2013 – BT

QUESTION BOOKLET CODE | A |

Test Paper Code : BT

Time : 3 Hours

Maximum Marks : 100

INSTRUCTIONS

A. General :

1. This Booklet is your Question Paper. It contains **28** pages and has 100 questions.
2. The Question Booklet **Code** is printed on the right-hand top corner of this page.
3. The Question Booklet contains blank spaces for your rough work. No additional sheets will be provided for rough work.
4. **Clip board, log tables, slide rule, cellular phone and electronic gadgets in any form are NOT allowed. Non Programmable Calculator is allowed.**
5. Write your **Name** and **Registration Number** in the space provided at the bottom.
6. All answers are to be marked only on the machine gradable Objective Response Sheet **(ORS)** provided along with this booklet, as per the instructions therein.
7. The Question Booklet along with the Objective Response Sheet **(ORS)** must be handed over to the Invigilator before leaving the examination hall.

B. Filling-in the ORS :

8. Write your Registration Number in the boxes provided on the **ORS** and darken the appropriate bubble under each digit of your Registration Number using a **black ink ball point pen.**
9. Ensure that the **code** on the **Question Booklet** and the **code** on the **ORS** are the same. If the codes do not match, report to the Invigilator immediately.
10. On the **ORS**, write your Name, Registration Number, Name of the Test Centre and put your signature in the appropriate box with ball-point pen. Do not write these anywhere else.

C. Marking of Answers on the ORS :

11. Each question has **4 choices** for its answer : (A), (B), (C) and (D). Only **ONE** of them is the correct answer.
12. On the right-hand-side of **ORS**, for each question number, darken with a **black ink ball point pen** ONLY one bubble corresponding to what you consider to be the most appropriate answer, from among the four choices.
13. There will be **negative marking** for wrong answers.

MARKING SCHEME :

(a) For each correct answer, you will be awarded **1 (One)** mark.

(b) For each wrong answer, you will be awarded **-1/3 (Negative 1/3)** mark.

(c) Multiple answers to a question will be treated as a wrong answer.

(d) For each un-attempted question, you will be awarded **0 (Zero)** mark.

Name							
Registration Number							

A

Q.1 Continuous culture technique at steady state (chemostat) is useful in isolating bacteria from a mixed culture. It exploits the differences in their

(A) maintenance requirements
(B) specific growth rates
(C) rates of specific product formation
(D) endogenous metabolism

Q.2 Biofilm observed in the lungs of cystic fibrosis patients is composed of

(A) polysaccharides
(B) polylactic acid
(C) polypeptides
(D) polyethylene glycol

Q.3 Match the pathogens listed in Column I with the diseases listed in Column II

Column I	Column II
P. Rotavirus	1. Food poisoning
Q. Leishmania	2. Diarrhea
R. *Salmonella* Typhimurium	3. Kala azar
S. Epstein-Barr Virus	4. Typhus fever
	5. Glandular fever

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

Q.4 The time required for an *E. coli* to divide is less than the time required to replicate its chromosome. This is possible because

(A) of an abundance of enzymes required for replication
(B) it linearizes the chromosome and replicates from both ends
(C) only one daughter cell receives the nuclear material
(D) of multiple replication forks

Q.5 A bacterial population contains a mixture of wild type and leucine auxotrophs. From this mixture, the leucine auxotrophs can be enriched by growing the mixture in minimal medium supplemented with

(A) leucine
(B) penicillin
(C) leucine and penicillin
(D) chloramphenicol

Q.6 Gram positive bacteria are more rigid than Gram negative bacteria because of the

(A) presence of multiple layers of peptidoglycan

(B) lack of D-amino acids in their cell wall

(C) presence of N-acetylgalactosamine in the peptidoglycan backbone

(D) presence of lipopolysaccharide

Q.7 *Helicobacter pylori* can survive in the highly acidic environment of human stomach because it

(A) creates an alkaline microenvironment around itself by urease action

(B) rapidly invades the stomach cells and escapes the acidic environment

(C) is capsulated and hence, is protected from acidic stress

(D) undergoes sporulation for self protection

Q.8 The waxy surface of dental plaques does not allow oxygen to diffuse readily. A sample of dental plaque was inoculated into a rich medium and incubated at 37°C with vigorous shaking. However, there was no bacterial growth. The absence of growth was attributed to the following reasons :

P: These bacteria are obligate anaerobes

Q: These bacteria require highly alkaline medium for growth

R: These bacteria require a very hard surface, such as that of teeth, to grow.

Which of these three reasons are likely to be correct?

(A) Only **P** (B) Both **P** and **Q**

(C) Both **Q** and **R** (D) Both **P** and **R**

Q.9 Cellulases and hemicellulases are in great demand nowadays for the preparation of second-generation

(A) biodiesel (B) bioplastics (C) bioethanol (D) antibiotics

Q.10 Marine microalgae are very important due to their potential industrial significance as single cell oil. These can be used for which of the following?

P: Biofuel production

Q: Recombinant insulin production

R: Atmospheric carbon dioxide sequestration

S: Antibody production

T: Poly-unsaturated fatty acid production

(A) Only **P**, **R** and **T**

(B) **Q** and **S**, but not **T**

(C) Only **Q**, **R** and **S**

(D) **P** and **Q**, but not **S**

Q.11 Match the enzymes in Column I with their commercial applications in Column II

Column I		Column II	
P.	Alkaline protease	1.	Production of biodiesel
Q.	Asparaginase	2.	Biosensor
R.	Immobilized aminoacylase	3.	High fructose corn syrup production
S.	Lipase	4.	Detergent formulation
T.	Immobilized glucose oxidase	5.	Resolution of DL amino acids and drugs
		6.	Treatment of lymphocytic leukemia

(A) P-4, Q-6, R-5, S-1, T-2

(B) P-6, Q-5, R-4, S-2, T-1

(C) P-3, Q-1, R-6, S-5, T-4

(D) P-4, Q-5, R-1, S-3, T-6

Q.12 A monoclonal antibody (mAb) against a specific cell surface receptor was generated. This was expected to block the receptor function. However, it led to activation instead of blocking. This is due to

(A) cross-linking of the receptors by mAb resulting in receptor activation

(B) binding of the Fab fragment to the cytoplasmic domain of the receptor

(C) binding of the Fc portion to the receptor giving activation signal

(D) the internalization of the mAb by the cell leading to activation

Q.13 Pfu polymerase has

(A) proofreading activity
(B) exonuclease activity
(C) false priming activity
(D) RNA polymerase activity

Q.14 Match the biotech products listed in Column I with the applications in Column II

Column I	Column II
P. Polyhydroxy alkanoates (PHA)	1. Size exclusion chromatography
Q. Biosurfactants / bioemulsifiers	2. Nutraceuticals / functional foods
R. 6-Aminopenicillanic acid (6–APA)	3. Human therapy and diagnostics
S. Docosahexanoic acid (DHA)	4. Bioplastics
T. Dextran	5. Precursor for β-lactam antibiotics
	6. Microbial enhanced oil recovery

(A) P-2, Q-4, R-6, S-3, T-1
(B) P-4, Q-6, R-5, S-2, T-1
(C) P-5, Q-1, R-4, S-6, T-3
(D) P-4, Q-5, R-1, S-3, T-6

Q.15 Match the materials listed in Column I with the techniques/purpose listed in Column II.

Column I	Column II
P. Phenyl agarose	1. Antifoaming agent
Q. Ni–NTA matrix	2. Polymerase chain reaction
R. TEMED	3. Hydrophobic interaction chromatography
S. Silicone oil	4. Gel electrophoresis for proteins
	5. Affinity chromatography

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

Q.16 Determine the correctness or otherwise of the following **Assertion [a]** and **Reason [r]** :

Assertion [a]: HeLa cells, derived from cervical cancer tissue, and fibroblasts from a normal human male CANNOT divide indefinitely in cell culture.

Reason [r]: Cells undergo senescence (i.e., ageing) even when grown in cell culture

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

Q.17 A human gene was PCR amplified from a cDNA library, cloned into an expression vector and transformed into *E. coli*. However, the expression of this gene was poor. This is probably because of

(A) the presence of introns
(B) the modifications of the mRNA that are unique to eukaryotes
(C) the incompatibility of the mRNA with *E. coli* ribosome
(D) a shortage of tRNAs for certain codons used in the human gene

Q.18 A student wanted to clone a gene G (size ~1.6 kb) in a vector V (size ~5 kb). The vector has sites for restriction enzymes RE1, RE2 and RE3 in its multiple cloning site. The site for RE2 is located in between the sites for RE1 and RE3.

The student carried out the following steps for cloning :

Step 1. Cut the gene G with restriction enzymes RE1 and RE3.
Step 2. Cut the vector V with restriction enzymes RE1 and RE3.
Step 3. Ligated G and V from Steps 1 and 2, transformed into *E. coli* and isolated plasmid L from the transformants.

The plasmid L was cut with RE2, which gave a band of size ~6.6 kb.

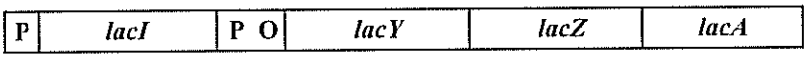
The following three reasons were given to explain this observation :

P: Plasmid L is same as the vector V, since *E. coli* got transformed only with uncut V.
Q: Gene G has a site for RE2.
R: RE1 and RE2 are isoschizomers.

Which of the above three reasons are possible?

(A) **P** alone, neither **Q** nor **R**
(B) **R** alone, neither **P** nor **Q**
(C) Either **Q** or **R**, but not **P**
(D) **Q** alone, neither **P** nor **R**

Q.19 The following is a schematic of the *lac* operon :



Which one of the following statements is correct?

(A) *lacI*, being part of the operon, is a structural gene
(B) P, being farthest from *lacA*, is trans-acting
(C) *lacZ* is a structural gene and it codes for an enzyme
(D) *lacI* is cis-acting, but the protein encoded by it is trans-acting

Q.20 Mammalian cells in the S phase can be monitored by incorporating which one of the following in the cell culture medium?

(A) ^{35}S Methionine
(B) ^{32}P-ATP
(C) ^{3}[H] Thymine
(D) ^{3}[H] Thymidine

Q.21 The following experiment was performed with a double stranded DNA sample S of size 1 kb:
Step 1: The two strands were separated
Step 2: The separated strands were annealed
Step 3: Treated the double stranded DNA from Step 2 with 3'→5' exonuclease
From agarose gel electrophoresis, it was found that the DNA from Step 3 is less than 1 kb. The most probable reason for not getting a 1 kb DNA in Step 3 is that the DNA in sample S
(A) is palindromic
(B) has sequence repeats
(C) has sequence inversion
(D) has strands, each of which has self-complementary sequence

Q.22 A batch of students studied the effect of changing either phospholipid composition or temperature on the transport of solutes across liposomal membranes. From these studies, the students arrived at the following conclusions:
P: Increase in the saturation of hydrocarbon chains led to an increase in the rate of diffusion of oxygen
Q: Decreasing the temperature to 5°C led to a decrease in the rate of potassium transport by valinomycin (a carrier ionophore)
R: Increase in the hydrocarbon chain length did not have any effect on the transport mediated by gramicidin (a channel ionophore)
Which of these conclusion(s) is/are **NOT** correct?
(A) Only **R** (B) Only **Q** and **R** (C) Only **P** (D) Only **P** and **Q**

Q.23 Circular DNA of a bacterium was allowed to replicate once. In this experiment, some of the nucleotides were fluorescently labeled. The primase was able to accept the labeled as well as the unlabeled nucleotides. However, the DNA polymerase could use only the unlabeled nucleotides. The fluorescent label is found in
(A) both the template and newly made strands (B) only the newly made strand
(C) only the template strand (D) neither of the two strands

Q.24 Consider the following metabolic pathway found in bacteria :

$$S \xrightarrow{E1} I1 \xrightarrow{E2} I2 \xrightarrow{E3} P$$

E1, E2 and E3 are enzymes which catalyze different steps of the pathway as indicated above.
There are three classes of mutants:
Class I – has defective E1, hence requires I1 in the medium to grow
Class II – has defective E2, hence requires I2 in the medium to grow
Class III – has defective E3, hence requires P in the medium to grow
Wild type grows in the minimal medium.
We mix Class I, II and III mutants and allow this mixture to grow in minimal medium. Suppose we observe growth because of revertants, then reversion has to be in
(A) All three Classes (B) Only Class I
(C) Only Class III (D) Any of the three classes

Q.25 The stain DAPI (4', 6-diamido-2-phenylindole) is used for total cell count because it reacts with

(A) Lipid bilayer
(B) RNA
(C) Membrane proteins
(D) DNA

Q.26 Which one of the following statements about cytoskeletal proteins is NOT TRUE?

(A) They give shape to the cell
(B) They are non-essential proteins
(C) They help in cell division
(D) They help in cell motility

Q.27 DNA was isolated from three samples of normal human cells. In each of these samples, cells were at different stages of cell division.
Sample 1: Cells were in G2 phase.
Sample 2: Cells were in anaphase.
Sample 3: Cells were in telophase.
DNA isolated from which of these samples conforms to Chargaff's rules?

(A) Only Samples 1 and 2
(B) Only Samples 1 and 3
(C) Only Samples 2 and 3
(D) Samples 1, 2 and 3

Q.28 Which of the following features are shared by mitochondria and chloroplasts?

P: The energy transducing membrane is highly invaginated.
Q: Stroma of chloroplast and matrix of mitochondria are alkaline.
R: Their number per cell is variable.

(A) Only **P** and **Q** (B) Only **P** and **R** (C) Only **Q** and **R** (D) **P**, **Q** and **R**

Q.29 Cilia and flagella are locomotor appendages found on some cells. A flagellum has an undulatory (i.e., snake-like) motion. A cilium has a back-and-forth (i.e., rocking chair-like) motion.
The following statements relate the direction of movement of a cell to the axis of flagellum / cilium that drives its motion :

P: The cell moves along a direction perpendicular to the axis of the flagellum
Q: The cell moves along a direction parallel to the axis of the cilium

(A) Both **P** and **Q** are correct
(B) Only **P** is correct
(C) Neither **P** nor **Q** is correct
(D) Only **Q** is correct

Q.30 Listed below are some classes of enzymes :

P: Exoproteases
Q: Glycosidases
R: Glycosyltransferase
S: Lipid transferases

Which of the above are associated with post-translational modification of proteins?

(A) All four classes
(B) Only **Q**, **R** and **S**
(C) Only **Q** and **R**
(D) Only **R** and **S**

Q.31 Cell A is in S phase of cell division. Cell B is in G_1 phase of cell division. If cell A and cell B were to be fused then the nucleus of the cell B in the heterokaryon

(A) continues to be in the G_1 phase
(B) enters the S phase
(C) enters the M phase
(D) enters the G_2 phase

Q.32 For a single-enzyme-single-substrate reaction, the half-life of the enzyme can be calculated using the following expression, wherein k is the first order rate constant or deactivation constant

(A) $\frac{693}{k}$ (B) $\frac{2.3\log 2}{k}$ (C) $\frac{69.3}{k}$ (D) $\frac{2.3\ln 2}{k}$

Q.33 The transmittance of a solution containing 10^{-5} M ATP is 0.75 (75%) at 260 nm in a 1 cm path length cuvette. According to Beer - Lambert law the absorbance is

(A) 0.750 (B) 0.155 (C) 0.125 (D) 0.250

Q.34 Which one of the following is applicable to an enzyme catalyzed reaction that follows zero order kinetics as per the Michaelis-Menten model?

(A) $[S] >> K_m$ and $V = \frac{V_{max}}{K_m}[S]$
(B) $[S] = K_m$ and $V = \frac{1}{2}V_{max}$
(C) $[S] << K_m$ and $V = \frac{V_{max}}{K_m}[S]$
(D) $[S] >> K_m$ and $V = V_{max}$

Q.35 The free energy change, under standard conditions, upon hydrolysis of a "high-energy bond" is large and negative.

ATP, phosphocreatine, phosphoenolpyruvate and acetyl coenzyme A are examples of molecules that contain such "high-energy bonds". Which of the following are high-energy bonds present in these molecules?

P: N–P
Q: C–S
R: P–O

(A) Only **R** (B) Only **P** and **R** (C) Only **P** and **Q** (D) **P**, **Q** and **R**

Q.36 Secretory IgA (sIgA) can exist in a protease rich mucosal environment because

(A) the secretory component masks the sites susceptible to proteases
(B) the action of proteases is neutralized by sIgA
(C) sIgA is secreted in vesicles and hence protected from proteases
(D) the J chain masks the protease-susceptible sites

Q.37 Suppose that the surface area of an erythrocyte is 167 μm^2. Also, suppose that the membrane of this erythrocyte contains 4.15×10^{-16} mol of phospholipid and 3.1×10^{-16} mol of cholesterol.
The cross-sectional area of a phospholipid molecule is 0.7 nm^2 and that of a cholesterol molecule is 0.38 nm^2.
Phospholipid and cholesterol isolated from this membrane were spread into a monolayer. The ratio of the area of this monolayer to that of the erythrocyte is approximately
(A) 0.5 (B) 1.0 (C) 1.5 (D) 2.0

Q.38 For the Na^+-mediated active transport of a molecule of glutamic acid from a concentration of 0.1 mM outside the cell to 20 mM inside the cell, calculate the minimum number of Na^+ ions required to supply the necessary free energy.
Use T = 37°C, pH = 7, $\Delta\Psi = -70$ mV and F = 23062 cal/mol.V.
ΔG released for the transport of one Na^+ is 3.3 kcal/mol. Glutamic acid carries a net charge of −1 at pH 7.
(A) 4 (B) 10 (C) 2 (D) 1

Q.39 NAD and NADP are two important cellular electron carriers.NAD is generally associated with catabolic reactions and NADP with anabolic reactions. A cell will have a fixed number of NAD molecules and a fixed number of NADP molecules. In a normal cell most of the
(A) NAD and NADP molecules will be in the reduced state
(B) NAD molecules will be in the reduced state whereas most of the NADP molecules will be in the oxidized state
(C) NADP molecules will be in the reduced state whereas most of the NAD molecules will be in the oxidized state
(D) NAD and NADP molecules will be in the oxidized state

Q.40 An animal's body plan has evolved over millions of years to suit its functions.
Given below are a few types of epithelia that line various organ systems:
P: Simple squamous epithelia that are thin and leaky
Q: Stratified squamous epithelia that can regenerate rapidly
R: Pseudostratified ciliated columnar epithelia that forms a mucous membrane
S: Cuboidal epithelia specialized for secretion
Which one of the following four options is correct?
(A) The digestive system has **Q**, but not **S**
(B) The respiratory system has **Q** and **R**, but not **S**
(C) The circulatory system has **P** as well as **R**
(D) Both excretory and endocrine systems have **S**

Q.41 Which one of the following four statements is TRUE regarding nitrogen fixation by bacteria?

(A) Nitrogen fixation is primarily an oxidation process requiring continuous supply of electron acceptors

(B) Molybdenum accepts, but cannot donate, electrons within nitrogenase

(C) Symbiotic nitrogen fixers have a respiratory mechanism for protecting nitrogenase

(D) Nitrogen fixation is inhibited in some bacteria due to depletion of carbon source

Q.42 The disciplines of evolutionary biology and ecology are closely linked to each other. The environment plays a major role in determining the prevailing flora and fauna. Given below are four statements showing this relationship :

P: Malaria is quite prevalent in African arid zones

Q: Plants with spiny leaves are commonly found in the tropical rainforests of Borneo

R: Halophiles are more prevalent at the bottom, as compared to the surface, of an estuary

S: Lions are rarely found in African grassland savanna

Which one of the following four options is correct?

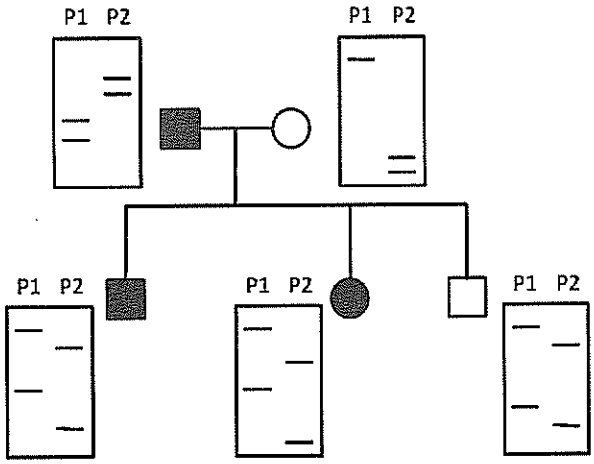
(A) **R** is true, but **P** is false

(B) **R** and **S** are true, but **Q** is false

(C) **P** and **Q** are true, but **S** is false

(D) **P** and **R** are false.

Q.43 The pedigree of a family affected by a certain genetic disorder is shown below. Microsatellite markers from these individuals were PCR amplified, separated by gel electrophoresis and detected by two probes P1 and P2. Probe P1 is for marker M1 and probe P2 is for marker M2. The resulting band patterns are shown along with the pedigree diagram.



From this data, it can be concluded that the

(A) father is homozygous at both the markers

(B) mother is heterozygous at both the markers

(C) trait is linked only to the marker M1

(D) trait is linked to both the markers

Q.44 Which of the following statements is NOT CORRECT?
(A) SDS-PAGE separates proteins based on molecular weight
(B) Gel filtration chromatography can be used to determine the molecular weight of a protein
(C) Ion exchange chromatography separates proteins based on their size
(D) Membrane dialysis is commonly used for desalting

Q.45 The radius of first "Bohr's stationary orbit" for hydrogen atom is 0.53 Å. The radius of the second orbit is
(A) 1.06 Å (B) 1.59 Å (C) 2.12 Å (D) 4.24 Å

Q.46 Calculate the wavelength of the alpha particle, if its mass = 6.6×10^{-27} kg and velocity = 2×10^{7} m/s. Assume Planck's constant h = 6.6×10^{-34} J s.
(A) 5.0×10^{-12} m (B) 5.0×10^{-13} m (C) 5.0×10^{-14} m (D) 5.0×10^{-15} m

Q.47 Among Mg^{2+}, Al^{3+}, F^{-} and O^{2-}, the ions with the lowest and highest ionic radii, respectively, are
(A) Al^{3+} and O^{2-} (B) Mg^{2+} and Al^{3+} (C) F^{-} and Al^{3+} (D) F^{-} and O^{2-}

Q.48 The molecule that shows paramagnetism is
(A) F_2 (B) N_2 (C) B_2 (D) C_2

Q.49 The pair which is isoelectronic is
(A) CN^{-} and NO (B) CN^{-} and CO (C) NO and CO (D) CN^{-} and O_2^{-}

Q.50 Complexes of Gd^{3+} are used in magnetic resonance imaging. The number of unpaired electrons in this ion is
(A) 1 (B) 3 (C) 5 (D) 7

Q.51 Porphyrin in iron-porphyrin is
(A) bidentate (B) tetradentate (C) pentadentate (D) hexadentate

Q.52 For the gaseous reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, the expression for the equilibrium constant Kp in terms of the degree of dissociation n and pressure P is
(A) $\frac{n}{1-n^2}$ (B) $\frac{n^2P}{1-n}$ (C) $\frac{nP^2}{1-n^2}$ (D) $\frac{n^2P}{1-n^2}$

Q.53 Heat capacity at constant volume C_v for a monoatomic perfect gas is
(A) $\frac{1}{2}R$ (B) R (C) $\frac{3}{2}R$ (D) $\frac{5}{2}R$

A

Q.54 $N_2 + 3H_2 \rightleftharpoons 2NH_3$ $\Delta H° = -3000$ J

What happens when, under equilibrium conditions, temperature is decreased (Case I) or hydrogen is added (Case II)?

(A) Ammonia production increases in both the cases
(B) Ammonia production decreases in both the cases
(C) Ammonia production increases in Case I and ammonia dissociation increases in Case II
(D) Ammonia dissociation increases in Case I and ammonia production increases in Case II

Q.55 Ruby consists of low concentration of Cr^{3+} ions in place of Al^{3+} in alumina. Its red color is due to

(A) fluoroscence
(B) phosphorescence
(C) radioactive decay
(D) chemiluminescence

Q.56 The acid dissociation constant of a weak acid HA is 1.0×10^{-5}. The pH of 0.1M solution of HA is

(A) 5.0 (B) 4.0 (C) 3.0 (D) 7.0

Q.57 Standard redox potentials E° for three different redox reactions are given below:

$Fe^{3+} + e \rightleftharpoons Fe^{2+}$ $E° = +0.77$ V

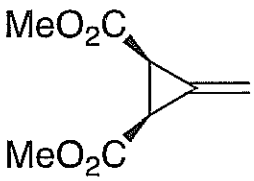
$Cl_2 + 2e \rightleftharpoons 2Cl^-$ $E° = +1.36$ V

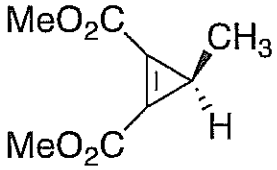
$I_2 + 2e \rightleftharpoons 2I^-$ $E° = +0.53$ V

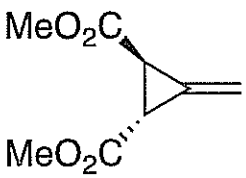
Under standard conditions, Fe^{3+} can oxidize

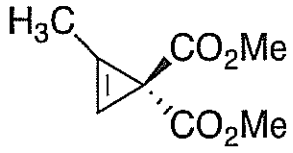
(A) I^- to I_2 but not Cl^- to Cl_2
(B) Cl^- to Cl_2 but not I^- to I_2
(C) Both I^- to I_2 and Cl^- to Cl_2
(D) Neither I^- to I_2 nor Cl^- to Cl_2

Q.58 Which one among the following is the correct structure for an optically active compound with a molecular formula $C_8H_{10}O_4$ showing only three signals in its ^1H NMR spectrum?

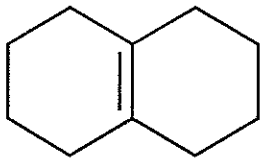
(A) 

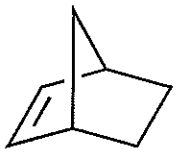
(B) 

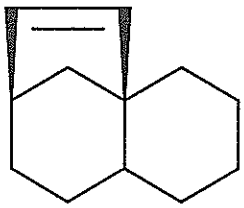
(C) 

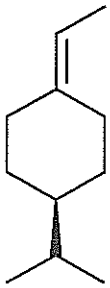
(D) 

Q.59 Which one of the following will give more than one organic compound upon ozonolysis followed by treatment with Ph_3P?

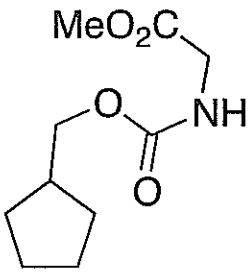
(A) 

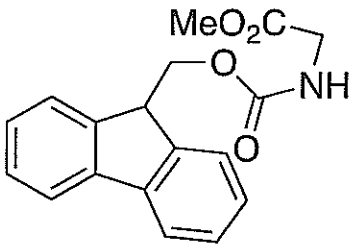
(B) 

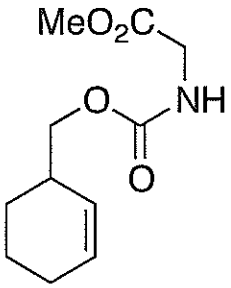
(C) 

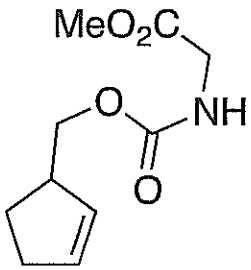
(D) 

Q.60 Identify the compound which will release glycine methyl ester fastest on treatment with piperidine.

(A) 

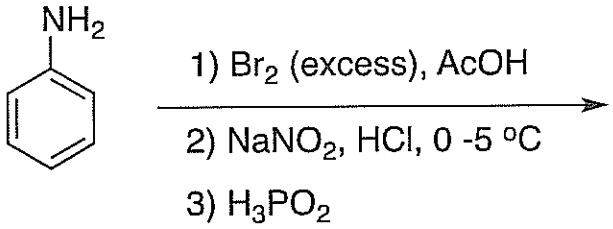
(B) 

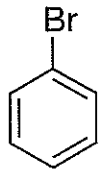
(C) 

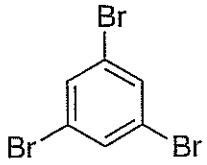
(D) 

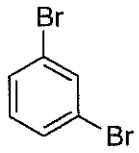
A

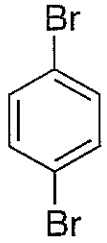
Q.61 Identify the major product formed in the following transformation:



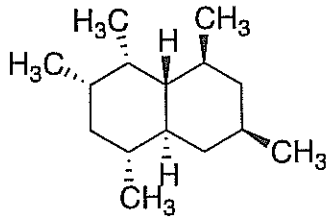
(A) 

(B) 

(C) 

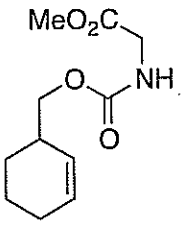
(D) 

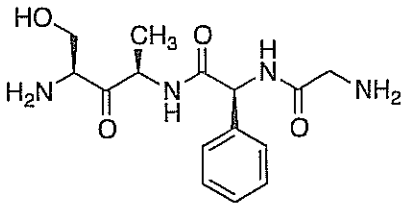
Q.62 How many CH_3 groups are in equatorial position in the most stable conformation of the following molecule?

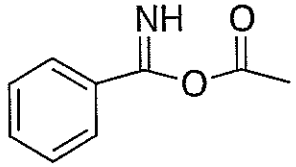


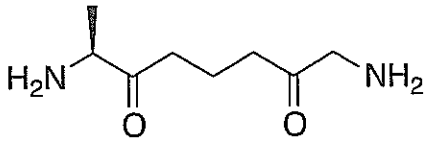
(A) 2 (B) 3 (C) 4 (D) 5

Q.63 Which one of the following compounds has peptide bonds?

(A) 

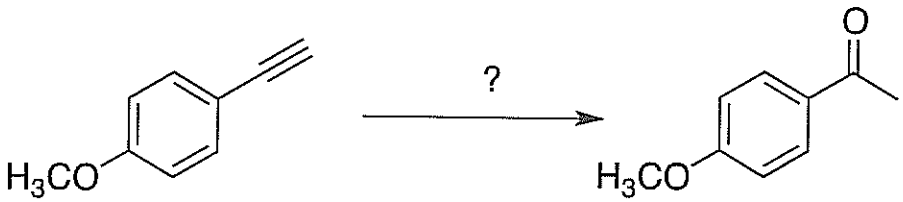
(B) 

(C) 

(D) 

A

Q.64 The condition under which the following transformation is carried out is



(A) (i) B_2H_6 (ii) $NaOH/H_2O_2$ (B) $Hg(OAc)_2$, H_2O

(C) (i) $Hg(OAc)_2$, H_2O (ii) $NaBH_4$, MeOH (D) H_2, Pd-$BaSO_4$

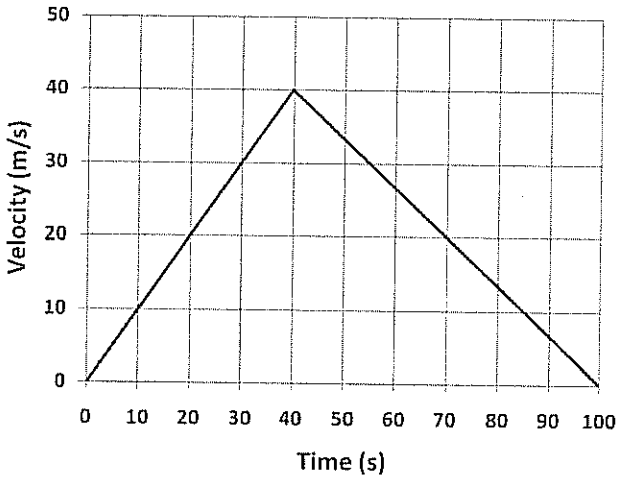
Q.65 Dimension of viscosity is

(A) $ML^{-2}T^{-1}$ (B) $ML^{-1}T^{-1}$ (C) $ML^{-1}T^{-2}$ (D) $ML^{-1}T$

Q.66 Consider a spherical organism of volume 1 μm^3. Assume that the organism consists of only a fluid whose density is that of water. Calculate the gravitational force felt by this organism on the surface of earth. Assume mass of earth$=6\times10^{24}\,kg$, radius of earth$=6\times10^{6}\,m$, density of water $=10^{3}\,kg/m^{3}$ and gravitational constant $G=6\times10^{-11}\,m^{3}/(kg\,s^{2})$

(A) 6×10^{-8} N (B) 10^{-14} N (C) 10^{-2} N (D) 1 N

Q.67 The graph below shows motion of a leopard over a period of 100 s. The total distance covered by the leopard in this period is



(A) 4400 m (B) 4000 m (C) 2000 m (D) 1000 m

A

Q.68 Consider a parallel plate capacitor with capacitance $C_0=(\varepsilon_0 A)/d$, where ε_0 is the permittivity constant, A is the area of each plate and d is the separation between the plates. Suppose a dielectric substance of dielectric constant K is inserted fully between the plates of the capacitor. The new capacitance C after inserting the dielectric is given by

(A) $C=(\varepsilon_0 A)/(Kd)$ (B) $C=(\varepsilon_0 KA)/d$ (C) $C=C_0/K^2$ (D) $C=K^{1/2}C_0$

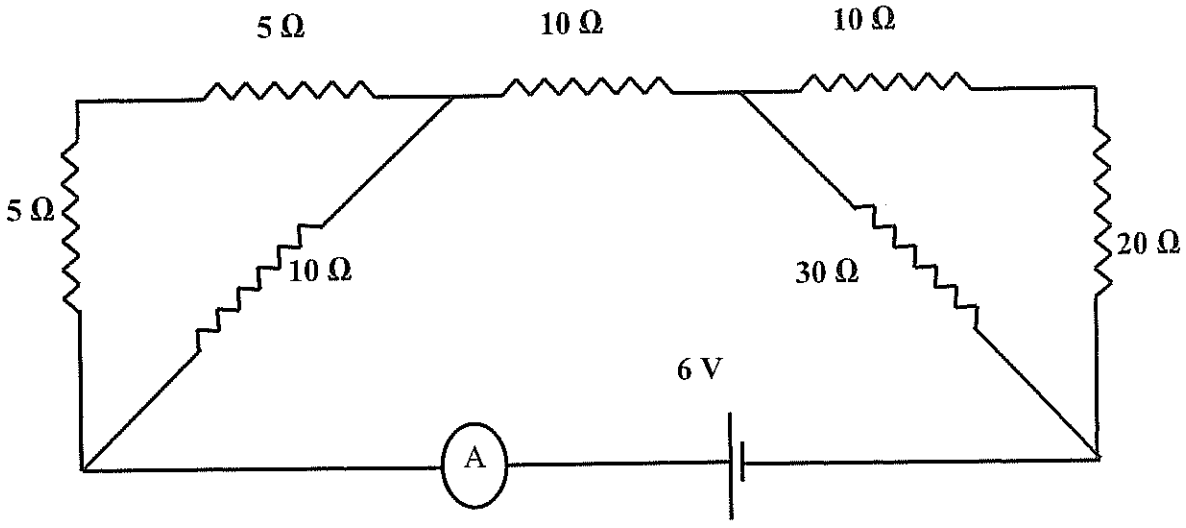
Q.69 A plane electromagnetic wave is travelling along the negative x direction in free space. At a particular point in space and time, the value of $\vec{B}$ is 5×10^{-9} T $\hat{j}$. The value of $\vec{E}$ is equal to

(A) 15 V/m $\hat{j}$ (B) 0.15 V/m $\hat{k}$ (C) 1.5 V/m $\hat{k}$ (D) 0.15 V/m $\hat{i}$

Q.70 Two coherent sources S_1 and S_2 are vibrating in phase. The intensity of each of these sources is I_0. For a path difference of $n\lambda$ (n=0,1,2,...) at any point P, the resultant intensity I is equal to

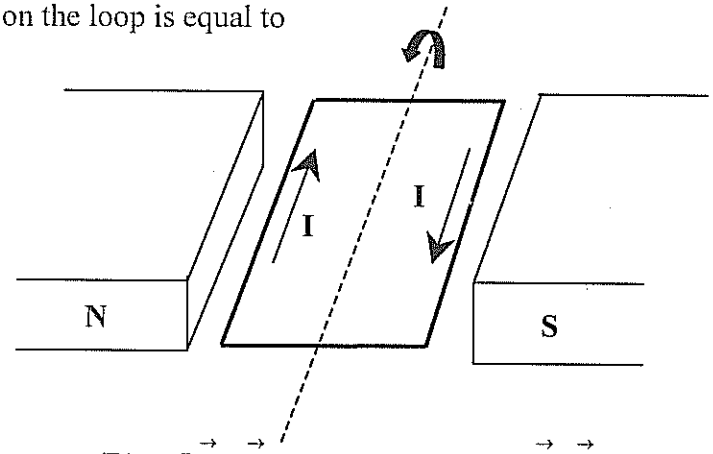
(A) I_0 (B) $2I_0$ (C) $4I_0$ (D) 0

Q.71 In the circuit shown below, the current flowing through the ammeter A is equal to



(A) 2.0 A (B) 0.2 A (C) 1.5 A (D) 36.2 A

Q.72 The figure below shows a rectangular loop of area A having just one turn and carrying a steady current I. The loop is placed in a uniform magnetic field B, and it rotates anti-clockwise. The torque $\vec{\tau}$ acting on the loop is equal to



(A) $I\vec{B}$ (B) $I\vec{A}\times\vec{B}$ (C) $I\vec{A}\bullet\vec{B}$ (D) $I\vec{A}$

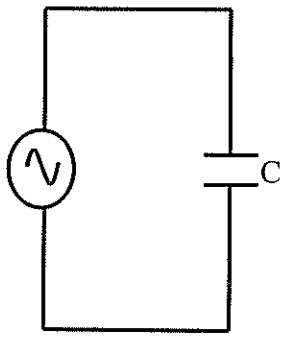
Q.73 In an experiment on photoelectric effect, the frequencies of incident radiations ν_1, ν_2 and ν_3 are such that $\nu_1 < \nu_2 < \nu_3$. The stopping potentials for ν_1, ν_2 and ν_3 are V_1, V_2 and V_3, respectively. Which one of the following is correct about the absolute values of V_1, V_2 and V_3?

(A) $V_1 < V_2 < V_3$ (B) $V_1 = V_2 = V_3$
(C) $V_1 > V_2 > V_3$ (D) $\nu_1 V_1 > \nu_2 V_2 > \nu_3 V_3$

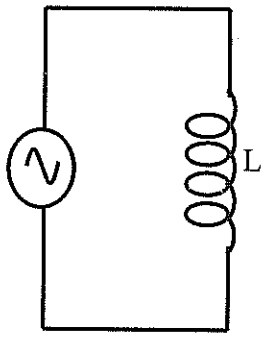
Q.74 Let N_0 be the number of nuclei at time $t=0$ of a radioactive material with half-life $T_{1/2}=\ln 2/\lambda$, where λ is the disintegration constant. The number of radioactive nuclei at time $t=\ln 16/\lambda$ is

(A) $N_0/4$ (B) $N_0/8$ (C) $N_0/16$ (D) $N_0/32$

Q.75 Consider two alternating circuits, circuit A and circuit B, as shown in the following figures.



Circuit A



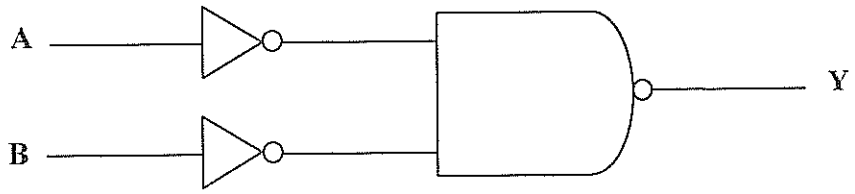
Circuit B

Choose the correct statement about these circuits.

(A) Current is $\pi/2$ ahead of voltage in circuit B and current lags the voltage by $\pi/2$ in circuit A
(B) Current is $\pi/2$ ahead of voltage in circuit A and current lags the voltage by $\pi/2$ in circuit B
(C) Current is $\pi/2$ ahead of voltage in both the circuits
(D) Current lags the voltage by $\pi/2$ in both the circuits

A

Q.76 The correct truth table for the following circuit is



(A)

Input		Output
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

(B)

Input		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

(C)

Input		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(D)

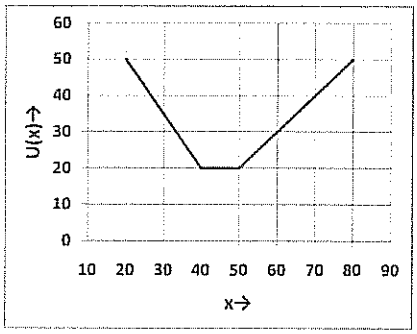
Input		Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

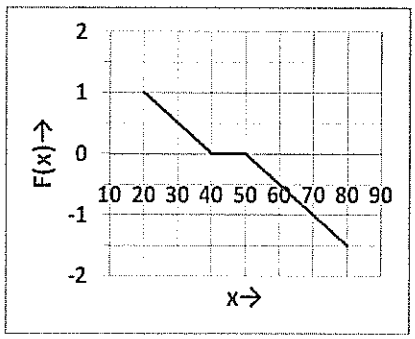
Q.77 The wireless communication frequency band for FM broadcast in India is
(A) 420–890 MHz (B) 76–88 MHz (C) 174–216 MHz (D) 88–108 MHz

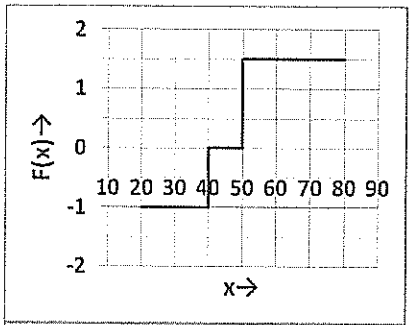
Q.78 On a freezer, the maximum cooling temperature is marked as –40°F. What is the corresponding value on Centigrade scale?
(A) –328°C (B) 24°C (C) –9.8°C (D) –40°C

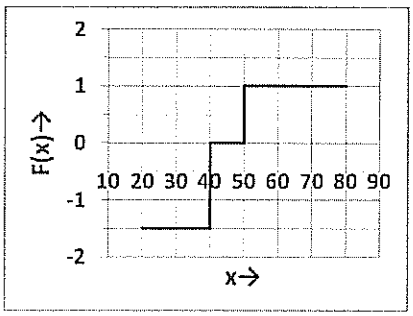
Q.79 A kinesin motor moves 8 nm for each ATP hydrolyzed. Hydrolysis of ATP results in release of free energy which can be used for work. Suppose that hydrolysis of 1 ATP molecule releases 20 k_BT of free energy and kinesin motor is 100% efficient (η=1), calculate the maximum force this motor can generate. Assume $1k_BT$=4 pN nm.
(A) 20 pN (B) 10 pN (C) 5 pN (D) 15 pN

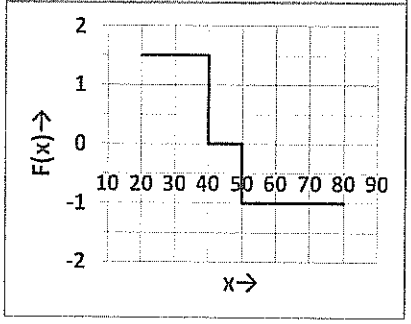
Q.80 The potential energy function U(x) for a particle is shown below. The force corresponding to this potential is :



(A)


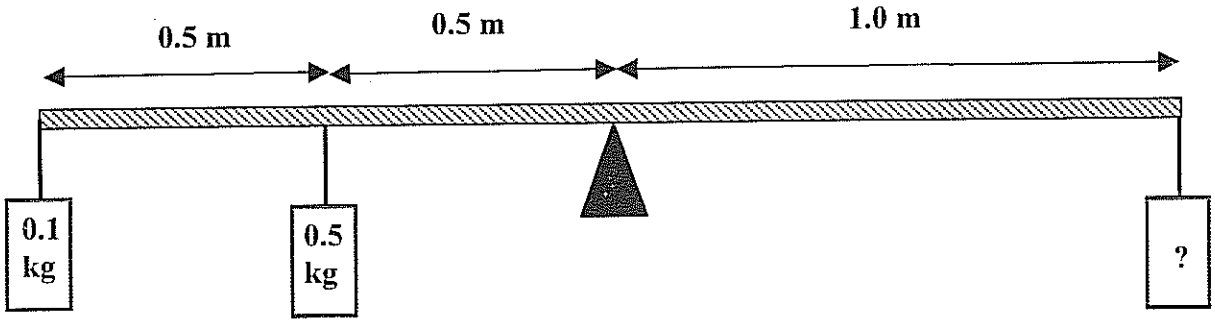
(B)


(C)


(D)


A

Q.81 A 2 m long rigid rod is placed symmetrically on a pivot and two masses are hung on the left side of the pivot as shown in figure. Calculate the mass required to be hanged at a distance of 1 m from pivot (on the right hand side of the rod) to keep the rod horizontal



(A) 0.60 kg (B) 0.35 kg (C) 0.30 kg (D) 0.10 kg

Q.82 A rectangular piece of aluminum has length 100 cm, width 10 cm and height 5 cm. A force of 7×10^5 N stretches it along its length. The strain of the rod is (assume Young's modulus of aluminum to be 7×10^{10}N/m^2)

(A) 2×10^3 (B) 2×10^{-3} (C) 2×10^{-1} (D) 2

Q.83 Evaluate the integral $\int_{-\infty}^{\infty} x\exp(-23x^2)dx$

(A) 1 (B) 0 (C) ∞ (D) 1/23

Q.84 Let d_1 and d_2 be determinants of two matrices as given below :

$$d_1=\begin{vmatrix} x & y & z \\ p & q & r \\ m & n & p \end{vmatrix} \text{ and } d_2=\begin{vmatrix} m & n & p \\ p & q & r \\ x & y & z \end{vmatrix}$$

Assuming d_1 and d_2 to be non zero, the correct relationship between them is

(A) $d_1=d_2$ (B) $d_1=2d_2$ (C) $d_2=2d_1$ (D) $d_1=-d_2$

Q.85 $\ln\left(\exp(\ln x^a)\right) =$

(A) $a\ln(x)$ (B) $a\exp(x)$ (C) ax (D) $\ln(a\ln x)$

Q.86 Many biological molecules are helices. Assuming that t is a continuous parameter between 0 and 1000, which set of the following equations represent a helix?

(A) $x = 3t, y = 3, z = 5t$ (B) $x = 3\cos t, y = 3\sin t, z = 5$

(C) $x = 3\sin t, y = 5, z = 5\sin t$ (D) $x = 3\cos t, y = 3\sin t, z = 5t$

Q.87 Evaluate $\text{cosec}^{-1}\left(\frac{1}{\sqrt{1-x^2}}\right)$

(A) $\cos^{-1}(x)$ (B) $\text{cosec}^{-1}(x)$ (C) $\sin^{-1}(x)$ (D) $\tan(x)$

Q.88 Consider a population of N haploid individuals. 10% of the population has chromosomes with gene A, while the rest do not have this gene. The total number of offspring in the next generation is also N. If the distribution of the chromosomes in the next generation is binomial, the probability that no offspring will have gene A is

(A) ${}^9C_1(0.1)^N$ (B) 0.9^N (C) ${}^9C_1(0.9)^N$ (D) 0.1^N

Q.89 The value of $\underset{x\to 0}{Lim}\frac{\sin 8x}{\sin 5x}$ is

(A) 8/5 (B) 0 (C) ∞ (D) 5/8

Q.90 You are picking a random number r from a uniform distribution between 0 and 1. The probability that r is between 0.5 and 0.7 is

(A) 0.2 (B) 1/2 (C) 1/7 (D) 0.1

Q.91 A bacterium of mass m moving in a fluid feels a viscous drag α. The velocity of the bacterium obeys the following differential equation :

$m\frac{dv(t)}{dt} = -\alpha v(t)$.

Given that $v(0)$ is the velocity at time $t = 0$, $v(t)$ is equal to

(A) $\left(\frac{\alpha}{m}\right)vt + v(0)$ (B) $v(0)\ln v(t)$

(C) $v(0)\exp\left(-\frac{\alpha}{m}t\right)$ (D) $v(0)\exp\left(\frac{\alpha}{m}t\right)$

Q.92 Match the types of matrices listed in Column I with the representative examples listed in Column II

Column I	Column II
P. Symmetric matrix	**1.** $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$
Q. Diagonal matrix	**2.** $\begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$
R. Skew-symmetric matrix	**3.** $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

(A) P-3, Q-3, R-1 (B) P-1, Q-3, R-3

(C) P-3, Q-1, R-1 (D) P-2; Q-3, R-3

Q.93 Consider the function $f(x) = Ax^4 - Bx^2$ such that A>0 and B>0. Which of the following statements are true?

P: The function has a maximum at x=0

Q: The function has a minimum at x=0

R: The value of the function is zero at x=0

S: The value of the function non-zero at x=0

(A) Only **Q** and **S** (B) Only **P** and **R** (C) Only **P** and **S** (D) Only **Q** and **R**

A

Q.94 Evaluate the derivative $\frac{d}{dx}(x\ln x+(1-x)\ln(1-x))$

(A) $\ln\frac{x}{1-x}$ (B) $\ln\frac{1-x}{x}$ (C) 0 (D) $2+\ln\frac{x}{1-x}$

Q.95 The operation $(P\cap Q)\cup(P\cap R)$ for sets P, Q and R can also be written as

(A) $P\cup(Q\cup R)$ (B) $P\cap(Q\cup R)$

(C) $P\cap(Q\cap R)$ (D) $P\cup(Q\cap R)$

Q.96 The number of roots of the polynomial equation $ay^5+by^4-\frac{cy^3}{dy^{-3}}+ey^2-fy+g=0$ is

(A) 4 (B) 3 (C) 6 (D) 5

Q.97 The complex number $\frac{\sqrt{5}+i\sqrt{15}}{6}$ when converted into polar form would be

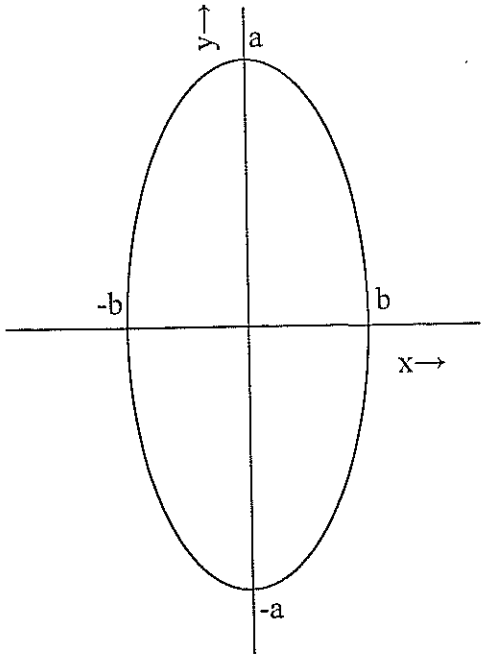
(A) $\frac{\sqrt{5}}{6}(\cos\frac{\pi}{3}+i\sin\frac{\pi}{3})$ (B) $\frac{\sqrt{5}}{6}(\cos\frac{\pi}{4}+i\sin\frac{\pi}{4})$

(C) $\frac{\sqrt{20}}{6}(\cos\frac{\pi}{3}+i\sin\frac{\pi}{3})$ (D) $\frac{\sqrt{20}}{6}(\cos\frac{\pi}{4}+i\sin\frac{\pi}{4})$

Q.98 A population of rats increases every year. Each year, increase in the population is twice that of the previous year. If the population is 1000 in 2013 and it increases to 3000 in 2014, what will be the number of rats in 2018?

(A) 12000 (B) 31000 (C) 63000 (D) 32000

Q.99 The correct equation for the ellipse shown below is



(A) $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ (B) $\frac{bx^2}{a^2}+\frac{ay^2}{b^2}=1$ (C) $\frac{x^2}{b^2}+\frac{y^2}{a^2}=1$ (D) $\frac{ax^2}{b^2}+\frac{by^2}{a^2}=1$

Q.100 The life-spans of three cells in a particular experiment are 3, 6 and 9 days. The standard deviation in the life-span is

(A) $\sqrt{18}$ days (B) $\sqrt{6}$ days (C) 18 days (D) 6 days

Space for rough work

Space for rough work

Space for rough work

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