JAM 2015

Question Paper with Answers

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JAM 2015: General Instructions during Examination

1. Total duration of the JAM 2015 examination is **180** minutes.

2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.

3. Any useful data required for your paper can be viewed by clicking on the **Useful Data** button that appears on the screen.

4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.

5. You are allowed to use only your own **non-programmable calculator**.

6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

 You have not visited the question yet.

 You have not answered the question.

 You have answered the question.

 You have NOT answered the question, but have marked the question for review.

 You have answered the question, but marked it for review.

7. The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is 'answered, but marked for review', then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

8. To answer a question, do the following:
   a. Click on the question number in the Question Palette to go to that question directly.

   b. Select the answer for a multiple choice type question and for the multiple select type question. Use the virtual numeric keypad to enter the answer for a numerical type question.

   c. Click on **Save & Next** to save your answer for the current question and then go to the next question.

   d. Click on **Mark for Review & Next** to save and to mark for review your answer for the current question, and then go to the next question.

   Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

9. You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

10. Procedure for answering a multiple choice question (MCQ):

   a. Choose the answer by selecting only one out of the 4 choices (A,B,C,D) given below the question and click on the bubble placed before the selected choice.

b. To deselect your chosen answer, click on the bubble of the selected choice again or click on the **Clear Response** button.

c. To change your chosen answer, click on the bubble of another choice.

d. To save your answer, you MUST click on the **Save & Next** button.

11. Procedure for answering a multiple select question (MSQ):

a. Choose the answer by selecting one or more than one out of the 4 choices (A,B,C,D) given below the question and click on the checkbox(es) placed before each of the selected choice (s).

b. To deselect one or more of your selected choice(s), click on the checkbox(es) of the choice(s) again. To deselect all the selected choices, click on the **Clear Response** button.

c. To change a particular selected choice, deselect this choice that you want to change and click on the checkbox of another choice.

d. To save your answer, you MUST click on the **Save & Next** button.

12. Procedure for answering a numerical answer type (NAT) question:

a. To enter a number as your answer, use the virtual numerical keypad.

b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.

c. To clear your answer, click on the **Clear Response** button.

d. To save your answer, you MUST click on the **Save & Next** button.

13. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ and MSQ types) or entered (for NAT) for a question that is* **Marked for Review***, that answer will be considered in the evaluation unless the status is modified by the candidate.*

14. To change your answer to a question that has already been answered, first select that question and then follow the procedure for answering that type of question as described above.

15. Note that ONLY those questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

Choosing a Section :

16. Sections in this question paper are displayed on the top bar of the screen. All sections are compulsory.

17. Questions in a section can be viewed by clicking on the name of that section. The section you are currently viewing will be highlighted.

18. To select another section, simply click the name of the section on the top bar. You can shuffle between different sections any number of times.

19. When you select a section, you will only be able to see questions in this Section, and you can answer questions in the Section.

20. After clicking the **Save & Next** button for the last question in a section, you will automatically be taken to the first question of the next section in sequence.

21. You can move the mouse cursor over the name of a section to view the answering status for that section.

JAM 2015 Examination
BT: Biotechnology

Duration: **180 minutes**   *Maximum Marks*: **100**

Read the following instructions carefully.

1. To login, enter your Registration Number and Password provided to you. Kindly go through the various coloured symbols used in the test and understand their meaning before you start the examination.

2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **Question Paper** button in the screen.

3. This test paper has a total of 60 questions carrying 100 marks. The entire question paper is divided into three **sections, A, B** and **C**. All sections are compulsory. Questions in each section are of different types.

4. **Section – A** contains **Multiple Choice Questions (MCQ)**. Each MCQ type question has four choices out of which only one choice is the correct answer. This section has 30 Questions and carry a total of 50 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.30 carry 2 marks each.

5. **Section – B** contains **Multiple Select Questions (MSQ)**. Each MSQ type question is similar to MCQ but with a difference that there may be one or more than one choice(s) that are correct out of the four given choices. The candidate gets full credit if he/she selects all the correct choices only and no wrong choices. This section has 10 Questions and carry 2 marks each with a total of 20 marks.

6. **Section – C** contains **Numerical Answer Type (NAT)** questions. For these NAT type questions, the answer is a real number which needs to be entered using the virtual numerical keypad on the monitor. No choices will be shown for these type of questions. This section has 20 Questions and carry a total of 30 marks. Q.1 – Q.10 carry 1 mark each and Questions Q.11 – Q.20 carry 2 marks each.

7. Depending upon the JAM test paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Data** button that appears at the top, right hand side of the screen.

8. The computer allotted to you at the examination centre runs specialized software that permits only one choice to be selected as answer for multiple choice questions using a mouse, one or more than one choices to be selected as answer for multiple select questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual numeric keypad and mouse.

9. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.

10. Multiple choice questions (Section-A) will have four choices against A, B, C, D, out of which only **ONE** choice is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (◯) placed before the choice.

11. Multiple select questions (Section-B) will also have four choices against A, B, C, D, out of which **ONE OR MORE THAN ONE** choice(s) is /are the correct answer. The candidate has to choose the correct answer by clicking on the checkbox (□) placed before the choices for each of the selected choice(s).

12. For numerical answer type questions (Section-C), each question will have a numerical answer and there will not be any choices. **For these questions, the answer should be entered** by using the mouse and the virtual numerical keypad that appears on the monitor.

13. In all questions, questions not attempted will result in zero mark. In **Section – A** (MCQ), wrong answer will result in **NEGATIVE** marks. For all 1 mark questions, 1/3 marks will be deducted for each wrong answer. For all 2 marks questions, 2/3 marks will be deducted for each wrong answer. In **Section – B** (MSQ), there is **NO NEGATIVE** and **NO PARTIAL** marking provisions. There is **NO NEGATIVE** marking in **Section – C** (NAT) as well.

14. **Non-programmable calculators** are allowed but sharing of calculators is not allowed.

15. Mobile phones, electronic gadgets other than calculators, charts, graph sheets, and mathematical tables are **NOT** allowed in the examination hall.

16. You can use the scribble pad provided to you at the examination centre for all your rough work. The scribble pad has to be returned at the end of the examination.

Declaration by the candidate:

"I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition".

SECTION – A

MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 – Q.10 carry one mark each.

Q.1   Which one of the following most accurately describes the process of natural selection?

(A) Selection of one species over a competing species
(B) Selection of individuals that successfully defend themselves against enemies
(C) Selection of individuals that produce more than the average number of offspring
(D) Selection of individuals that are more attractive to the opposite sex

Q.2   Identify the statement that is **TRUE** of operons.

(A) Fine regulation of the expression of individual genes are made possible by operons
(B) Only genes involved in carbohydrate metabolism are present in operons
(C) Feedback inhibition of the biosynthesis of multiple enzymes by a single small molecule is made possible by operons
(D) In the case of inducible operons, the inducer binds to the operator

Q.3   Signaling pathways usually comprise of several intermediate steps that are arranged in the form of a cascade. What is the primary outcome of such an arrangement?

(A) Specificity of signal transduction
(B) Specificity of the cellular response
(C) Amplification of the cellular response
(D) Fine-tuning of the cellular response

Q.4   Which among the following contain(s) oxygen-rich blood in the human vascular system?
I. Right ventricle
II. Aorta
III. Pulmonary vein

(A) I only   (B) I and II only
(C) I, II and III   (D) II and III only

Q.5   Choose the option that lists the correct sequence of steps involved in gene therapy.
P.   Injection of expression vector into patient
Q.   Wild-type gene is inserted into expression vector
R.   Wild-type gene is isolated and cloned
S.   Wild-type gene is transcribed and translated in the patient

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

Q.6   Cephalin, a biological surfactant, is

(A) choline phosphoglyceride
(B) ethanolamine phosphoglyceride
(C) glycosphingolipid
(D) sphingolipid

Q.7   The major product(s) produced by gas phase UV irradiation of 2-pentanone is (are)

(A) acetone and ethene
(B) acetic acid and propionic acid
(C) 2-pentanol
(D) cyclopentane

Q.8   If a projectile lifts off from the surface of the Earth with a speed of 11.2 km.s^{-1}, then it can escape from the Earth's gravitational field completely. This is called the escape velocity. If the radius of the Earth were 2 times larger and the mass 8 times larger, then the escape velocity (in km.s^{-1}) would be

(A) 5.6   (B) 11.2   (C) 22.4   (D) 44.8

Q.9   The speed of an electron (v), in the lowest energy orbit in the Bohr model of the Hydrogen atom divided by the speed of light in vacuum (c), is given by (where m is the mass of the electron, M is the mass of the proton, ε_0 is the permittivity of free space, a_0 is the Bohr radius)

(A) $\dfrac{v}{c} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{e^2}{\hbar c}$

(B) $\dfrac{v}{c} = \dfrac{e^4}{32\pi^2\,\varepsilon_0^2\hbar^2 c^2}$

(C) $\dfrac{v}{c} = \dfrac{m}{M}$

(D) $\dfrac{v}{c} = \dfrac{\hbar}{mca_0}$

Q.10   Let $\mathbb{R}$ be the set of all real numbers. Consider the sets $P = \{x \in \mathbb{R} : (x-1)(x^2+1) = 0\}$, $Q = \{x \in \mathbb{R} : x^2 - 9x + 2 = 0\}$ and $S = \{x \in \mathbb{R} : x = 5y \text{ for some } y \in \mathbb{R}\}$.
       Then the set $(P \cap S) \cup Q$ contains

(A) exactly two elements   (B) exactly three elements
(C) exactly four elements   (D) infinitely many elements

Q. 11 – Q. 30 carry two marks each.

Q.11   In a population growing according to the logistic growth model

(A) individuals reproduce according to their physiological capacity
(B) the per capita rate of increase approaches zero as the population nears the carrying capacity
(C) the number of births is always more than the number of deaths
(D) the birth-to-death ratio is NOT influenced by the carrying capacity

Q.12   Which part of the genomic DNA contains the sequence corresponding to the 5' untranslated region (5' UTR)?

(A) Exon   (B) Intron
(C) Upstream of the transcription start site (D) Upstream of the promoter

Q.13   Which one of the following is **NOT TRUE** of RNA polymerase II?

(A) It requires a primer to initiate the transcription
(B) It makes an RNA copy of only one strand of a double-stranded DNA at any given time
(C) It does not synthesize rRNA and tRNA
(D) It catalyzes the polymerization of RNA only in the 5'→3' direction

Q.14   Choose the option that shows the correct pairing of the cellular components with their corresponding function.

P. Dynein	i. Movement of organelles
Q. Desmosome	ii. Membrane vesicle
R. Endosome	iii. Beating of flagella
S. Kinesin	iv. Attachment of cells together

(A) P-iv, Q-i, R-ii, S-iii   (B) P-iii, Q-iv, R-ii, S-i
(C) P-iii, Q-i, R-ii, S-iv   (D) P-ii, Q-i, R-iv, S-iii

Q.15   An enzyme shows highest activity in the pH range 2.0 - 3.0. At pH 4.0 and pH 7.0, the enzyme exhibits 50% and 1%, respectively, of its highest activity. Which of the following states of an amino acid residue in the catalytic site is most responsible for its activity profile?

(A) A protonated Asp   (B) A deprotonated Asp
(C) A deprotonated Asn   (D) A protonated Asn

Q.16   The specific productivity (q_p) of cellulase production by *Aspergillus niger* follows a linear relationship with the specific growth rate (μ) and is of the form $q_p = \alpha\mu + \beta$, where α and β are constants. Assuming that the values of α and β are 0.006 and 25, respectively, which type of product formation kinetics is **TRUE**?

(A) Growth-dependent kinetics   (B) Non-growth-dependent kinetics
(C) Both growth- and non-growth-dependent kinetics   (D) Inhibition kinetics

Q.17   Choose the option that shows the correct pairing of the diseases with their corresponding causative organisms.

P. Chagas disease	i. *Trypanosoma gambiense*
Q. Sleeping sickness	ii. *Plasmodium falciparum*
R. Malaria	iii. *Yersinia pestis*
S. Plague	iv. *Trypanosoma cruzi*

(A) P-iv, Q-i, R-iii, S-ii   (B) P-iv, Q-i, R-ii, S-iii
(C) P-i, Q-iv, R-ii, S-iii   (D) P-i, Q-iv, R-iii, S-ii

Q.18   Choose the option that shows the correct pairing of the products with their corresponding microorganisms.

P. Citric acid	i. *Micromonospora purpurea*
Q. Polyhydroxyalkonates	ii. *Zymomonas mobilis*
R. Gentamycin	iii. *Aspergillus niger*
S. Ethanol	iv. *Ralstonia eutropha*

(A) P-ii, Q-iii, R-i, S-iv   (B) P-iv, Q-ii, R-iii, S-i
(C) P-iii, Q-iv, R-i, S-ii   (D) P-iii, Q-i, R-iv, S-ii

Q.19   Determine the correctness or otherwise of the following Assertion [a] and Reason [r].
        Assertion [a]. B cells secrete antibodies against a virus while cytotoxic T cells kill virus-infected
                         cells.
        Reason [r].   B cells confer active immunity while cytotoxic T cells confer passive immunity.

        (A) [a] and [r] are true and [r] is the correct reason for [a]
        (B) [a] and [r] are true but [r] is not the correct reason for [a]
        (C) [a] is true but [r] is false
        (D) [a] false but [r] is true

Q.20   Which one of the following options shows the correct pairing of the enzyme with its corresponding
        application?
                P. Papain   i. Gluten complex reduction
                Q. Bromelain   ii. Immuno assay marker enzyme
                R. Peroxidase   iii. Maltose syrup preparation
                S. β-amylase   iv. Meat tenderizer

        (A) P-iv, Q-i, R-ii, S-iii   (B) P-iv, Q-iii, R-i, S-ii
        (C) P-iv, Q-i, R-iii, S-ii   (D) P-i, Q-ii, R-iv, S-iii

Q.21   The rate constant for the reaction O (g) $+ O_3$ (g) $\rightarrow 2O_2$ (g) is 8.0×10^{-15} cm^3 $molecule^{-1}$ s^{-1}. The
        rate constant in dm^3 mol^{-1} s^{-1}, would be

        (A) 4.8×10^{-6} (B) 4.8×10^{6}
        (C) 4.8×10^{-9} (D) 8.0×10^{6}

Q.22   The UV spectrum of 2-butanone and the UV spectrum of methyl vinyl ketone (MVK) are
        independently recorded and compared. Among the various λ_{max}, 185 nm, 219 nm, 277 nm and 324
        nm, the absorption at $\lambda_{max}= 324$ nm is due to

        (A) n→π* transition in 2-butanone
        (B) n→π* transition in MVK
        (C) π→π* transition in 2-butanone
        (D) n→σ* transition in 2-butanone

Q.23   The compound *meso* 2,3-dibromobutane is obtained by

        (A) electrophilic addition of HBr to (*E*)-1-bromobut-2-ene
        (B) electrophilic addition of Br_2 to (*E*)-2-butene
        (C) electrophilic addition of Br_2 to (*Z*)-2-butene
        (D) nucleophilic addition of Br_2 to (*Z*)-1-bromobut-2-ene

Q.24   The major product in the following reaction is

1. NaOEt/EtOH
2. Br(CH$_2$)$_4$Br
3. H$_3$O$^+$, heat

(A)

(B)

(C)

(D)
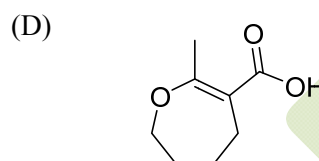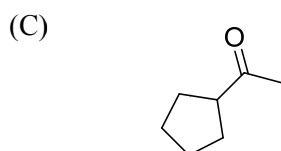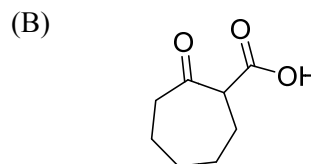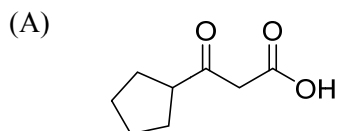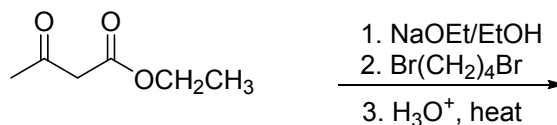
Q.25   An archaeological sample (remains of an animal) containing ^{14}C isotope of Carbon is found to give 10 beta decays per minute per gram of Carbon. It is known that the natural abundance of ^{14}C in organic matter that is in equilibrium with the atmosphere today will give 15 beta decays per minute per gram of Carbon. The half life of ^{14}C is known to be 5730 years. The estimated age of the sample (in years) is

(A) 3010   (B) 3350   (C) 3500   (D) 3800

Q.26   The minimum light intensity that the human eye can perceive is 10^{-10} Wm^{-2}. The area of the opening of our eye (the pupil) is approximately 0.4 cm^{-2}. Consider yellow light with wavelength λ=600 nm. The number of photons incident on the retina per second at the minimum intensity for the eye to respond is

(A) 1.5×10^3 (B) 5×10^3 (C) 8×10^3 (D) 1.2×10^4

Q.27   Three NOT gates are connected in series and the output of the last gate is fed back to the input of the first one as shown in the figure. Each gate has a propagation delay of T_d =1 nano second, which means that the gate requires 1 nano second to change the output after the signal arrives at the input. What is the expected output at point A?
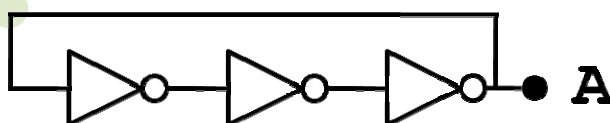
(A) Sine wave with a frequency of 666 MHz   (B) Square wave with a frequency of 666 MHz
(C) Random white noise   (D) Square wave with a frequency of 333 MHz

Q.28
Let ^nC_r denote the number $\dfrac{n!}{r!(n-r)!}$. Then for $n = 100$, the sum of the series

$1 - {}^nC_1 + {}^nC_2 - {}^nC_3 + \cdots \cdots + (-1)^r\, {}^nC_r + \cdots \cdots + (-1)^n\, {}^nC_n$ is

(A) 0   (B) 1   (C) 2   (D) 1024

Q.29   The lengths of two sides of a triangle are 2 units and 3 units and the angle included by these two sides is $60°$. The length of the third side of the triangle will be

(A) $\sqrt{5}$ units   (B) $\sqrt{7}$ units   (C) 4 units   (D) 5 units

Q.30   If A and B are two skew-symmetric matrices, the matrix $AB + BA$ must be

(A) skew-symmetric   (B) symmetric
(C) invertible   (D) NOT invertible

SECTION - B

MULTIPLE SELECT QUESTIONS (MSQ)

Q. 1 – Q. 10 carry two marks each.

Q.1   In a large wild flower population, assume that no new mutations occur and that no natural selection operates. What factor(s) will affect the frequency of a genotype in this population?

(A) Non-random mating
(B) Gene flow
(C) Out-breeding within the population
(D) Invasion of a new pathogen that kills a large number of individuals in the population

Q.2   What is (are) the difference(s) between microtubules and microfilaments?

(A) Microtubules are made up of tubulin and microfilaments are made up of intermediate filaments
(B) Microtubules are important for compression resistance and microfilaments bear tension
(C) Microtubules are important for the functions of cilia and flagella and the microfilaments are important for cytoplasmic streaming
(D) Microtubules – muscle contraction; microfilaments – ciliary movement

Q.3   N and N_0 represent the number of viable cells at time 't' during sterilization and at the start of sterilization (t=0), respectively. Assuming that cell death follows first order kinetics and that k is the death rate constant, which of the following relationship(s) is/are correct?

(A) $N = N_0 e^{kt}$ (B) $-\ln (N/N_0) = k\,t$ (C) $N = N_0\,k\,t^2$ (D) $N - N_0 = k\,t$

Q.4   Which of the following statements about antigen-antibody (Ag-Ab) complexes is (are) **TRUE**?

(A) Hydrogen bonds and van der Waals forces participate in Ag-Ab interactions
(B) Ionic bonds and hydrophobic bonds participate in Ag-Ab interactions
(C) The combined strengths of all interactions between a single antigen binding site on an antibody and a single epitope is called avidity
(D) Antibody elicited by one antigen can cross react with an unrelated antigen

Q.5   The superoxide ion, O_2^-, is produced by the reaction $K+O_2 \rightarrow KO_2$. The correct statement(s) pertaining to oxygen and superoxide ion is (are):

(A) oxygen is paramagnetic and has two unpaired electrons
(B) the bond order in oxygen is 2
(C) the bond order in superoxide is 1.5
(D) the superoxide ion is not paramagnetic

Q.6   Among the following compounds, which of these will show two singlets in their ^{1}H-NMR spectrum?

(A) 1,4-Dichlorobenzene   (B) 1,2-Dichlorobenzene
(C) Dimethoxymethane   (D) Methylacetate

Q.7   Among the following pairs of co-ordination compounds, the pair(s) which represent(s) a case of "ionization isomerism" is (are):

(A) $[Pt(en)_2Cl_2]Br_2$ and $[Pt(en)_2Br_2]Cl_2$

(B) $[Cr(NH_3)_4ClBr]NO_2$ and $[Cr(NH_3)_4ClNO_2]Br$

(C) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$

(D) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5 SO_4]Br$

Q.8   The "strong nuclear force" holds the protons and neutrons (nucleons) together in the nucleus of an atom. It is found that the binding energy per nucleon (for the nucleus of an element) when plotted against the mass number (A) of that element changes very little for $30 < A < 150$. The binding energy is lower for $A \ll 30$ or $A \gg 150$. This leads us to conclude that

(A)   the strong nuclear force must oscillate with distance with a periodicity approximately same as the size of a proton or neutron
(B)   the fusion of two elements, both with $A \ll 30$ or fission of an element $A \gg 150$ may release energy
(C)   the strong nuclear force changes very slowly with distance (i.e. It is long ranged on the scale of the size of nucleus)
(D)   the strong nuclear force goes to zero very rapidly with distance (i.e. It is short ranged on the scale of the size of nucleus)

Q.9   Let $\vec{a}$ and $\vec{b}$ be two non-zero vectors such that $|\vec{a} + \vec{b}| = |\vec{a} - \vec{b}|$. Then

(A) $\vec{a}$ and $\vec{b}$ are parallel to each other   (B) $\vec{a}$ and $\vec{b}$ are perpendicular to each other
(C) $\vec{a}$ is NOT a scalar multiple of $\vec{b}$ (D) $\vec{a} \times \vec{b} = \vec{0}$

Q.10   Let $\mathbb{N}$ be the set of all natural numbers. Consider the relation R on $\mathbb{N}$ given by
$R = \{(m,n) : m - n \text{ is divisible by } 2\}$. Then

(A) R is symmetric and transitive   (B) R is symmetric but NOT transitive
(C) R is reflexive but NOT symmetric   (D) R is reflexive and transitive

SECTION – C

NUMERICAL ANSWER TYPE (NAT)

Q. 1 – Q. 10 carry one mark each.

Q.1   The pH of a 0.1 M solution of monosodium succinate ($pKa_1 = 4.19$ and $pKa_2 = 5.57$) is _____

Q.2   The deactivation rate constant of an enzyme is 0.346 h^{-1}. Assuming that the deactivation process follows first order kinetics, the half life of the enzyme in minutes is _____

Q.3   An enzyme preparation containing 10 mg/ml protein shows a specific activity of 50 U/mg. The initial velocity of reaction in a standard 1 ml reaction mixture containing 10 µl of the preparation in $\mu mol.ml^{-1}.min^{-1}$ is _____

Q.4   The number of peaks in the ^{13}C-NMR spectrum of $CDCl_3$ is _____

Q.5   The number of phosphorous-hydrogen bonds in H_3PO_2 is _____

Q.6   A man weighing 70 kg stands on a weighing scale which is placed in an elevator. The elevator is moving up towards its destination floor with a velocity of $1.0 \ ms^{-1}$. As it approaches the destination floor it starts slowing down, such that it comes to rest in 2 seconds. Assuming the acceleration due to gravity, $g = 9.8 \ ms^{-2}$, the reading of the weighing scale just *before* the elevator comes to rest is _____

Q.7   A 50-metre tall antenna transmits at 107 MHz (one of the FM radio broadcast frequencies). Calculate the maximum distance from the antenna at which the transmitted signal can be heard. Ignore atmospheric attenuation and give your answer correct to the nearest kilometer only. You are given that the radius of the earth is 6400 km.

Q.8   The total number of mappings from the set $\{1,2\}$ to the set $\{3,4,5,6,7\}$ is _____

Q.9   The value of the complex number $(1+i)^{150} + (1-i)^{150}$ is _____

Q.10   Let the function $f : \mathbb{R} \to \mathbb{R}$ be defined by

$$f(x) = \begin{cases} \dfrac{\tan x}{x} & \text{if } x \neq 0; \\ k & \text{if } x = 0. \end{cases}$$

If f is continuous at $x = 0$, then the value of k must be equal to _____

Q. 11 – Q. 20 carry two marks each.

Q.11   Assume that the gene *UNC* is essential for the coordinated movement of a nematode and that the wild-type allele *U* is dominant over the mutant allele *u*. Similarly, the wild-type allele *D* of another gene *DPY*, which is responsible for the normal body length, is dominant over the mutant allele *d*. Assume the *UNC* and *DPY* are on two different chromosomes. If a female of genotype *UUDD* mates with a male of the genotype *uudd*, the percentage of the F2 progeny that will display uncoordinated movement but will have normal body length is _____

Q.12   The pH of gastric juice in the stomach is 2.0. However the pH inside the cells that line the stomach is 7.0. For transport of protons from inside the cell to the stomach, the free energy change (ΔG) in $kJmol^{-1}$ at $37^{\circ}C$ is _____
       [Assume Universal Gas constant R = 8.314 $Jmol^{-1}K^{-1}$]

Q.13   A solution containing NAD^+ and NADH has an optical density of 0.233 at 340 nm and 1.000 at 260 nm. While this solution absorbs at 260 nm, NADH alone absorbs at 340 nm. All measurements are carried out in a 1-cm cuvette. Given the extinction coefficients (ε) (see the table below), the concentration of the oxidized form of the cofactor in µM is _____

Compound	ε $(M^{-1} cm^{-1})$	
	260 nm	340 nm
NAD^+	18000	0
NADH	15000	6220

Q.14   *Drosophila melanogaster* is a diploid organism having 8 chromosomes. The number of combinations of chromosomes which are possible in its gametes is _____

Q.15   The number of equatorial hydrogens in the following structure is _____
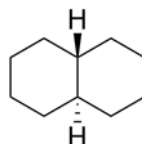
Q.16   The axis of rotation of the earth makes an angle of 66.5° with the plane containing the Earth's orbit around the Sun (called the plane of the ecliptic). If this angle were 50°, then the area of the Earth's surface from which a "midnight Sun" (24 hour daylight) can be observed would change. The ratio of the new area to the previous area is _____

Q.17   A nuclear power plant generates 1000 Megawatts (MW) of electrical power and used half of its fuel supply in 5 years. The reactor uses ^{235}U with 33% efficiency for the conversion of heat released by nuclear fission to electrical power. Each atom of ^{235}U releases 200 MeV of energy. How many tons of ^{235}U did the reactor start with? (1 ton = 1000 kg; Avogadro number = 6.023×10^{23} mol^{-1})

Q.18   A bat emitting ultrasound at 50 kHz is flying directly towards a solid wall with a speed of 3 ms^{-1}. If the speed of sound in air is 330 ms^{-1}, the frequency of the reflected signal (in kHz) heard by the bat will be _____

Q.19   A circle is given by the equation $2x^2 + 2y^2 + 8x - 20y + 10 = 0$. The area of a square whose side equals the radius of the circle is _____

Q.20   The value of the integral $\int_0^\pi |\cos x| \, dx$ is _____

END OF THE QUESTION PAPER

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Answer Keys are given below for all Codes of this subject paper. Please Scroll Down

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JAM 2015

Answer Keys for the Test Paper: Biotechnology (BT)

Section A - MCQ Multiple Choice Questions			Section B - MSQ Multiple Select Questions			Section C - NAT Numerical Answer Type Questions		
Q. No.	Key	Marks	Q. No.	Key	Marks	Q. No.	Range	Marks
1	X	1	1	A;B;C;D	2	1	4.80 to 4.90	1
2	C	1	2	B;C	2	2	119.8 to 120.2	1
3	C	1	3	B	2	3	5.0 to 5.0	1
4	D	1	4	A;B;D	2	4	3.0 to 3.0	1
5	D	1	5	A;B;C	2	5	2.0 to 2.0	1
6	B	1	6	C;D	2	6	66.0 to 67.0	1
7	A	1	7	A;B;D	2	7	25 to 26	1
8	C	1	8	B;D	2	8	25 to 25	1
9	A or D	1	9	B;C	2	9	0 to 0	1
10	B	1	10	A;D	2	10	1 to 1	1
11	B	2				11	18 to 19	2
12	A	2				12	29.0 to 30.0	2
13	A	2				13	24.0 to 25.0	2
14	B	2				14	16.0 to 16.0	2
15	A	2				15	8.0 to 8.0	2
16	B	2				16	2.5 to 3.0	2
17	B	2				17	11.5 to 12.5	2
18	C	2				18	50.75 to 51.25	2
19	C	2				19	24.0 to 24.0	2
20	A	2				20	2.0 to 2.0	2
21	B	2						
22	B	2						
23	B	2						
24	C	2						
25	B	2						
26	D	2						
27	X	2						
28	A	2						
29	B	2						
30	B	2						

Note: 'X' means 'Marks to All'.