GENERAL APTITUDE

Q. No. 1 – 5 Carry One Mark Each

1. Arrange the following three-dimensional objects in the descending order of their volumes:

(i) A cuboid with dimensions 10 cm, 8 cm and 6 cm

(ii) A cube of side 8 cm

(iii) A cylinder with base radius 7 cm and height 7 cm

(iv) A sphere of radius 7 cm

(A) (i), (ii), (iii), (iv) (B) (ii), (i), (iv), (iii)

(C) (iii), (ii), (i), (iv) (D) (iv), (iii), (ii), (i)

Answer: (D)

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2. For $0 \le x \le 2\pi$, sin x and cos x are both decreasing functions in the interval _____.

(A) $\left(0, \frac{\pi}{2}\right)$ (B) $\left(\frac{\pi}{2}, \pi\right)$ (C) $\left(\pi, \frac{3\pi}{2}\right)$ (D) $\left(\frac{3\pi}{2}, 2\pi\right)$

Answer: (B)

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3. "When she fell down the _____, she received many _____ but little help."

The words that best fill the blanks in the above sentence are

(A) stairs, stares (B) stairs, stairs

(C) stares, stairs (D) stares, stares

Answer: (A)

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4. "In spite of being warned repeatedly, he failed to correct his ____behaviour."

The word that bestfills the blank in the above sentence is

(A) rational (B) reasonable (C) errant (D) good

Answer: (C)

5. The area of an equilateral triangle is $\sqrt{3}$. What is the perimeter of the triangle?

(A) 2 (B) 4 (C) 6 (D) 8

Answer: (C)

Q. No. 6 –10 Carry Two Marks Each

6. An automobile travels from city A to city B and returns to city A by the same route. The speed of the vehicle during the onward and return journeys were constant at 60 km/h and 90 km/h, respectively. What is the average speed in km/h for the entire journey?

(A) 72 (B) 73 (C) 74 (D) 75

Answer: (A)

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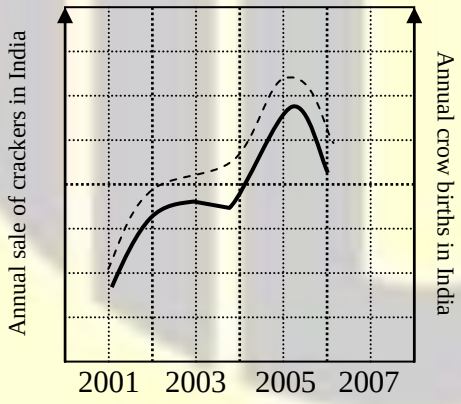
7. In a detailed study of annual crow births in India, it was found that there was relatively no growth during the period 2002 to 2004 and a sudden spike from 2004 to 2005. In another unrelated study, it was found that the revenue from cracker sales in India which remained fairly flat from 2002 to 2004, saw a sudden spike in 2005 before declining again in 2006. The solid line in the graph below refers to annual sale of crackers and the dashed line refers to the annual crow births in India. Choose the most appropriate inference from the above data.



(A) There is a strong correlation between crow birth and cracker sales.

(B) Cracker usage increase crow birth rate

(C) If cracker sale declines, crow birth will decline.

(D) Increased birth rate of crows will cause an increase in the sale of crackers.

Answer: (A)

8. To pass a test, a candidate needs to at least 2 out of 3 questions correctly. A total of 6,30,000 candidates appeared for the test. Question A was correctly answered by 3,30,000 candidates. Question B was answered correctly by 2,50,000 candidates. Question C was answered correctly by 2,60,000 candidates. Both questions A and B were answered correctly by 1,00,000 candidates. Both Both questions B and C were answered correctly by 90,000 candidates. Both questions A and C were answered correctly by 80,000 candidates. If the number of students answering all questions correctly is the same as the number answering none, how many candidates failed to clear the test?

(A) 30,000 (B) 2,70,000 (C) 3,90,000 (D) 4,20,000

Answer: (D)

---

9. A setof 4 parallel lines intersect with another set of 5 parallel lines. How many parallelograms are formed?

(A) 20 (B) 48 (C) 60 (D) 72

Answer: (C)

---

10. If $x^2 + x - 1 = 0$ what is the value of $x^4 + \frac{1}{x^4}$?

(A) 1 (B) 5 (C) 7 (D) 9

Answer: (C)

BIOTECHNOLOGY

Q. No. 1 - 25 Carry One Mark Each

1. Consider an unfair coin. The probability of getting heads is 0.6. If you toss this coin twice, what is the probability that the first or the second toss is heads?

(A) 0.56 (B) 0.64 (C) 0.84 (D) 0.96

Answer: (C)

---

2. If serumis removed from the growth medium of human embryonic kidney cellline (HEK), then the cells will

(A) proliferatefaster (B) proliferate normally

(C) undergo cellcyclearrest (D) undergo immediate apoptosis

Answer: (C)

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3. Therepeatsequenceof telomere in humansis

(A) 5'-TATAAT-3' (B) 5'-TTAGGG-3'

(C) 5'-GGGCCC-3' (D) 5'-AAAAAA-3'

Answer: (B)

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4. If a segment of a sense strand of DNAis5'-ATGGACCAGA-3', then the resulting RNA sequence after transcription is

(A) 5'-AGACCAGGTA-3' (B) 5'-UCUGGUCCAU-3'

(C) 5'-UACCUGGUCU-3' (D) 5'-AUGGACCAGA-3'

Answer: (D)

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5. Which oneof thefollowingis an exampleofaneurotoxin?

(A) Choleratoxin (B) Streptolysin-O

(C) Botulinumtoxin (D) Diphtheria toxin

Answer: (C)

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6. Which ofthe followingcomponents constitute amolecularmechanics forcefield?

P. Bond stretching

Q. Bond anglebending

R. Torsional bond rotation

S. Non-bonded interactions

(A) P and Q only (B) P, Qand R only

(C) P, Q and Sonly (D) P, Q, R and S

Answer: (D)

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7. WhichoneofthefollowingBLASTsearchprogramsisusedtoidentifyhomologsofa genomicDNA queryin aprotein sequencedatabase?

(A) blastp (B) blastn (C) blastx (D) tblastn

Answer: (C)

---

8. A mixture contains three similarly size d peptides P, Q and R. The peptide P is positively charged, Q is weakly negative and R is strongly negative. If this mixture is passed through anion-exchange chromatography column containing an anionicres in, their order of elution will be

(A) P, Q, R (B) R, Q, P

(C) Q, R, P (D) P, Q and R elute together

Answer: (B)

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9. Which one of the following is **INCORRECT** about protein structures?

(A) A protein fold is stabilized by favorable non-covalent interactions

(B) All parts of a fold can be classified as helices, strands or turns

(C) Two non-covalentatoms cannot be closer than the sum of their van der Waals radii

(D) The peptide bond is nearly planar

Answer: (B)

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10. Which one of the following metabolic processes in mammalian cells does **NOT** occur in the mitochondria?

(A) Citric acidcycle (B) Oxidative phosphorylation

(C) Fattyacid β-oxidation (D) Glycolysis

Answer: (D)

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11. Which one of the following is **NOT** a principal component of innate immunity?

(A) Mucosal epithelia (B) Dendritic cells

(C) Complement system (D) MemoryB-cells

Answer: (D)

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12. Which of the following technique(s) can be used to study conformational changes in myoglobin?

P. Mass spectrometry

Q. Fluorescence spectroscopy

R. Circular dichroism spectroscopy

S. Light microscopy

(A) P only (B) P and Sonly (C) Q and R only (D) S only

Answer: (C)

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13. Which one of the following bioreactor configurations is the basis for a trickling biological filter?

(A) Stirred tank (B) Packed bed

(C) Air lift (D) Fluidized bed

Answer: (B)

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14. Cell type A secretes molecule X in to the culture medium. Cell type B in the same culture responds to the molecule X by expressing protein Y. Which one of the following modes of signaling represents the interaction between A and B?

(A) Autocrine (B) Juxtacrine

(C) Paracrine (D) Intracrine

Answer: (C)

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15. Which one of the following statements is true for actin?

(A) Actin filament is structurally polarized and the two ends are not identical

(B) Denovoactin polymerization is a single-step process

(C) The pointed end of the actin filaments is the fast growing end

(D) Actin forms spindle fibers during mitosis

Answer: (A)

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16. Standard error is

(A) the probability of a type Ierrorin a statistic altest

(B) the error in estimating a sample standard deviation

(C) the standard deviation of a variable that follows standard normal distribution

(D) the standard deviation of distribution of sample means

Answer: (D)

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17. Which one of the following techniques is used to monitor RNA transcripts, both temporally and spatially?

(A) Northern blotting (B) In situhybridization

(C) Southern blotting (D) Western blotting

Answer: (B)

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18. Identify the character based method(s) used for the construction of a phylogenetic tree.

P. Maximum parsimony **Q.** Neighborjoining

R. Maximum likelihood **S.** Bootstrapping

(A) Q only (B) P and R only

(C) Q and Sonly (D) Sonly

Answer: (B)

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19. Which one of the following is the solution for $\cos^2 x + 2\cos x + 1 = 0$, for values of x in the range of $0° < x < 360°$?

(A) 45° (B) 90° (C) 180° (D) 270°

Answer: (C)

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20. Which one of the following plant secondary metabolites is a natural insecticide?

(A) Digitoxin (B) Pyrethrin (C) Salicylicacid (D) AvenacinA-1

Answer: (B)

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21. The determinant of the matrix $\begin{pmatrix} 4 & -6 \\ -3 & 2 \end{pmatrix}$ is _____

Answer: (–10)

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22. The variable z has a standard normal distribution. If $P(0 \le z \le 1) = 0.34$, then $P(z^2 > 1)$ is equal to (up to two decimal places)_____.

Answer: (0.32)

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23. The absorbance of a solution of tryptophan measured at 280 nm in a cuvette of 2.0cm path length is 0.56 at pH 7. The molar extinction coefficient (ε) for tryptophanat 280 nmis $5600 M^{-1} cm^{-1}$ at pH 7.

The concentration of tryptophan $(\text{in } \mu M)$ in the solution is _____.

Answer: (50)

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24. A single stem cell undergoes 10 a symmetric cell divisions. The number of stem cells at the end is _____.

Answer: (1)

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25. Genomic DNA is olated from a bacterium was digested with a restriction enzyme that recognizes a 6-basepair (bp) sequence. Assuming random distribution of bases, the average length (in bp) of the fragments generated is_____.

Answer: (4096)

Q. No. 26-55 Carry Two MarksEach

26. Inleguminous plants, both the rhizobiumgenes and the plant genes influence nodulation and nitrogen fixation. Which one of the following functions is **NOT** encoded by the host plant genes?

(A) Production of inducers that modifyrhizobial cell wall

(B) Production off lavonoid inducers

(C) Establishment of contact between bacteria and legume

(D) Root hair curling

Answer: (D)

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27. Which of the following cytokines are endogenous pyrogens?

P. Tumor necrosis factor –α

Q. Interleukin-1

R. Transforming growth factor –β

S. Interleukin-10

(A) Pand Q only (B) Pand R only (C) R and Sonly (D) Q and Sonly

Answer: (A)

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28. Match the classes of RNA molecules in Group-I with their functions in Group-II.

Group-I		**Group-II**	
P.	snoRNA	**1.**	Protects germline from transposable elements
Q.	piRNA	**2.**	Blocks translation ofselected mRNA
R.	miRNA	**3.**	Template for telomere elongation
S.	snRNA	**4.**	Modification and processingof rRNA
		5.	Splicingof RNA transcripts

(A) P-3, Q-5, R-2, S-4 (B) P-1, Q-3, R-2, S-5

(C) P-1, Q-4, R-5, S-2 (D) P-4, Q-1, R-2, S-5

Answer: (D)

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29. Determine the correctness or otherwise of the following Assertion [a]and the Reason [r]

Assertion[a]: A binitiogene finding algorithms that predict protein coding genesineukaryotic genomes are not completely accurate.

Reason[r]: Eukaryotic splice sites are difficult to predict.

(A) Both [a]and [r] are false

(B) [a] is true but [r] is false

(C) Both [a]and [r] are true and [r]is the correct reason for [a]

(D) Both [a]and [r] are true but [r]is not the correct reason for [a]

Answer: (C)

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30. Which one of the following amino acid siscatalyzed by activated macrophages to produce reactive nitrogen species?

(A) Arginine (B) Asparagine (C) Cysteine (D) Histidine

Answer: (A)

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31. Determine the correctness or otherwise of the following Assertion [a]and the Reason [r]

Assertion[a]: The association constant in water for the G-C base pairis three times lower than that for the A-T base pair.

Reason[r]: There are three hydrogen bonds in the G-C base pair and two in the A-T base pair.

(A) Both [a]and [r] are true and [r]is the correct reason for [a]

(B) [a] is false but [r]is true

(C) Both [a]and [r] are false

(D) Both [a]and [r] are true and [r]is not the correct reason for[a]

Answer: (B)

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32. Which one of the combinations of the following statements is true a boutanti body structure?

P. Limited proteolysis of rabbit IgG with the enzyme pepsin generates two antigen-binding regions (Fab) and an Fc fragment

Q. Limited proteolysis of rabbit IgG with the enzyme papain generates a single bivalent antigen-binding region $F(ab')_2$ and peptide fragments

R. The Fc fragment of IgG can self-associate and crystallize into a lattice

S. The $F(ab')_2$ fragment of IgG is composed of both light and heavy chains

(A) P and Q only
(B) P and R only
(C) R and Sonly
(D) Q and Sonly

Answer: (C)

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33. Which one of the following statements is true with regard to processing and presentation of protein antigens?

(A) In the class II MHC pathway, protein antigens in the cytosol are processed by proteasomes.
(B) In the class IMHC pathway, extracellular protein antigen sareendocy to sedintovesicles and processed
(C) In the class IMHC pathway, transporter associated antigen processing (TAP) protein is required for translocating processed peptides generated in the cytosol
(D) Invariantchaininendoplasmicreticulumisinvolvedintransportofpeptidesandloading of clasIMHC

Answer: (C)

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34. Which ofthe followingare trueabout bacterial superoxide dismutase?

P. Present in obligate aerobes
Q. Present in facultative anaerobes
R. Present in aerotolerantanaerobes
S. Absent in obligate aerobes

(A) P and Q only
(B) P, Qand Ronly
(C) P andR only
(D) Q and Sonly

Answer: (B)

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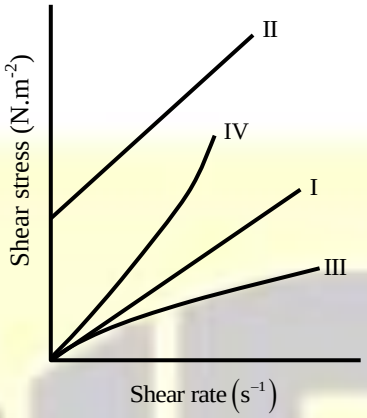
35. Which of the following are true with regard to an aerobic respiration in bacteria?

P. The final electron acceptor is an inorganic substance other than molecular oxygen
Q. The number of ATP molecules produced perglucose molecule is more than that produced in aerobicrespiration
R. The number of ATP molecules producedper glucose molecule is less than that produced in aerobicrespiration
S. Only substrate level phosphorylation is used to generate ATP

(A) P and Sonly
(B) Q and Sonly
(C) P andR only
(D) P, Q and Sonly

Answer: (A)

36. Shear stress versus shear rate behavior of four different types of fluids (I, II, III and IV) are shown in the figure below.



Which one of the following options is correct?

(A) I-Newtonian, II-Bingham plastic, III-Dilatant, IV-Pseudoplastic

(B) I-Pseudoplastic, II-Dilatant, III-Newtonian, IV-Bingham plastic

(C) I-Newtonian, II-Pseudoplastic, III-Bingham plastic, IV-Dilatant

(D) I-Newtonian, II-Bingham plastic, III-Pseudoplastic, IV-Dilatant

Answer: (D)

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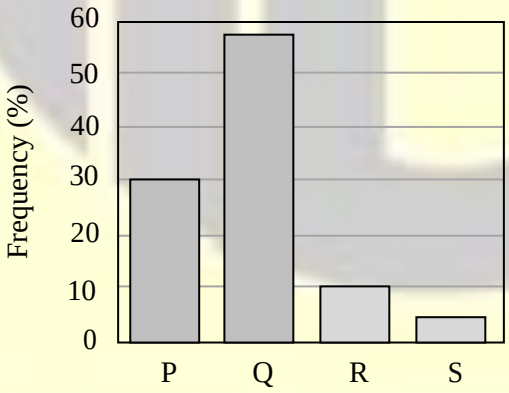
37. Ananalysis of DNA protein interactions was carried out using all DNA- protein complexes in the protein data bank (PDB). The frequency distribution of four amino acid residues, represented as P, Q, R and S, occurring in non-covalentinteractions between the protein and DNA back bone is shown below.



Which one of the following is correct?

(A) P-Lys, Q-Arg, R-Gln, S-Glu

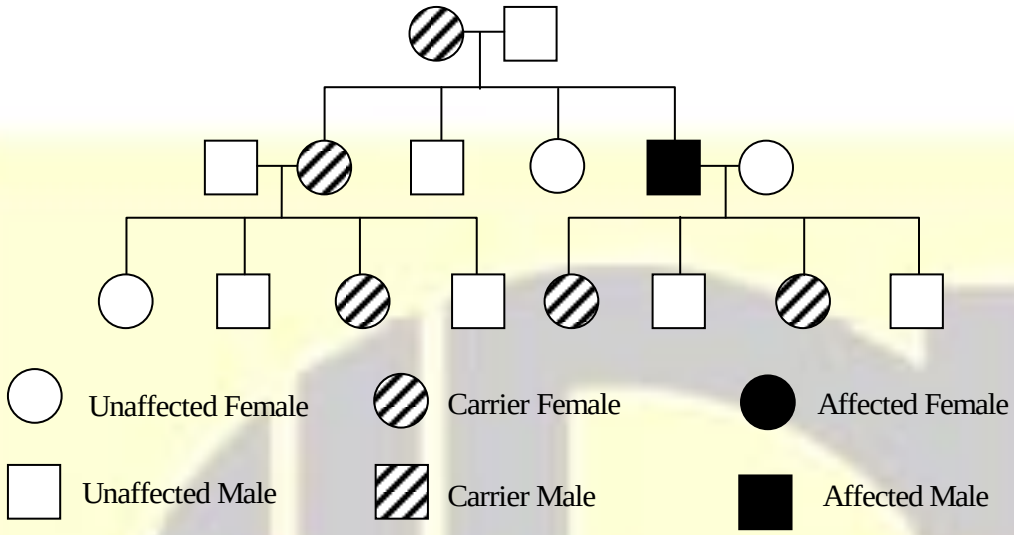
(B) P-Gln, Q-Glu, R-Lys, S-Arg

(C) P-Asn, Q-Asp, R-Arg, S-Lys

(D) P-His, Q-Glu, R-Gln, S-Lys

Answer: (A)

38. A pedigree of an inheritable disease is shown below.



What type of in heritance does the disease follow?

(A) Autosomal dominant
(B) X-linked dominant
(C) X-linked recessive
(D) Autosomal recessive

Answer: (C)

---

39. Match the industrial products mentioned in Group-I with their producer organisms in Group-II

	Group-I		**Group-II**
P.	Citric acid	**1.**	Trichoderma viride
Q.	Cellulase	**2.**	Clostridium acetobutylicum
R.	Vitamin B_{12}	**3.**	A spergillus niger
S.	Butanol	**4.**	Propionibacterium freudenreichii

(A) P-4, Q-3, R-1, S-2
(B) P-3, Q-1, R-2, S-4
(C) P-2, Q-1, R-4, S-3
(D) P-3, Q-1, R-4, S-2

Answer: (D)

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40. 5'capping of mRNA transcripts in eukaryotes involves the following events:

P. Addition of GMP on the5'end

Q. Removal of γ-phosphate of the triphosphate on first base at the5'end

R. 5'-5'linkagebetweenGMP and the first base at 5'end

S. Addition of methyl group to N7 position of guanine

Which one of the following is the correct sequence of events?

(A) P, Q, R, S (B) P, R, Q, S

(C) Q, P, R, S (D) Q, P, S, R

Answer: (C)

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41. Calculate the following integral (up to two decimal places)

$\int_0^1 (x+3)(x+1)dx =$ _____.

Answer: (5.33)

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42. The probability distribution for a discrete random variable X is given below.

X	1	2	3	4
P(X)	0.3	0.4	0.2	0.1

The expectation value of X is_____.(up to one decimal place)

Answer: (2.1)

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43. If $1+r+r^2+r^3+...\infty = 1.5,$

then, $1+2r+3r^2+4r^3+...\infty =$ _____.(up to two decimal places)

Answer: (2.25)

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44. Moist heat sterilization of spores at121°C follows first order kinetics as per the expression:

$$\frac{dN}{dt} = -k_d N$$

where, *N* is the number of viable spores, *t* is the time, k_d is the rate constant and $\frac{dN}{dt}$ is therate of changeof viablespores.

If k_d value is $1.0\,min^{-1}$, the time (in minutes) required to reduce the number of viable spores from an initial value of 10^{10} to a final value of 1 is(up to two decimal places) _____.

Answer: (23.03)

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45. An aqueous solution containing 6.8mg/L of an antibioticis extracted with amylacetate. If the partition coefficient of the antibiotic is 170 and the ratio of water to solvent is85, then the extraction factor is_____.

Answer: (2)

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46. A microbial strain is cultured in a 100L stirred fermenter for secondary metabolite production. If the specific rate of oxygen up take is $0.4h^{-1}$ and the oxygen solubility in the broth is 8mg/L, then the volumetric mass transfer coefficient $(K_{La})\,(in\,s^{-1})$ of oxygen required to achieve a maximum cell concentration of 12 g/L is (up to two decimal places) _____.

Answer: (0.167)

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47. In a chemostat, the feed flow rate and culture volume are 100ml/hand1.0L, respectively. With glucose as substrate, the values of μ_{max} and K_s are $0.2\,h^{-1}$ and $1\,g/L$, respectively. For a glucose concentration of 10g/L in the feed, the effluent substrate concentration (ing/L) is _____.

Answer: (1)

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48. Mammalian cells in active growth phase were seeded at a density of 1×10^5 cells/ml. After 72 hours, 1×10^6 cells/ml were obtained. The population doubling time of the cells in hours is (up to two decimal places) _____.

Answer: (22)

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49. Yeast converts glucose to ethanol and carbondioxide by glycolysis as per the following reaction:

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Assuming complete conversion, the amount of ethanol produced (ing) from 200g of glucose is _____. (up to two decimal places)

Answer: (102.28)

50. At the end of a batch culture, glucose solution is added at a flow rate of 200mL/h. If the culture volume after 2h of glucose addition is 1000ml, the initial culture volume (inml) is_____.

Answer: (600)

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51. Consider the following alignment of two DNA sequences:

AGTAAC

AA – –AC

Assuming an affine gap scoring scheme of an identity matrix for substitution, a gap initiation penalty of 1 and a gap extension penalty of 0.1, the score of the alignment is _____.(up to one decimal place).

Answer: (1.9)

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52. First order deactivation rate constants for soluble and immobilized amyloglucosid a seen zyme are $0.03\,min^{-1}$ and $0.005\,min^{-1}$, respectively. The ratio of half-life of the immobilized enzyme to that ofthe soluble enzyme is (rounded off to the nearest integer) _____.

Answer: (6)

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53. Consider a simple uni-substrateen zyme that follows Michael is Menten kinetics. When the enzyme catalyzed reaction was carried out in the presence of 10nM concentration of an inhibitor, there was no change in the maximal velocity. However, the slope of the Lineweaver-Burkplotincreased3-fold.Thedissociationconstantfortheenzyme-inhibitor complex (in nM)is _____.

Answer: (5)

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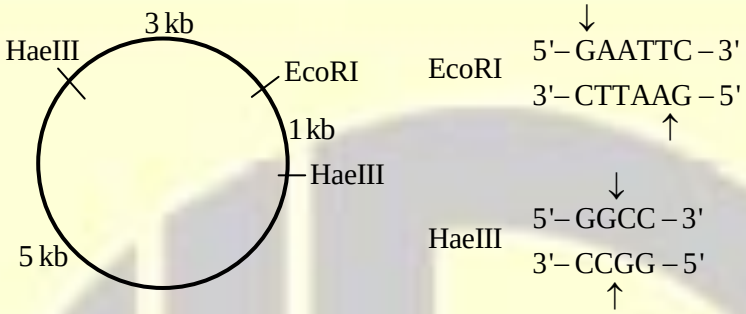
54. The product of complete digestion of the plasmid shown below with *Eco*RI and *Hae*III was purified an dusedasatemplatein are action containing Klenow fragmen to fDNA polymerase, dNTPs and $\left[\alpha -^{32} \mathrm{P}\right]-\mathrm{dATP}$ in a suitable reaction buffer. The product thus obtained was purified and subjected to gel electrophores is followed by autoradiography.



The number of bands that will appear on theX-ray film is_____.

Answer: (2)

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55. A rod shaped bacterium has a length of $2\,\mu\mathrm{m}$, diameter of $1\mu\mathrm{m}$ and density the same as that of water. If proteins constitute 15% of the cell mass and the average protein has a mass of 50 kDa, the number of proteins in the cellis _____ $\left(1\mathrm{Da}=1.6\times10^{-24}\,\mathrm{g}\right)$

Answer: (2937500)