SECTION – A

MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 – Q.10 carry one mark each.

Q.1 The antigen binding site of an antibody is present

(A) at the constant region
(B) at the C-terminal
(C) at the variable region
(D) between the constant and the variable region

Q.2 Which of the following is **NOT** involved in eukaryotic translation?

(A) Ribosome (B) Spliceosome (C) mRNA (D) tRNA

Q.3 Which of the following statements is correct?

(A) Gram negative bacteria are colored purple after Gram staining
(B) Gram negative bacteria are commonly more resistant to antibiotics than Gram positive bacteria
(C) Gram negative bacteria cell wall consists of a thick layer of peptidoglycan outside the plasma membrane
(D) Cell wall of Gram negative bacteria does not contain an outer membrane

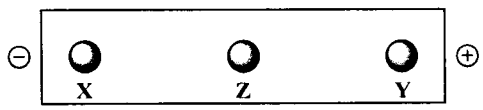
Q.4 The role of enzyme E synthesized by phage ϕX174 during host infection is to

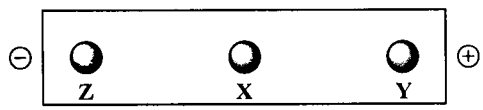
(A) block peptidoglycan synthesis
(B) enhance synthesis of viral +RNA
(C) inhibit lipid metabolism
(D) stimulate dsDNA replication

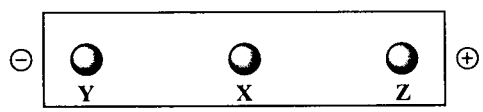
Q.5 Among CH_4, H_2O, NH_3 and PH_3, the molecule having the smallest percent *s* character for the covalent bond (X–H) between the central element (X = C, O, N or P) and hydrogen is

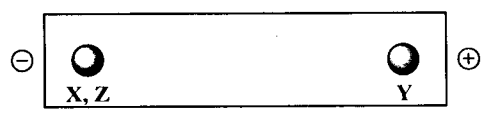
(A) CH_4 (B) H_2O (C) NH_3 (D) PH_3

Q.6 The result of an electrophoretic separation of a mixture of amino acids **X**, **Y** and **Z** at *p*H = 5.0 is represented as (Given the isoelectric points of **X**, **Y**, and **Z** are 9.87, 3.22 and 5.43, respectively)

(A) 

(B) 

(C) 

(D) 

Q.7 $\cos(x + yx) =$

(A) $\cos(x)\cos(yx) - \sin(x)\sin(yx)$ (B) $\cos(x)\cos(yx) + \sin(x)\sin(yx)$
(C) $\cos(x)\sin(yx) - \sin(x)\cos(yx)$ (D) $\cos(x)\sin(yx) + \sin(x)\cos(yx)$

Q.8 If $\begin{bmatrix} x & y \\ p & q \\ u & v \end{bmatrix} R = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then the order of R is

(A) 2×3 (B) 3×2 (C) 2×2 (D) 3×3

Q.9 The average energy of a diatomic gaseous molecule at temperature T is $\frac{5}{2} k_B T$ where k_B is Boltzmann's constant. The average energy of this molecule per degree of freedom is

(A) $\frac{1}{2} k_B T$ (B) $\frac{2}{3} k_B T$ (C) $k_B T$ (D) $\frac{3}{2} k_B T$

Q.10 The refractive index of diamond is 2.419. If the speed of light in vacuum is 3×10^8 m s^{-1}, then the speed of light in diamond is

(A) 1.240×10^8 m s^{-1} (B) 1.352×10^8 m s^{-1} (C) 1.521×10^8 m s^{-1} (D) 2.433×10^8 m s^{-1}

Q. 11 – Q. 30 carry two marks each.

Q.11 Which of the following is true of protein synthesis **ONLY** in prokaryotes?

(A) Translation and transcription are coupled
(B) The codon AUG codes for the start signal
(C) The tRNA anticodon can bind to two or more different codons
(D) The functional ribosomes contain two subunits constructed of proteins and RNA

Q.12 Match the entries in Group I with that in Group II

Group I	Group II
P) Phytase	1) paper and pulp processing
Q) Xylanase	2) delignification
R) Laccase	3) gluten complex reduction
S) Bromelain	4) improve mineral availability
	5) phosphorylation

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

Q.13 If an aldol cleavage of glucose-6-phosphate occurs in glycolysis, it will result in

(A) products of equal carbon chain length (B) products of unequal carbon chain length
(C) removal of phosphate group (D) three C_2 compounds

Q.14 The natural geographical distribution of kangaroos is limited to the Australian continent because

(A) abiotic factors determine the distribution
(B) dispersal is limited by accessibility to other continents
(C) kangaroos have not selected habitats in other continents
(D) predators limit the distribution in other continents

Q.15 Which of the following is **NOT** an example of an adaptive defense mechanism against predation?

(A) Bright colors of bird pollinated flower
(B) Insect that resembles a stick
(C) Nicotine in the tobacco plant
(D) Spines on porcupine

Q.16 Match the entries in Group I with that in Group II

Group I	Group II
P) Nucleolus	1) lipid storage
Q) Sphaerosomes	2) breakdown of fatty acids
R) Peroxisomes	3) transport of macromolecules
S) Plasmodesmata	4) RNA synthesis

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

Q.17 The nitrogenase of diazotrophs

(A) contains Cu-S center and uses 12 NADH to reduce one N_2
(B) contains one (4Fe-4S) cluster and uses 8 $FADH_2$ to reduce one N_2
(C) is a complex of Fe-protein and MoFe-protein and uses 16 ATPs to reduce one N_2
(D) is a MoFe protein and uses 4 ATP and 4 $FMNH_2$ to reduce one N_2

Q.18 During eukaryotic cell division, the amount of DNA doubles

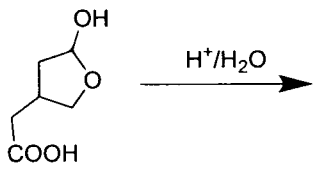
(A) between prophase and anaphase of mitosis
(B) between prophase I and prophase II of meiosis
(C) between the G1 and G2 phases of the cell cycle
(D) during the M phase of the cell cycle

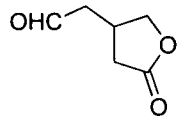
Q.19 The correct sequence of the following events in the human female reproductive cycle is

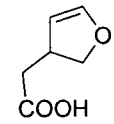
I: Secretion of FSH
II: Growth of corpus luteum
III: Growth of follicle and oogenesis
IV: Ovulation
V: Sudden increase in the levels of LH

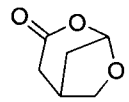
(A) I, II, IV, V, III
(B) II, I, III, IV, V
(C) I, III, V, IV, II
(D) I, V, III, IV, II

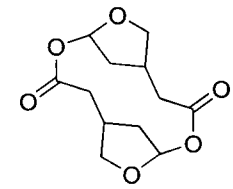
Q.20 The major product formed in the following reaction is



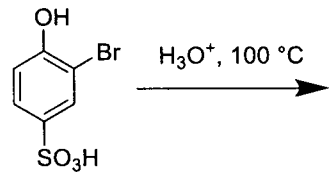
(A) 

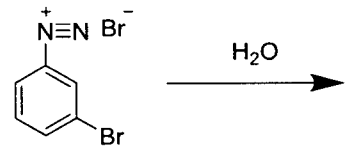
(B) 

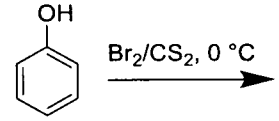
(C) 

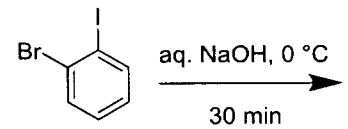
(D) 

Q.21 The reaction that produces *o*-bromophenol as the major product is

(A) 

(B) 

(C) 

(D) 

Q.22 For an autocatalytic second order reaction R → P, the rate law is [where v is rate of the reaction and k is the rate constant]

(A) $v = k\,[R]$ (B) $v = k\,[R]\,[P]$ (C) $v = k\,[R]^2$ (D) $v = k\,[P]^2$

Q.23 In metal-carbonyl complexes, the π-back bonding is

(A) pπ – dπ type
(B) dπ – dπ type
(C) dπ – π* type
(D) dπ – σ* type

Q.24 If $u(x)$ and $v(x)$ are differentiable at $x = 0$, and if $u(0) = 5$, $u'(0) = -3$, $v(0) = -1$ and $v'(0) = 2$, then the value of $\frac{d}{dx}\left(uv + \frac{u}{v}\right)$ at $x = 0$ is

(A) –20 (B) –7 (C) 6 (D) 13

Q.25 Two dice are thrown simultaneously. The probability that the sum of the numbers obtained is divisible by 7 is

(A) $^1/_6$ (B)) $^1/_{36}$ (C) 0 (D)) $^1/_{18}$

Q.26 If one of the diameters of a circle has end points (2, 0) and (4, 0), then the equation of that circle is

(A) $x^2 - 3x + y^2 + 5 = 0$
(B) $x^2 - 4x + y^2 + 6 = 0$
(C) $x^2 - 5x + y^2 + 7 = 0$
(D) $x^2 - 6x + y^2 + 8 = 0$

Q.27 If P = {1, 2, –1, 3}, Q = {0, 4, 1, 3} and R = {1, 6, 7}, then P∩(Q∪R)=

(A) {1, 2} (B) {1, 3} (C) {2, 1} (D) {2, 3}

Q.28 The position of a particle along the y-axis is $y = P\,t^4 + Q$. For the equation to be dimensionally consistent, the dimension of P in terms of length [L] and time [T] is

(A) LT^{-1} (B) LT^{-2} (C) LT^{-3} (D) LT^{-4}

Q.29 Two inductors P and Q having inductance ratio 1:2 are connected in parallel in an electric circuit. The energy stored in the inductors P and Q are in the ratio

(A) 1 : 4 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1

Q.30 A body X of mass M moving with velocity v hits a stationary body Y of mass m. If M >> m and X moves with the velocity v', then the velocity of Y after an elastic collision is

(A) $2v$ (B) $v + v'$ (C) $v - v'$ (D) $2v'$

SECTION - B

MULTIPLE SELECT QUESTIONS (MSQ)

Q. 31 – Q. 40 carry two marks each.

Q.31 The cells involved in allergic reactions and containing surface receptors of IgE antibodies and histamine are

(A) Basophils (B) Mast cells (C) Monocytes (D) Neutrophils

Q.32 Which of the following is(are) **INCORRECT** in the regulation of the *trp* operon?

(A) It is an example of a negatively controlled repressible operon
(B) The amino acid Trp inactivates the repressor
(C) The amino acid Trp induces the operon
(D) The repressor binds to the operator in the presence of amino acid Trp

Q.33 Which of the following organs are correctly paired with their function?

(A) Large intestine – Protein digestion
(B) Oral cavity – Starch digestion
(C) Pancreas – Bile production
(D) Small intestine – Fat digestion

Q.34 The $\Delta G^{0\prime}$ for homolactic fermentation converting glucose to lactate is –196 kJ mol^{-1}. If $\Delta G^{0\prime}$ for the formation of ATP is +30.5 kJ mol^{-1}, then

(A) homolactic fermentation is 31% energy efficient
(B) the efficiency of energy conservation is 69%
(C) the energy stored in the form of ATP is 31%
(D) the process results in the loss of 31% of energy

Q.35 Bacterial plasmid genes of non-chromosomal origin are associated with
A) providing resistance against antibacterial agents
B) the degradation of toxic materials
C) the production of certain toxins
D) the transfer of genetic material from one cell to another cell

Q.36 The elements with atomic numbers 19, 37 and 55

(A) form cubic chloride salts with the coordination number of cation being 6
(B) form ionic fluorides with general formula MF
(C) have lowest density of solids in their respective periods
(D) have lowest ionization energy in their respective periods

Q.37 Fehling's solution

(A) contains a copper complex of tartaric acid
(B) forms a brick-red precipitate with glucose
(C) forms a white precipitate with aldehydes
(D) is used as a test reagent for reducing sugars

Q.38 Which of the following point(s) lies(lie) on the plane $2x + 3y + z = 6$?

(A) (0, 0, 6) (B) (0, 2, 0) (C) (1, 1, 1) (D) (3, 0, 0)

Q.39 Kinetic theory of an ideal gas is based upon the following assumption(s)

(A) Gases are made of molecules with negligible volume
(B) The gaseous molecules do not possess kinetic energy
(C) The molecules are in constant random motion
(D) Intermolecular forces of attraction are negligible

Q.40 The electric field and capacitance of a capacitor in the absence of dielectric material are E and C, respectively. When the capacitor is filled with a dielectric material, the electric field and capacitance of the capacitor becomes E' and C', respectively. Which of the following is(are) correct?

(A) $E' > E$ and $C' = C$ (B) $E' < E$ and $C' > C$
(C) $E' = E$ and $C' > C$ (D) $E' > E$ and $C' < C$

SECTION – C

NUMERICAL ANSWER TYPE (NAT)

Q. 41 – Q. 50 carry one mark each.

Q.41 Antigen and antibody interaction is shown by the following scheme

$$Ab + Ag \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} Ab\text{-}Ag$$

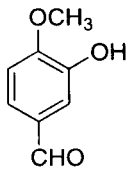
Where Ab is antibody, Ag is antigen and Ab-Ag is antigen-antibody complex. The values of k_1 and k_{-1} are 5×10^{-5} μM^{-1} s^{-1} and 2×10^{-7} s^{-1}, respectively. The dissociation constant for the complex is _____ nM.

Q.42 The population of a bacterial culture increases from one thousand to one billion in five hours. The doubling time of the culture (correct to 1 decimal place) is _____ min.

Q.43 The K_M and v_{max} of lactate dehydrogenase for conversion of pyruvate to lactate are 1 mM and 5 nM s^{-1}, respectively. At 0.25 mM pyruvate, the velocity of the reaction catalyzed by lactate dehydrogenase is _____ nM s^{-1}.

Q.44 A linear DNA contains five restriction sites for EcoRI and three restriction sites for BamHI. The number of fragments that will be generated after digestion with EcoRI is _____.

Q.45 Total number of singlets observed in the ^1H NMR of the following compound is _____.



Q.46 The $[H^+]$ of 0.1 N acetic acid solution is 1.33×10^{-3}. The *p*H of the solution (correct to two decimal places) is _____.

Q.47 The positive root of the equation $x^4 + x^2 - 2 = 0$ is _____ .

Q.48 $\int_0^1 x\,dx + \int_1^2 (2 - x)\,dx =$ _____ .

Q.49 One gram of radioactive nuclei with a half life of 300 days is kept in an open container. The weight of nuclei remaining after 900 days (correct to 1 decimal place) is _____ mg.

Q.50 Two sources P and Q produce electromagnetic waves with wavelengths λ and 2λ, respectively. Source P ejects a photon with a maximum kinetic energy of 4.0 eV from a metal with work function 2.0 eV. The maximum kinetic energy (eV) of a photon ejected by source Q from the same metal is _____ .

Q. 51 – Q. 60 carry two marks each.

Q.51 The standard oxidation potentials for oxidation of NADH and H_2O are + 0.315 V and –0.815 V, respectively. The standard free energy for oxidation of 1 mole of NADH by oxygen under standard conditions (correct to 1 decimal place) is _____ kJ. [Faraday Constant is 96500 C $mole^{-1}$]

Q.52 The K_M and v_{max} of an enzyme are 4 mM and 0.1 nM h^{-1} respectively. In the presence of 1.5 mM inhibitor, the K'_M and v'_{max} of the enzyme are 6 mM and 0.1 nM h^{-1}, respectively. The value of inhibition constant, K_I (correct to 1 decimal place) is _____ mM.

Q.53 The relationship between $log_{10}(MW)$ [where MW = molecular weight in kDa] of a mixture of protein standards and their retention factors (R_f) obtained from native-PAGE is $log_{10}(MW) = -2R_f + 3$. If the measured retention factor for a protein with 180 amino acids is 0.5, then the number of identical monomers in the protein is _____ .

Q.54 In bacteria, a ribosome synthesizes a protein containing 300 amino acids from mRNA in 20 seconds. If the average lifetime of a mRNA is 2 minutes, the number of ribosomes that can translate a single mRNA containing 1350 nucleotides is _____ .

Q.55 In 2 N H_2SO_4, an organic compound shows fluorescence with quantum yield, $\phi_f = 0.42$ and fluorescence rate constant, $k_f = 5.25 \times 10^7\ s^{-1}$. The observed fluorescence life time of it under the same conditions (correct to 1 decimal place) is _____ ns.

Q.56 In acidic solution, permanganate ion is reduced by ferrous ion. The number of electrons involved in the reduction of permanganate ion is _____ .

Q.57 If $\vec{a}$ and $\vec{b}$ are unit vectors and the angle between them is $\frac{\pi}{3}$, then the magnitude of $\vec{a} - \vec{b}$ is _____ .

Q.58 Using the letters in the word TRICK a new word containing five distinct letters is formed such that T appears in the middle. The number of distinct arrangements is _____ .

Q.59 An X-ray tube operates at 30 kV. If one electron converts 10% of its energy into a photon at first collision, then the wavelength of the photon (correct to two decimal places) is _____Å.
[$h = 4.14 \times 10^{-15}\ eVs^{-1}$, $c = 3 \times 10^3\ ms^{-1}$ and $e = 1.6 \times 10^{-19}$ C]

Q.60 In a mass spectrometer, a deuteron with kinetic energy 17 MeV enters a uniform magnetic field of 2.4 T with its velocity perpendicular to the field. The deuteron moves in a circular path in the magnetic field. The radius of its path in the magnetic field (correct to two decimal places) is _____ cm. [mass of deuteron is 3.34×10^{-27} kg, 1 MeV = 1.6×10^{-13} J and $e = 1.6 \times 10^{-19}$ C]

END OF THE QUESTION PAPER

JAM 2017 ANSWER KEY

Model Answer Key for BT Paper

Paper:**BIOTECHNOLOGY**	Code:**BT**

SECTION – A (MCQ)				SECTION – B (MSQ)		SECTION – C (NAT Type)			
Q. No.	**KEY**	**Q. No.**	**KEY**	**Q. No.**	**KEYS**	**Q. No.**	**KEY RANGE**	**Q. No.**	**KEY RANGE**
01	C	**16**	B	**31**	A, B	**41**	4 to 4	**56**	5 to 5
02	B	**17**	C	**32**	B, C	**42**	14.0 to 16.0	**57**	1 to 1
03	B	**18**	C	**33**	B, D	**43**	1 to 1	**58**	24 to 24
04	A	**19**	C	**34**	A, C	**44**	6 to 6	**59**	4.10 to 4.20 or 0.00 to 0.01
05	D	**20**	A	**35**	A, B, C, D	**45**	3 to 3	**60**	34.00 to 36.00
06	A	**21**	A	**36**	B, C, D	**46**	2.86 to 2.89		
07	A	**22**	B	**37**	A, B, D	**47**	1 to 1		
08	A	**23**	C	**38**	A, B, C, D	**48**	1 to 1		
09	A	**24**	C	**39**	A, C, D	**49**	124.0 to 126.0		
10	A	**25**	A	**40**	B or C or B, C	**50**	1 to 1		
11	A	**26**	D			**51**	–219.0 to –217.0		
12	B	**27**	B			**52**	2.9 to 3.1		
13	B	**28**	D			**53**	5 to 5		
14	B	**29**	C			**54**	4.0 to 4.1		
15	A	**30**	B			**55**	7.9 to 8.1		