8 kcal/mole at 25°C. The equilibrium concentrations of G-6-P and G-1-P, respectively are
 (1) 96 mM, 45 mM (2) 100 mM, 0mM
 (3) 45 mM, 96 mM (4) 0 mM, 100 mM

75. Differential scanning calorimetric study of calf thymus DNA was carried out to measure midpoint of thermal denaturation (T_m). ΔH_m (enthalpy change at T_m) and ΔC_p (constant-pressure heat capacity change). It has been observed that $\Delta C_p = 0$, $T_m = 75.5^\circ\text{C}$ and $\Delta H_m = 50.4$ kcal/mole. The Gibbs free energy change at 37°C is
 (1) 25.5 kcal/mole (2) 2.6 kcal/mole
 (3) 0.6 kcal/mole (4) 5.6 kcal/mole

76. The following reactions are part of the citric acid cycle. The numbers in parenthesis indicate the number of carbon atoms in each molecule.



Which of the following sequences of the reaction systems A→D is correct?
 (1) $\text{NAD}^+ \rightarrow \text{NADH} + \text{H}^+ \rightarrow \text{NAD}^+, \text{CO}_2 \rightarrow \text{NADH} + \text{H}^+, \text{GDP}, \text{CO}_2 \rightarrow \text{GTP}, \text{FAD}, \text{iP} \rightarrow \text{FADH}_2$
 (2) $\text{NAD}^+ \rightarrow \text{NADH} + \text{H}^+, \text{NAD}^+, \text{CO}_2 \rightarrow \text{NADH} + \text{H}^+, \text{ADP}, \text{CO}_2 \rightarrow \text{ATP}, \text{FAD}, \text{iP} \rightarrow \text{FADH}_2$
 (3) $\text{NAD}^+ \rightarrow \text{NADH} + \text{H}^+, \text{FAD}^+, \text{CO}_2 \rightarrow \text{FADH}_2, \text{ADP} \rightarrow \text{ATP}, \text{NAD}^+, \text{iP} \rightarrow \text{NADH} + \text{H}^+, \text{CO}_2$
 (4) $\text{NAD}^+ \rightarrow \text{NADH} + \text{H}^+, \text{FAD}^+, \text{CO}_2 \rightarrow \text{FADH}_2, \text{GDP} \rightarrow \text{GTP}, \text{NAD}^+, \text{iP} \rightarrow \text{NADH} + \text{H}^+, \text{CO}_2$

77. The respiratory chain is relatively inaccessible to experimental manipulation in intact mitochondria. Upon disrupting mitochondria with ultrasound, however, it is possible to isolate functional sub mitochondrial particles, which consist of broken cristae that have resealed inside out

into small closed vesicles. In these vesicles the components that originally faced the matrix are now exposed to the surrounding medium. This arrangement helps in studying electron transport and ATP synthesis because:
 (1) it is difficult to manipulate the concentration of small molecules (NADH, ATP, ADP, Pi) in the matrix of intact mitochondria
 (2) in broken cristae, the enzymes and other molecules responsible for electron transport are more active
 (3) intact mitochondria are more unstable than broken cristae
 (4) purification of intact mitochondria is not possible

78. Cystic fibrosis (CF) trans membrane conductance regulator (CFTR) protein is known to be a cAMP- dependent Cl^- channel. CF patients (with mutant CFTR proteins) show reduced Cl^- permeability and as a result exhibit elevated Cl^- level in sweat. To prove this, CFTR proteins (both wild type and mutant) are inserted in a model membrane (liposome) and Cl^- transport is followed with radioactive Cl^- . It is known that topology of CFTR in membrane is important for its function. Despite no proteolytic degradation or denaturation of CFTR proteins, wild type CFTR failed to transport Cl^- in liposome.

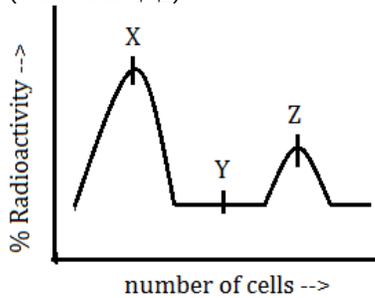
Which of the following is the correct explanation of this?
 (1) CFTR protein gets mutated during insertion in liposomes.
 (2) CFTR protein loses affinity with Cl^- ions.
 (3) CFTR protein gets wrongly inserted in liposomes.
 (4) CFTR protein loses channel forming property in liposomes.

79. Which of the following statement regarding aquaporin or water channels is NOT correct?
 (1) Aquaporins are found in both plants and animals membranes
 (2) Aquaporins cannot transport uncharged molecules like ammonia
 (3) Phosphorylation and calcium concentration regulates aquaporin activity
 (4) Activity of aquaporin is regulated by pH and reactive oxygen species

80. The intestinal absorption of glucose is impaired by use of ouabain, an inhibitor of $\text{Na}^+ - \text{K}^+$ ATPase. Indicate the correct explanation
 (1) The inhibitor has blocked the transport of Na^+ from intestinal lumen to epithelial cells
 (2) The inhibitor has blocked the transport of Na^+ from epithelial cells to intestinal lumen
 (3) The inhibitor has blocked the transport of Na^+ from intestinal lumen to interstitial cells
 (4) The inhibitor has blocked the transport of Na^+ from interstitial cell to intestinal lumen

81. A synthetically prepared mRNA contains repetitive AU sequences. The mRNA was incubated with mammalian cell extract which contains ribosomes, tRNA s and all the factors required for protein synthesis. Assuming no initiation codon is required for protein synthesis, which of the following peptides will most likely be synthesized?
 (1) A single peptide composed of the same amino acid sequence
 (2) A single peptide with alternating sequence of two amino acids
 (3) A single peptide with alternating sequence of three amino acids
 (4) Three different peptides each sequence composed of a single amino acid.

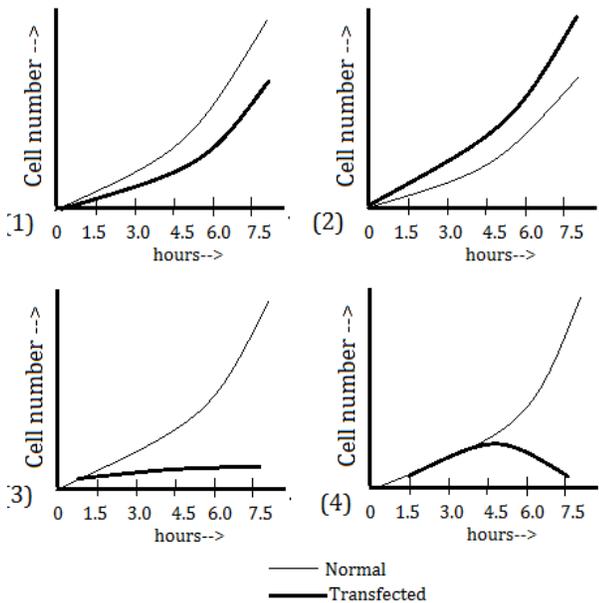
82. Hoechst 33342 is a membrane-permanent dye that fluoresces when it binds to DNA through intercalating process. If a population of cells is incubated briefly with Hoechst dye and stored in flow cyclometer the cells display various levels of fluorescence in different phases of cell cycles as shown in figure below (marked as X,Y,Z)



Which of the following is correct?

- (1) X is G₁, Y is G₂+M and Z is S
- (2) X is G₁, Y is S and Z is G₂+M
- (3) X is S, Y is G₂+M and Z is G₁
- (4) X is S, Y is G₁ and Z is G₂ +M

83. During cell cycle regulation in eukaryotes, there are post-translational modifications of protein factors, which act as switches for different phases of cell cycle. A cell population of yeast was transfected with gene for wee 1 kinase (modifies cdc2 protein). Assuming that the transfection efficiency was 50% only, which of the following graphical representation of the results is most appropriate?



84. In semi-conservative mode of DNA replication two parental strands unwind and are used for synthesis of new strands following the rule of complementary base pairing. Synthesis of complimentary strands require that DNA synthesis proceeds in opposite direction, while the double helix is progressively unwinding and replicating in only one direction. one of the DNA strands is continuously synthesised in the same direction as the advancing replication fork and is called leading strand whereas the other strands is synthesised discontinuously in segments and is referred to as lagging strands. These short fragments made discontinuously are labelled as okazaki fragments. These okazaki fragments need to be matured into continuous DNA strand by which one of the following combination of enzymes?

- (1) DNA Pol III and DNA ligase
- (2) DNA pol I and DNA ligase
- (3) DNA pol II and DNA ligase
- (4) DNA gyrase and DNA ligase

85. The lac operon in *E. coli*, is controlled by both the lac repressor and the catabolite activation protein CAP. In an *in vivo* experiment with *lac* operon, the following observations are made:

- (A) cAMP levels are high
- (B) Repressor is bound with allolactose
- (C) CAP is interacting with RNA polymerase

Which one of the following conclusions is most appropriate based on the above observations?

- (1) Glucose and lactose are present.
- (2) Glucose is present and lactose is absent
- (3) Both are absent
- (4) Glucose is absent and lactose is present

86. Assuming that the histone octamer forms a cylinder 9 nm in diameter and 5 nm in height and that the human genome forms 32 million nucleosomes, what fraction (approximately) of the volume of nucleus (6 μm diameter) is occupied histone octamers?

- (1) 1/22
- (2) 1/11
- (3) 10/21
- (4) 10/11

87. A reporter cell line with stably integrated retroviral promoter-luciferase construct was transfected with an expression vector for a cellular protein. The protein seems to regulate the activation of retroviral promoter as analyzed by luciferase activity assay. Which one of the following techniques will you use to show "*in vivo*" recruitment of the cellular protein on the integrated retroviral promoter?

- (1) Electrophoretic mobility shift assay
- (2) RNase protection assay
- (3) DNase hypersensitivity assay
- (4) Chromatin immunoprecipitation assay.

88. In a tissue, cells are bound together by physical attachment between cell to cell or between cell to extra cellular matrix. Following are some of the characteristics of cell junctions:

- (A) Aderens junctions are cell-cell anchoring junctions connecting actin filament in one cell with that in next cell.
- (B) Desmosomes are cell-matrix anchoring junctions connecting actin filament to extra cellular matrix
- (C) gap junctions are channel for,ming junctions allowing passage of small water soluble molecules from cell to cell.
- (D) Tight junctions are occluding junctions, which seal gap between two cells
- (E) Hemidesmosomes are cell-matrix anchoring junctions connecting intermediate filament in one cell to extra cellular matrix.

Which of the following combinations of statements is NOT correct?

- (1) (A) and (B)
- (2) (A) and (C)
- (3) (C) and (D)
- (4) (D) and (E)

89. A mouse was primed with trinitrophenyl-lipopolysaccharide (TNP-LPS) whereas another mouse was primed with TNP-keyhole limpet hemocyanin (TNP-KLH). After three weeks, these mice were sacrificed and splenic cells were fractionated to B cells and T cells. B cells from TNP-LPS primed mice were co-cultured with T cells from TNP-LPS or TNP-KLH-primed mice. Similarly, B cells from TNP-KLH primed mice were co-cultured with the T cells from TNP-LPS or TNP-KLH-primed mice. So, we have four co-cultures:

- (A) B^{TNP-LPS} x T^{TNP-LPS}
- (B) B^{TNP-LPS} x T^{TNP-KLH}
- (C) B^{TNP-KLH} x T^{TNP-LPS}
- (D) B^{TNP-KLH} x T^{TNP-KLH}

Among these co-cultures, where do you expect the highest IgG production?

- (1) A
- (2) B
- (3) C
- (4) D

90. A large protein of a pathogenic bacterium has been enzymatically digested to generate a mixture of peptides ranging in size from 3 to 8 amino acids in length. Peptide mixtures were then administered in experimental animals to generate peptide-specific antibodies. In order to develop diagnostics for the bacteria, the antisera were used Western blotting to detect bacterial antigen. Western blotting failed despite the use of a wide range of antisera concentrations. What is the most probable cause of the problem?

- (1) Peptide-specific antibody mixture is unstable.
- (2) Peptide-specific antibodies were not generated as adjuvant was not administered
- (3) Peptide-specific antibodies were not generated as they were not coupled to a protein carrier
- (4) Peptide-specific antibodies could not recognize the bacterial antigen.

91. Ten different mouse strains were primed with whole Keyhole limpet hemocyanin (KLH). KLH was broken into 10 peptides for *in vitro* stimulation. The splenocytes from ten different primed mouse strains were re-stimulated with each of these 10 peptides and responsiveness to these were measured *in vitro*. It was found that each of these mouse strains had responded to one of the peptides. When the peptide 3 responder was mated with peptide 4 responder, the splenocyte of F₁ offsprings responded to both the peptide. Which of the following is most appropriate

- (1) Mouse strains responding to peptide 3 or peptide 4 have different MHC haplotypes
- (2) Mouse strains responding to peptide 3 or peptides 4 have either of these T cell receptors
- (3) Mouse strains responding to peptide 3 or peptide 4 cannot process KLH
- (4) Mouse strains responding to peptide 3 or peptide 4 did not express MHC class I molecule

92. Upon ligand binding, cell surface receptors move laterally to be capped and internalized. *Leishmania* a protozoan parasite, can use several receptors on macrophages to get internalized. One of them is Toll-like receptor 2 (TLR2) that binds lipophosphoglycan on *Leishmania*. Once internalized, the parasite is destroyed in the phagolysosome. Which of the following treatments of *Leishmania*-infected macrophages will result in lowest parasite number in macrophages?

- (1) membrane cholesterol-depleting drug, β -methyl cyclodextrin (β -MCD)
- (2) ammonium chloride that increases lysosomal pH
- (3) both β -MCD and ammonium chloride.
- (4) anti-TLR2 antibody.

93. Oncogenes and tumor suppressor genes are termed as cancer-critical genes. Increasingly powerful tools are now available for systematically searching the DNA or mRNAs of cancer cells for either significant mutations or altered expression. To identify independently an oncogene or a tumor suppressor gene, which of the following would be the most convincing tests to be used?

- (1) Transgenic mice that overexpress the candidate oncogene and knockout mice that lack candidate tumour suppressor gene.
- (2) Transgenic mice that overexpress the candidate tumor suppressor gene and knockout mice that lack candidate oncogene.
- (3) Transgenic mice that overexpress the candidate oncogene and tumor suppressor gene.
- (4) Knockout mice that lack the candidate oncogene and tumor suppressor gene.

94. The functionality of the pax6 gene in the formation of optic and nasal structure may be attributed to the following

- (A) Pax6 makes the optic vesicle competent and allows lens formation.
- (B) The optic vesicle can induce any part of the head ectoderm to form the nasal and optic structures, due to presence of Pax6.
- (C) Pax6 renders the head ectoderm competent to receive signals from optic vesicle.
- (D) Apart from the optic vesicle, the head ectoderm may also be induced by BMP and FGF, so pax6 is not exclusive for lens formation.

Which of the above attributes are true?

- (1) (A) and (D)
- (2) (C) and (D)
- (3) (B) and (C)
- (4) (C) only

95. The pattern of embryonic cleavage specific to a species is determined by two major parameters.

- (A) The amount and distribution of yolk protein within the cytoplasm.
- (B) The factors in the cytoplasm that influence the angle mitotic spindles and the timings of its formation.

Which of the following statements are true?

- (1) Species having telocithal egg follow a holoblastic cleavage.
- (2) Species having isolecithal egg follow a holoblastic cleavage.
- (3) Species having centrolecithal egg follow a holoblastic cleavage.
- (4) Species having isolecithal egg follow a meroblastic cleavage.

96. The fate of a cell or a tissue is specified when it is capable of differentiating autonomously on being placed in a neutral environment with respect to the developmental pathway. An embryo will show development pattern based on its type of specification:

Based on the above facts it can be said that potency of a cell is:

- (A) Equal to its normal fate in regulative development
- (B) greater than its normal fate in regulative development
- (C) equal to its normal fate in mosaic development
- (D) greater than its normal fate in mosaic development

Which of the above statements are true?

- (1) (B) and (C)
- (2) (A) and (D)
- (3) (A) and (C)
- (4) (B) and (D)

97. In the context of the proximal-distal growth and differentiation of a tetrapod limb following experiments were visualized

- (A) If the apical ectodermal ridge (AER) is removed at any time during the limb development, further development of distal limb skeletal elements ceases.
- (B) If leg mesenchyme is placed directly beneath the wing AER, proximal hind limb structures develop at the end of the limb
- (C) If an extra AER is grafted onto an existing limb bud, supernumerary structures are formed usually at the distal end of the limb.
- (D) If leg mesenchyme is placed directly beneath the wing AER, proximal hind limb structures develop at the end of the limb

Which of the above experiments would show the possible interactions between the AER and the limb mesenchyme directly beneath it during limb development?

- (1) (A) and (B) only
- (2) (B) and (C) only
- (3) (C) and (D) only
- (4) (A), (B) and (C)

98. The following statements have been proposed for plant vegetative development:

- (A) Lateral roots develop from epidermal cells.
- (B) Shoots axillary meristem develops from shoot apical meristem during differentiation of leaf primordia.
- (C) Root cap is made of dead cells.
- (D) Lateral meristem and cylindrical meristem found in roots and shoots results in secondary growth.

Which of the above statements are true?

- (1) (A) and (B) (2) (B) and (D)
- (3) (A), (B) and (D) (4) (C) and (D)

99. Red and far-red lights are perceived by plants through various photoreceptors including phytochromes. The activation of phytochromes is caused by?

- (1) Conversion of Pr to Pfr form through the effect of red light
- (2) repression of Pr form through the effect of far-red light
- (3) equal proportion of red and far red light at same fluence rate
- (4) presence of red and far-red light at different fluence rate

100. Following are some facts regarding localization of photosynthetic supramolecular complexes on plastid lamellae:

- A. PSII is preferentially localized on granal lamellae
- B. ATP synthase and PSI is preferentially localized in stromal lamellae
- C. PSI and PSII are located adjacent to each other in stromal lamellae
- D. Cytochrome b_6/f complex is not a membrane bound complex

Which of the following combinations of the above statements is true?

- (1) A and B (2) C and D
- (3) B and D (4) B and C

101. Phenyl ammonia lyase (PAL) and chalcone synthase (CHS) involved in biosynthesis of phenolic compound in plants. Following are some statements regarding the action of PAL and CHS:

- A. Substrate for PAL is phenyl alanine and for CS is chalcone
- B. PAL catalyze conversion of phenyl alanine to trans-cinnamic acid
- C. PAL catalyze conversion of phenyl alanine to p-coumaric acid
- D. Coumaryl CoA is converted to chalcone by chalcone synthase

Which of the following combinations of above statement is true?

- (1) A and B (2) A and C
- (3) B and C (4) B and D

102. Upon absorption of a photon, a chlorophyll molecule get converted to its excited state when the energy of photon is

- (1) more than that of ground state of pigment molecule
- (2) equal to that of pigment molecule's excited state
- (3) more than that of ground state but lesser than excited state of the pigment molecule
- (4) equal to energy gap between ground state and excited state energy

103. Following are certain facts about the effect of abscisic acid (ABA) on the development and physiological effect of plants:

- A. ABA promotes leaf senescence independent of ethylene.
- B. ABA promotes shoot growth and inhibits root growth at low water potential.
- C. ABA inhibits gibberellin induced enzyme production
- D. Seed dormancy is controlled by ratio of ABA and gibberellin

Which one of the following combination of above statements is true?

- (1) A, B and C (2) B, C and D
- (3) A, B and D (4) A, C and D

104. While studying the primary effect of different abiotic stresses on plants, a researcher observed water potential reduction and cellular dehydration. Which of the following combination of abiotic stress may cause observed effect?

- (1) Water deficit, salinity and chilling
- (2) Salinity, high temperature and Flooding
- (3) Freezing, salinity and water deficit
- (4) Freezing, chilling and flooding

105. In an experiments, sperm removed from epididymis of a male mouse was added in a dish containing appropriate media and oocyte. No fertilization was seen. However, when sperm from epididymis were directly placed in uterus of an ovulated female, she became pregnant. These observation suggest that

- (1) The sperm need to travel some distance to attain fertilizing ability.
- (2) The oocyte secretes some biochemicals or factors which help sperm to fertilize.
- (3) The hormones in body help sperm to attain fertilizing ability.
- (4) The contents of female reproductive tract interact with sperm and activate it for fertilization

106. Level of follicle stimulating hormone (FSH) during infancy and adulthood is the same but spermatogenesis is seen only during adulthood. mRNA levels coding for FSH receptor are also found to be the same in testis of both age groups.

Which of the following investigations will clarify this paradox a little more?

- (1) Culture testicular cells and add LH to see testosterone production.
- (2) Culture testicular cells and add testosterone to see comparative rise in FSH mRNA from both age groups.
- (3) Culture testicular cells and add FSH to see comparative rise in cAMP production by both age groups.
- (4) Add both LH and FSH to testicular cells and evaluate cAMP production

107. GnRH is secreted during infancy (0-6 month) and puberty onwards (4 years and above) in monkeys. However, *i. v.* injection of GnRH during pre-pubertal period (about 2 years of age) led to elevated LH and FSH in blood compared to untreated 2 years old monkey. This suggest that

- (A) Hypothalamus is active during pre-pubertal period
- (B) GnRH action on pituitary is age dependent
- (C) Pituitary matures during adulthood
- (D) Pituitary is active in all stages of development in monkeys

Which one of the following is true?

- (1) A and B (2) B and C
- (3) C only (4) D only

108. The stereocilia of auditory hair cells are arranged in rows but the height of stereocilia are not the same in all the rows. Though the height of stereocilia is the same within a particular row, the heights increase in subsequent rows. When the stereocilia of shorter rows are mechanically pushed toward the taller rows, the hair cells are depolarized but a push on opposite direction hyperpolarize them. The significance of this graded height of stereocilia is:

- (A) Each row of stereocilia may be displaced independent of other rows in physiological conditions
- (B) The tip of the taller stereocilia will show greater displacement as compared to shorter ones when all the rows are moving in same axis
- (C) The hair cells will be depolarized or hyperpolarized in different grades when the axis of displacement is changed
- (D) The taller stereocilia are involved with depolarization and shorter ones are responsible for hyperpolarization

Which of the following is correct?

- (1) A only (2) B only
- (3) B and C (4) A and D

109. A person suffering from thyrotoxicosis has extremely high level of thyroid hormone in blood. There is failure of feedback regulation in hypothalamic-pituitary-thyroid axis. The detailed blood investigation exhibited high level of the following:

- A. Thyroid stimulating hormone (TSH)
- B. Thyroid stimulating Immunoglobulin (TSI)
- C. Thyroid releasing hormone
- D. Parathyroid hormone

In your opinion, which one of the following is the reason for such thyrotoxicosis

- (1) A only
- (2) B only
- (3) A and C
- (4) C and D

110. A person has been suffering from night blindness. On consultation, the doctor advised person to eat carrots and/or cod fish oil. After some time having seen no improvement, doctor gave person vitamin A injection. Still no marked improvement was seen. The doctor mooted several suggestions indicating lack of the following enzymes for failure of treatment:

- A. Retinol dehydrogenase
- B. Retinal reductase
- C. Retinal isomerase
- D. Retinal synthase

According to your opinion which is correct reason for night blindness in above case?

- (1) A only
- (2) B only
- (3) B and C both
- (4) C and D both

111. The rate of mutation in *E. coli* from *lac* to *lac⁺* are determined using medium containing lactose, as the only sole source of energy. The principle of spontaneity can be said to be violated if:

- (1) the rate of mutation increase during starvation
- (2) in the presence of lactose the rate of mutation from *lac* to *lac⁺* increases but overall rate of mutation is not
- (3) The rate of mutation in *lac* gene is always greater than in other genes
- (4) The rate of mutation in *lac* gene is always less than in other genes

112. Three *E. coli* mutants were isolated which require compound 'A' for their growth. The compounds B, C and D are known to be involved in biosynthetic pathway to A. In order to determine pathway, the mutants were grown in a minimal medium supplemented with ONE OF THE COMPOUNDS, A TO D. The results obtained are summarized below:

Mutant	Medium supplemented with compound			
	A	B	C	D
1	+	0	0	0
2	+	0	0	+
3	+	0	+	+

'+' = Growth on medium

'0' = No growth

Which of the following equation represents the biosynthetic pathway of A?

- (1) B→C→D→A
- (2) C→D→B→A
- (3) B→D→C→A
- (4) A→C→D→B

113. A cell undergoing meiosis produces four daughter cells, two of which are aneuploids, while two are haploid. This can occur due to:

- (1) Non-dysjunction during first meiotic division only
- (2) Non-dysjunction during second meiotic division only
- (3) Non-dysjunction during either first or second meiotic divisions
- (4) Non-dysjunction during both first and second meiotic divisions

114. When two independent pure lines of pea with white flowers are crossed, the F₁ progeny has purple flowers. The F₂ progeny obtained on selfing shows both purple and white flower in a ratio of 9:7. The following conclusions were made

- A. Two different genes are involved, mutation in which lead to formation of white flower.
- B. These two genes show independent assortment
- C. This is an example of complementary gene action
- D. This is an example of duplicate genes

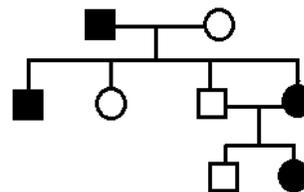
Which of the following conclusions are correct?

- (1) A and C only
- (2) A and D only
- (3) A, B and D
- (4) A, B and C

115. Following are four modes of inheritance

- A. X-linked recessive
- B. X-linked dominant
- C. Autosomal recessive
- D. Autosomal dominant

Which of the above modes of inheritance can explain the pedigree shown below?



Which of the following modes can be represented by pedigree chart above?

- (1) A and C
- (2) B and C
- (3) C and D
- (4) D only

116. Four different mutant lines showing similar phenotype were identified from a genetic screen. When genetic crosses among these mutants were carried out, the first mutant was found to complement the second, third and fourth mutant lines. However, no other complementation groups do the four mutant lines belong to?

- (1) 1
- (2) 2
- (3) 3
- (4) 4

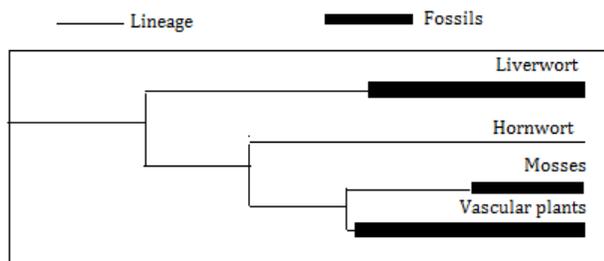
117. Why lysogenic cycle is more beneficial to a virus than lytic cycle under certain circumstances?

- (1) The Lysogenic cycle prevent local extinction of host while still retaining infectious potential
- (2) By integrating with the bacterial chromosomes, the genetic instructions for the virus become refreshed after one or more replication events during binary fission
- (3) Lysogenic infection cycles do not harm their host cells, so they can produce virus particles indefinitely
- (4) Lysogeny causes more mutations to occur in the virus, creating more variants upon which natural selection can operate

118. Two auxotrophic strains of *E. coli*: A (*met⁻ bio⁻ thr⁺ leu⁺ thi⁺*) and B (*met⁺ bio⁺ thr⁻ leu⁻ thi⁺*) were incubated together for 18 hours in liquid medium and then ~10⁸ cells were plated on minimal medium. Prototrophs were observed at frequency of 1 X 10⁻⁷ cells. This may have happened by process of genetic recombination between two strains or by mutation of strains. Which of the following control experiment would help rule out the possibility of mutation?

- (1) Plating strains A and B directly on minimal medium
- (2) Growing the mixture of strain A and B for 18 hours and then plating on complete medium
- (3) Growing strains A and B individually in a liquid complete medium for 18 hours and then plating on a minimal medium
- (4) Growing the obtained prototroph in a liquid complete medium for 18 hours and then plating them on minimal medium

119. According to fossil record, the earliest fossils of liverworts are found in late Devonian, of mosses in early cretaceous, and vascular plants in the later Silurian/early Devonian. *Anthoceros* (hornworts) fossils have not been recovered. Reading fossil records we would say that vascular plants appeared first and then liverworts.



- Cambrian Ordovician Silurian Devonian Cretaceous Permian
- However phylogenetic relationship (shown in figure) suggest otherwise. It may be that
- evolutionary history can be read directly from fossil record
 - The moss lineage goes back to at least early Silurian/early Devonian
 - Fossil can only set a maximum age for a lineage
 - Fossil can only set a minimum age for a lineage
 - the divergence between liverworts and rest of land plants goes back to at least early Ordovician

Which of the following statements is correct?

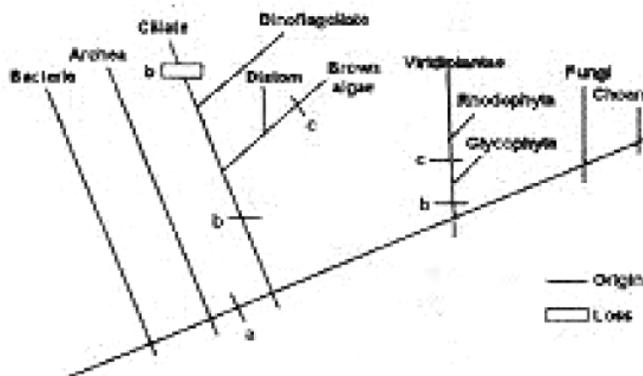
- A, B, C and E
- B, D and E
- A, B, D and E
- B, C and E

120. Which of the following hypothesis best explains the occurrence of Himalayan floral element in Western Ghats of India ?

- Continental drift theory
- Deccan trap hypothesis
- Himalayan glaciations theory
- Coromondal coast hypothesis

121. In which of the following classes of vertebrates there are group of animals without limbs?

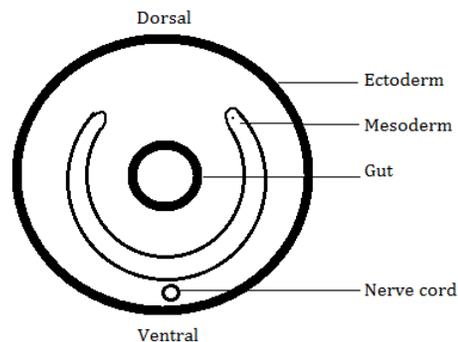
- Fish, reptiles and mammals
- Reptiles only
- Amphibians and Reptiles
- Amphibian only



122. Identify 'a', 'b' and 'c' in the figure

- a=mitochondria, b= multicellularity, c=chloroplast
- a= mitochondria, b= chloroplast, c=multicellularity
- a=chloroplast, b= multicellularity, c= mitochondria
- a= chloroplast, b= nucleus, c= multicellularity

123. The schematic section given below of an animal indicates that the animal is



- Based on above diagram the organism is
- triploblastic, coelomate and invertebrate
 - triploblastic, acoelomate and invertebrate
 - diploblastic, coelomate and invertebrate
 - triploblastic, coelomate and vertebrate

124. A researcher collected information from four forest using sensors to assess their green cover. Observed average spectral values from each of the forest are given in the table below:

Forest	spectral value	
	NIR	VIS
A	0.50	0.08
B	0.04	0.30
C	0.50	0.20
D	0.60	0.20

The forest cover in the order of highest to lowest is

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

125. In Lotka and Volterra's two species competition model:

$$\frac{dN_1}{dt} = r_1 N_1 \left[\frac{K_1 - N_1 - N_2 \alpha_{12}}{K_2} \right] \text{ and}$$

$$\frac{dN_2}{dt} = r_2 N_2 \left[\frac{K_2 - N_2 - \alpha_{21} N_1}{K_2} \right]$$

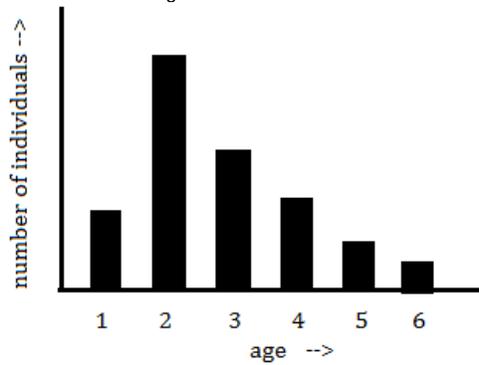
Where N represents population size, r growth rate and K maximum carrying capacity for species 1 and 2. The inter-specific competition coefficient $\alpha_{12} < 1$ will mean:

- Individuals of species 2 have less inhibiting effect on individuals of species 1 than individuals of species 1 on other of their own species
- Individuals of species 2 have greater inhibiting effect on individuals of species 1 than individuals of species 1 on other of their own species
- Individuals of species 1 have less inhibiting effect on individuals of species 2 than individuals of species 2 on other of their own species
- Individuals of species 1 have greater inhibiting effect on individuals of species 2 than individuals of species 2 on other of their own species

126. While studying the diversity of 3 communities, 5 species and 50 individuals were recorded from each community. The number of individuals under each species was listed as mentioned in the following Table. In which of the following community Pielou's Evenness index (e) will be 1?

	Community	Species				
		1	2	3	4	5
(1)	A	20	8	7	5	10
(2)	B	10	10	10	10	10
(3)	C	10	12	10	8	10
(4)	D	1	1	1	1	46

127. At a given time, the age class distribution of a population was as shown in figure:



Which of the following can be inferred from the figure?

- (1) Age class 2 has maximum fecundity
- (2) Age class 2 has maximum survival
- (3) Age class distribution is at equilibrium
- (4) Age class distribution is not at equilibrium

128. Average annual precipitation and temperature are two important determinants of world's major biomes. Which of the following combinations are correct?

	Temperature and Precipitation		Biome
A	25 °C and 255 cm	i.	Temperate Forest
B	15 °C and 300 cm	ii.	Savannah
C	15 °C and 100 cm	iii.	Temperate rain forest
D	25 °C and 255 cm	iv.	Tropical rain forest

- (1) A-iv; B-iii; C-i; D-ii
- (2) A-iii; B-ii; C-iv; D-i
- (3) A-ii; B-i; C-iii; D-iv
- (4) A-i; B-iv; C-ii; D-iii

129. Which of the following is a prediction of neutral theory of molecular evolution that is supported by data?

- (1) Human and chimps differ more in DNA sequences of pseudogenes than in coding regions of functional genes
- (2) Human and chimps differ more in DNA sequences of coding regions of functional genes than of pseudogenes
- (3) Human have a faster evolution of most of their DNA sequences than chimps
- (4) The more advanced species have more number of functional genes

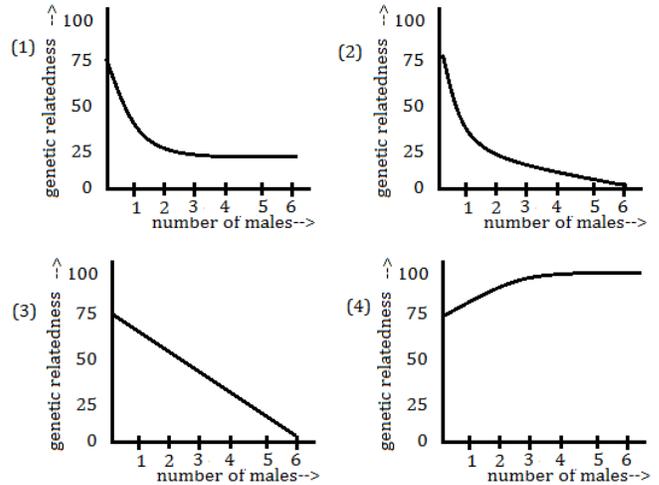
130. During line-transect sampling of two solitary species of ground mammals the following observations were made:

		Smaller species	Larger Species
A	Transect length (Km)	100	100
B	Number of animals recorded	30	36
C	Mean perpendicular distance from transect line (m)	10	40

Which of the following can be inferred from the data?

- (1) Smaller species is more abundant but seen less frequently
- (2) Smaller species is less abundant but seen less frequently
- (3) Larger species is more abundant but seen less frequently
- (4) The large species is seen more frequently but its abundance cannot be compared with smaller species

131. In hymenoptera insects, males are haploid and females are diploid. All fertilized eggs give rise to female and unfertilized eggs give rise to males. As a result, if a female mates with a single male, the females in progeny are related to 75 %. But if the mother had mated with males, the mean genetic relatedness of female progeny is correctly represented by



132. There are 'n' numbers of alleles at a given locus in a diploid population. The proportion of all homozygotes in the population

- (A) All alleles are equal abundant
- (B) All alleles are not in equal abundant
- (1) $1/n$ and $<1/n$
- (2) $1/n$ and $>1/n$
- (3) $1/n^2$ and $<1/n^2$
- (4) $1/n^2$ and $>1/n^2$

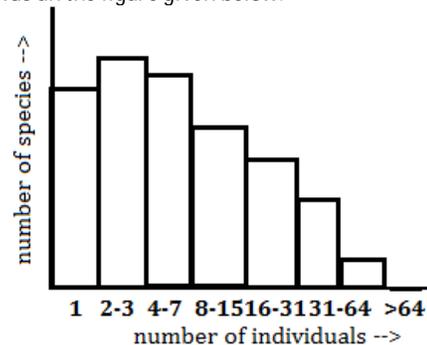
133. A species has the following population characteristics:

- A. reduction in population size $\geq 90\%$ over last 10 years or 3 generations
- B. Geographical range: Extent of occurrence <100 Km² and Area of occupancy: <10 km²
- C. Population size less than 50 mature individuals
- D. Probability of extinction in wild at least 50 % within the next 10 years or 3 generations

To which of the following categories the species will be assigned according to IUCN categorization of threatened species (version 3.1)?

- (1) Endangered
- (2) Vulnerable
- (3) Critically endangered
- (4) Extinct in wild

134. Biologist randomly sampled about 300 insects from a newly found island. The distribution of their abundance in the sample was as shown in the figure given below.

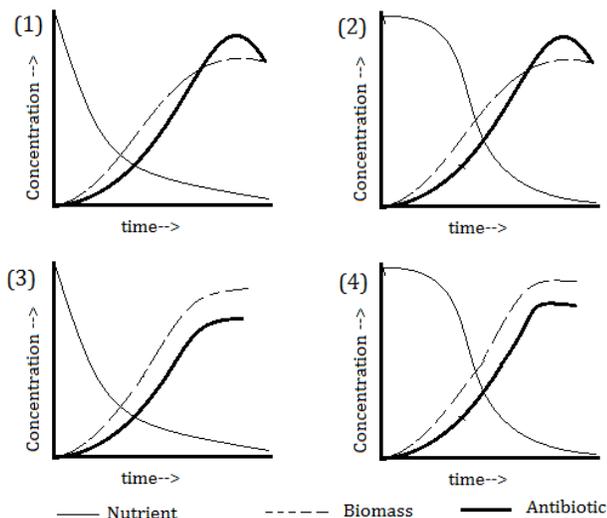


Which of the following can be correctly inferred from the graph?

- (1) Many species have only one individual each on the island
- (2) The bar on the extreme right represents a large number of species with very few individuals
- (3) Summation of the height of all columns will be exactly equal to the total number of species present on the island
- (4) All species from the island may not be represented in the sample

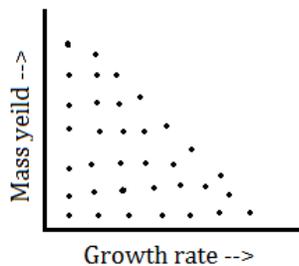
135. Northern elephant seal had been reduced to about 20 in 1800s. Biologist studied variation in protein in the species. They found no genetic differences in the protein among individuals. This lack of variation is due to
 (1) the fact that elephant seal lives in constant environment where there was no need for genetic variation
 (2) population bottle neck and genetic drift
 (3) natural selection resulting in a single best genotype
 (4) a very low rate of mutation

136. Which of the following curve correctly represents the antibiotic production by *Streptomyces* species?



137. Stem cells are widely used for their regenerative property and capacity to differentiate into different lineages. A person with a damaged liver approaches a stem cell therapist. Which of the following therapeutic strategy would be safest?
 (1) Transplanting adult liver cells from healthy donor and grafting them into patient
 (2) Transforming skin cells from patient into iPS cells and using them for further differentiation and grafting in liver
 (3) Injecting embryonic stem cells into the damaged liver
 (4) Injecting cord blood cells into the liver directly

138. The Scatter plot of growth rate and growth yield for 100 random environment isolates of bacteria is shown below



Which of the following can be inferred from data ?

- (1) The two parameters are not related.
- (2) Growth rate is inversely proportional to growth yield.
- (3) Growth yield is negatively correlated with growth rate.
- (4) High growth rate cannot be accompanied by high growth yield.

139. In Radio Immuno Assay (RIA) for glucocorticoid hormone, glucocorticoid (tritiated) is added to RIA cocktail. When the amount of bound hormone was measured no radioactive counts were observed. The following possible explanation(s) were proposed:
 A. The radioactive hormone was insufficient
 B. The radioactive tag to the hormone completely dissociated during storage
 C. Antibody was not added to the cocktail
 D. The specific activity of tritium was low

Choose the correct option(s):
 (1) A only (2) C only
 (3) B and C (4) A and D

140. Four different receptors viz, A, B, C and D bind to same ligand 'X'. In order to determine when receptors has the highest ligand binding affinity following experiment was carried out. Cells were transfected with green fluorescent protein (GFP)-tagged receptors (A, B, C and D) individually, then incubated with red fluorescent protein (RFP) tagged ligand 'X' and subjected to FACS. Following are the results

	Receptor A		Receptor B		Receptor C		Receptor D	
RFP	24 %	5 %	52 %	19 %	19 %	52 %	5 %	24 %
GFP	52 %	19 %	24 %	5 %	5 %	24 %	19 %	52 %

Which receptor has highest binding affinity for ligand 'X'?

- (1) A (2) B
- (3) C (4) D

141. If one wishes to design a microarray chip for whole genome expression analysis of an eukaryotic system, which region of the gene should be preferred for selection of unique target sequences?
 (1) Any region of coding DNA sequence
 (2) 3' region from coding DNA sequence (CDS) and 3' untranslated region (UTR)
 (3) 5' region of CDS and 5' UTR
 (4) 1st intron only

142. For the generation of transgenic plant in crop improvement, one important regulatory gene 'X' was overexpressed in a crop plant. Out of 30 transgenic rice plants generated, 22 showed high levels of gene 'X' expression. However, rest 8 lines displayed low level of expression. One explanation of such observation may be:
 (1) Suppression effect of the transgene
 (2) Knock down effect of gene X
 (3) Gene silencing effect
 (4) Co-suppression effect of transgene

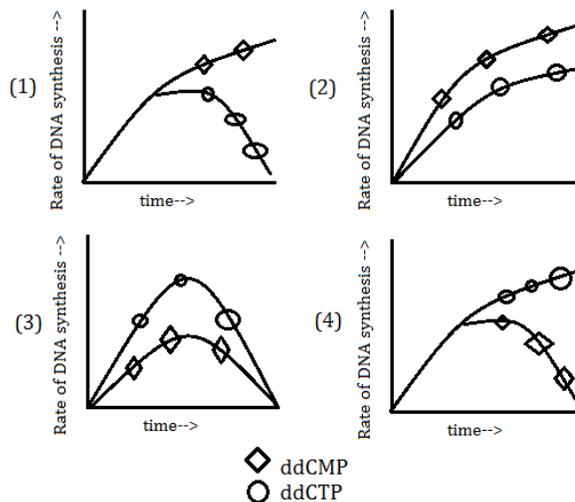
143. For 5' end labelling of DNA, the following reaction are carried out sequentially as indicated
 5' dephosphorylated DNA → [γ³²] dATP + T₄ polynucleotide kinase (T4PNK) and incubated for 2 hours → Ammonium acetate → Tris EDTA → Ethanol

If the trace amount of ammonium ion (NH₄⁺) is present in initial DNA mix, which of the following statement would most likely be true?
 (1) NH₄⁺ ion activates T4PNK, thereby increasing the labeling efficiency
 (2) NH₄⁺ ion inhibits T4PNK, therefore should not be present in DNA mix
 (3) NH₄⁺ ion does not have any effect on T4PNK
 (4) NH₄⁺ ion dephosphorylates DNA, thereby increasing labeling efficiency

144. A protein contains 2 Trp and 4 Tyr residues. The molecular mass of the protein is 17000 D and that of Trp and Tyr are 204 and 180 D respectively. Values of $E^{1\%_{1cm}}$, the absorption coefficient of 1% (g/v) solutions of Trp and Tyr in 1-cm cell at 280 nm, are 269.60 and 83.33, respectively. The absorption of 1 mg/ml protein solution in 1 cm-cell at 280 nm will be:

- (1) 0.1 (2) 1.0
(3) 0.7 (4) 1.7

145. Double stranded DNA replicates in a semi-conservative manner. In an in vitro DNA synthesis reaction, dideoxy CTP and dideoxy CMP were individually added in excess (in separate reaction tubes) in addition to dNTPs and other necessary reagents. Rate of DNA Synthesis was measured by incorporation of 3H -thymidine. The four graphs drawn below represent the rate of DNA synthesis in two separate reaction tubes.



Which of the following graphs represents the expected data?

NOTE:

This paper has been solved by IFAS, Jodhpur. Utmost care has been taken while solving paper but IFAS Jodhpur does not take responsibility for any mistakes in answers provided. For any suggestion regarding question or answer, feel free to mail at: ifasnet@gmail.com

ANSWER KEY

PART-A

1	3	2	3	3	3	4	4	5	1	6	3	7	2	8	2	9	4	10	4
11	3	12	2	13	1	14	3	15	2	16	1	17	2	18	2	19	1	20	3

PART-B

21	1	22	4	23	4	24	4	25	2	26	3	27	2	28	2	29	2	30	4
31	1	32	3	33	1	34	4	35	3	36	1	37	1	38	3	39	1	40	2
41	1	42	2	43	1	44	2	45	1	46	3	47	2	48	4	49	1	50	3
51	3	52	3	53	2	54	2	55	4	56	1	57	4	58	4	59	1	60	2
61	3	62	1	63	1	64	4	65	2	66	3	67	2	68	3	69	2	70	3

PART-C

71	3	72	2	73	1	74	1	75	4	76	1	77	1	78	3	79	2	80	2
81	2	82	2	83	1	84	2	85	4	86	2	87	4	88	1	89	4	90	3
91	1	92	3	93	1	94	2	95	2	96	1	97	4	98	2	99	1	100	1
101	4	102	4	103	4	104	3	105	4	106	3	107	4	108	3	109	2	110	1
111	2	112	1	113	2	114	4	115	3	116	2	117	1	118	3	119	2	120	3
121	3	122	2	123	1	124	2	125	1	126	2	127	4	128	1	129	1	130	1
131	1	132	2	133	3	134	4	135	2	136	2	137	2	138	4	139	3	140	4
141	2	142	3	143	2	144	2	145	1	IFAS JODHPUR									