Participant ID	
Participant Name	
Test Center Name	
Test Date	29/09/2020
Test Time	9:00 AM - 12:30 PM
Subject	NEST 2020
Marks Obtained	9.00000

Section : **General**

Q.1 Anwara, Babita and Cathy were carrying an unequal number of marbles with them when they decided to play a game. Anwara challenged Babita that if Babita had less marbles than herself (Anwara), only then they would exchange their marbles. After this transaction was complete, Cathy challenged Babita that if Babita had less marbles than herself (Cathy), only then they would exchange their marbles. After that, Anwara challenged Cathy that if Cathy had less marbles than herself (Anwara), only then they would exchange the marbles.

At the end, suppose that Anwara, Babita and Cathy have m_A, m_B and m_C numbers of marbles respectively, then

Ans

✗ 1. $m_A < m_B < m_C.$

✓ 2. $m_A < m_C < m_B.$

✗ 3. $m_B < m_A < m_C.$

✗ 4. $m_C < m_B < m_A.$

Question Type : **MCQ**
Question ID : **414664508**
Status : **Answered**
Chosen Option : **3**
Marks : **0**

Q.2 In the following table, some diseases are given on the left and the list of pathogens on the right. Match each disease with respective pathogen:

Disease	Causal Agent
p. Encephalitis	i . Bacteria
q. Malaria	ii . Virus
r. Filariasis	iii . Protozoan parasite
s. Typhoid	iv . Parasitic nematode

Ans

  ✗ 1. q - iii ; p - ii ; s - iv ; r - i.

  ✗ 2. r - ii ; s - i ; q - iv ; p - iii.

  ✗ 3. s - ii ; p - iii ; r - iv ; q - i.

  ✓ 4. p - ii ; q - iii ; r - iv ; s - i.

Question Type : **MCQ**
Question ID : **414664506**
Status : **Answered**
Chosen Option : **4**
Marks : **3**

Q.3 A satellite located above the equator receives electromagnetic (say, radio) signals from various sources on the earth. Every signal is emitted at the same universal time (UTC) and reaches the satellite at the same time. The sources are either located on the surface of the ground all at the same altitude or on the sea bed at the same depth. Then,

Ans ✗ 1.

all the sources will be either on ground, or else all the sources will be distributed over the sea bed.

✗ 2.

all the sources on ground will be located along the same latitude while all the sources on sea bed will be located at a higher latitude (nearer to the poles).

✗ 3.

all the sources on ground will be located along the same latitude while all the sources on sea bed will be located at a lower latitude (nearer to the equator).

✓ 4.

the sources are distributed over circular arcs, with the on ground sources having a larger radius of the circular arc compared to that of the sources on the sea bed.

Question Type : **MCQ**
Question ID : **414664509**
Status : **Answered**
Chosen Option : **4**
Marks : **3**

Q.4 Consider the following set of four cards lying on a table, the other side of the card not visible until you turn them. Each card has a letter from the English alphabet on one side and a single digit number on the other side.

You need to choose the minimum number of cards to turn to test whether the following hypothesis is true:
If there is a vowel on one side of the card, then there will be an even number on the other side of the card.

Choose among the following options which cards need to be turned.

Ans
 ✗ 1. A and 4.

 ✗ 2. D and A.

 ✗ 3. A only.

 ✔ 4. A and 7.

Question Type : **MCQ**
Question ID : **414664507**
Status : **Answered**
Chosen Option : **4**
Marks : **3**

Q.5 Most printing machines use the CMYK colour scheme where four basic colours are used in different combinations to get the whole colour palette. The colour which does NOT belong to this set of basic colours is,
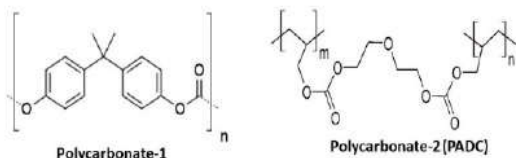
Ans
 ✗ 1. Black.
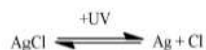
 ✗ 2. Yellow.

 ✔ 3. Maroon.

 ✗ 4. Cyan.

Question Type : **MCQ**
Question ID : **414664505**
Status : **Answered**
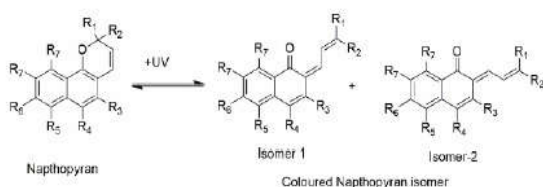Chosen Option : **1**
Marks : **0**

Comprehension:

Sunglasses are a common accessory used in sunlight. It would be interesting to know their chemical constituents and their properties which protect our eyes from the suns ultraviolet (UV) radiation. Sunglass manufacturers usually make lenses out of either glass or plastics. The plastic lenses are made of organic polymer containing carbonate functional groups. The commonly used carbonate polymers are organic materials such as Polycarbonate-1 and Polycarbonate-2. Polycarbonate-2 is also known as polyallyl diglycol carbonate (PADC) or CR-39. The chemical structure of polycarbonates are given as follows:

Polycarbonate-1   Polycarbonate-2 (PADC)

The glass lenses are coated with aluminium or silver that give a mirrored look. The lenses are also coated with metal oxide that reduces the amount of UV radiation transmitted through the sunglasses, and protects the eyes. Various metal oxides (SiO, TiOx, Fe2O3, MnO2) are used to lower UV radiation transmission. The metal oxides can also provide a colored tint to the lenses. A different class of sunglasses use photochromatic glass lenses which usually use copper-doped silver halides salts that produce elemental silver in UV light as per the following reaction:

$$AgCl \underset{}{\overset{+UV}{\rightleftharpoons}} Ag + Cl$$

After the occurrence of this UV reaction, the silver forms clusters which absorb UV and visible light and cause the darkening. Further, the doped copper ion (Cu+) ion of glass lenses reduces the newly formed elemental Cl under UV-light and prevents the escaping of elemental Cl from glass lenses. However, the plastic lenses rely on organic compounds that isomerize reversibly in UV light to produce dark tints. For example, Napthopyran compound isomerize to coloured Napthopyran isomers as **Isomer-1** and **Isomer-2** as per given equation in below:

Napthopyran   Isomer 1   Isomer-2

Coloured Napthopyran isomer

SubQuestion No : 6

Q.6 Polycarbonates derivatives are being used in making sunglass lenses. Choose the **INCORRECT** statement.

Ans ✔️ 1.

Both polycarbonates are aromatic polymers.

❌ 2.

The carbonate groups of both polymers are bonded covalently.

❌ 3.

The oxygen contents of both polycarbonates are unequal.
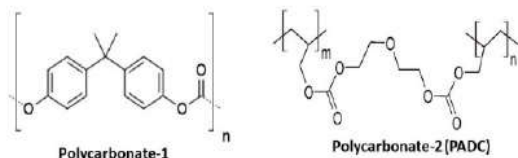
❌ 4.

Both polycarbonates are non-reactive with sunlight.

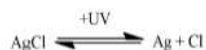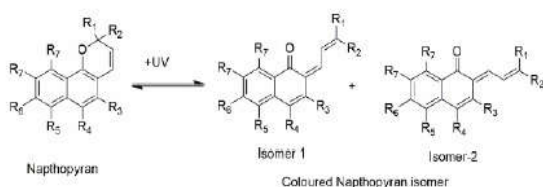|	
Question Type :	**MCQ**
Question ID :	**414664513**
Status :	**Answered**
Chosen Option :	**2**
Marks :	**0**

Comprehension:

Sunglasses are a common accessory used in sunlight. It would be interesting to know their chemical constituents and their properties which protect our eyes from the suns ultraviolet (UV) radiation. Sunglass manufacturers usually make lenses out of either glass or plastics. The plastic lenses are made of organic polymer containing carbonate functional groups. The commonly used carbonate polymers are organic materials such as Polycarbonate-1 and Polycarbonate-2. Polycarbonate-2 is also known as polyallyl diglycol carbonate (PADC) or CR-39. The chemical structure of polycarbonates are given as follows:

Polycarbonate-1   Polycarbonate-2 (PADC)

The glass lenses are coated with aluminium or silver that give a mirrored look. The lenses are also coated with metal oxide that reduces the amount of UV radiation transmitted through the sunglasses, and protects the eyes. Various metal oxides (SiO, $TiOx$, $Fe2O3$, $MnO2$) are used to lower UV radiation transmission. The metal oxides can also provide a colored tint to the lenses. A different class of sunglasses use photochromatic glass lenses which usually use copper-doped silver halides salts that produce elemental silver in UV light as per the following reaction:

$$AgCl \underset{}{\overset{+UV}{\rightleftharpoons}} Ag + Cl$$

After the occurrence of this UV reaction, the silver forms clusters which absorb UV and visible light and cause the darkening. Further, the doped copper ion ($Cu+$) ion of glass lenses reduces the newly formed elemental Cl under UV-light and prevents the escaping of elemental Cl from glass lenses. However, the plastic lenses rely on organic compounds that isomerize reversibly in UV light to produce dark tints. For example, Napthopyran compound isomerize to coloured Napthopyran isomers as **Isomer-1** and **Isomer-2** as per given equation in below:

Napthopyran   Isomer 1   Isomer-2

Coloured Napthopyran isomer

SubQuestion No : 7

Q.7 The chromophore (Napthopyran) of plastic lenses are isomerized into two different organic compounds (Isomer-1 & Isomer -2) with UV-light by the simple chemical reaction. Choose the **INCORRECT** statement.

Ans ✖ 1.

Napthopyran is more aromatic than other isomers.

✖ 2.

Both isomers have an equal number of double bonds.

✔ 3.

The rotation of bonds is irrelevant for the formation of Isomer-1 & Isomer-2

✖ 4.

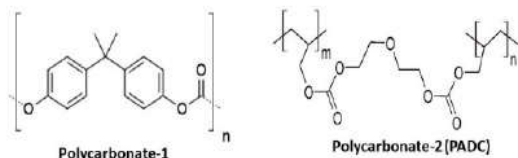The cleavage of C-O bond occurs in Napthopyran.

Question Type : **MCQ**
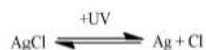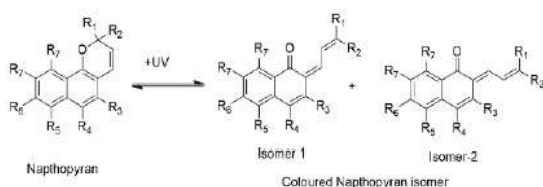Question ID : **414664511**
Status : **Answered**

Comprehension:

Sunglasses are a common accessory used in sunlight. It would be interesting to know their chemical constituents and their properties which protect our eyes from the suns ultraviolet (UV) radiation. Sunglass manufacturers usually make lenses out of either glass or plastics. The plastic lenses are made of organic polymer containing carbonate functional groups. The commonly used carbonate polymers are organic materials such as Polycarbonate-1 and Polycarbonate-2. Polycarbonate-2 is also known as polyallyl diglycol carbonate (PADC) or CR-39. The chemical structure of polycarbonates are given as follows:

Polycarbonate-1   Polycarbonate-2 (PADC)

The glass lenses are coated with aluminium or silver that give a mirrored look. The lenses are also coated with metal oxide that reduces the amount of UV radiation transmitted through the sunglasses, and protects the eyes. Various metal oxides (SiO, $TiOx$, $Fe2O3$, $MnO2$) are used to lower UV radiation transmission. The metal oxides can also provide a colored tint to the lenses. A different class of sunglasses use photochromatic glass lenses which usually use copper-doped silver halides salts that produce elemental silver in UV light as per the following reaction:

$$AgCl \underset{}{\overset{+UV}{\rightleftharpoons}} Ag + Cl$$

After the occurrence of this UV reaction, the silver forms clusters which absorb UV and visible light and cause the darkening. Further, the doped copper ion ($Cu+$) ion of glass lenses reduces the newly formed elemental Cl under UV-light and prevents the escaping of elemental Cl from glass lenses. However, the plastic lenses rely on organic compounds that isomerize reversibly in UV light to produce dark tints. For example, Napthopyran compound isomerize to coloured Napthopyran isomers as **Isomer-1** and **Isomer-2** as per given equation in below:

Napthopyran

Coloured Napthopyran isomer

SubQuestion No : 8

Q.8 The glass photochromic lenses contain copper-doped silver halides salts that produce elemental silver in UV light which causes the darkening along with other important reactions with copper ions. Choose the **INCORRECT** statement.

Ans ✔️ 1.

Copper ions are unaffected with Chlorine atoms.

❌ 2.

Silver atoms absorb UV and visible light

❌ 3.

Copper-doped-silver halides contain their ionic form.

❌ 4.

Silver Chloride salt reacts with UV light.

Question Type : **MCQ**	
Question ID : **414664512**	
Status : **Answered**	

Comprehension:

The ancient Egyptian hieroglyphs form a pictographic script, i.e. each sound was denoted by picture of an object. Thus, you will typically find each letter (consonant or vowel) as a separate hieroglyph. The only exception is joint consonants like 'kh', 'nh', 'sh' etc., where 'h' merely symbolises a different way of pronouncing 'k', 'n' or 's'. You will find below names of five Egyptian royals, namely 'Tutankhamun', 'Hatshepsut', 'Cleopatra', 'Amenhotep' and 'Nefertiti', in some random order. Match the names with appropriate lines of hieroglyphs and answer the following questions.

Adapted from https://www.mobilefish.com/services/hieroglyphs/hieroglyphs.php

SubQuestion No : 9

Q.9 The lion symbol denotes the letter

Ans

  ✗ 1. f.

  ✗ 2. m.

  ✗ 3. p.

  ✔ 4. l.

Question Type : **MCQ**

Question ID : **414664516**

Status : **Answered**

Chosen Option : **1**

Marks : **0**

Comprehension:

The ancient Egyptian hieroglyphs form a pictographic script, i.e. each sound was denoted by picture of an object. Thus, you will typically find each letter (consonant or vowel) as a separate hieroglyph. The only exception is joint consonants like 'kh', 'nh', 'sh' etc., where 'h' merely symbolises a different way of pronouncing 'k', 'n' or 's'. You will find below names of five Egyptian royals, namely 'Tutankhamun', 'Hatshepsut', 'Cleopatra', 'Amenhotep' and 'Nefertiti', in some random order. Match the names with appropriate lines of hieroglyphs and answer the following questions.

Adapted from https://www.mobilefish.com/services/hieroglyphs/hieroglyphs.php

SubQuestion No : 10

Q.10 The two letters which have the same symbol are

Ans ✗ 1. s & t.

✗ 2. m & n.

✔ 3. o & u.

✗ 4. e & i.

Question Type :	**MCQ**
Question ID :	**414664515**
Status :	**Answered**
Chosen Option :	**2**
Marks :	**0**

Section : **Biology**

Q.1 Three given polypeptides (P, Q and R), of same size and same pI (7.2), have a single aspartic acid in each of them. In polypeptide P, the aspartic acid residue is on the surface. In polypeptide Q, it is surrounded by negatively charged residues, whereas in polypeptide R it is deeply buried in a hydrophobic core. pKa of the side chain carboxylate of free (in solution) aspartic acid is 3.65. The polypeptides are in a buffer of pH 7.4. The change in pKa of the aspartic acid side chain carboxylate in the polypeptides P, Q and R is likely to _____.

Ans ✔ 1.

remain the same in P, modest increase in Q and greater increase in R

✘ 2.

remain the same in all the three polypeptides

✘ 3.

increase in P, decrease in Q and remain the same in R

✘ 4.

remain the same in P, increase Q and decrease in R

Q.2 You are provided with a bacterial culture (generation time of 30 min) in exponential (logarithmic) growth phase. You transferred an aliquot of this culture to a fresh medium, which now contains 3.2×10^6 cells/millilitre. Considering that this culture does not exhibit a lag phase, and growth conditions remain unchanged, the cells/millilitre that you would obtain after 1.5 hours of incubation is _____.

Ans ✘ 1. 10.5×10^7

✔ 2. 2.56×10^7

✘ 3. 1.28×10^7

✘ 4. 3.20×10^7

Q.3 Given is a diagram representing the annual mean temperature and the annual mean precipitation in three biomes **P**, **Q** and **R** on the planet. All the animals living in these biomes together can be largely grouped into two major classes 'Regulators' and 'Conformers'. Regulators are the animals that can regulate their body temperature and Conformers are those animals whose body temperature changes as per the environmental temperature. Assuming that these animals do not have any specialised adaptations, the correct statement would be _____.
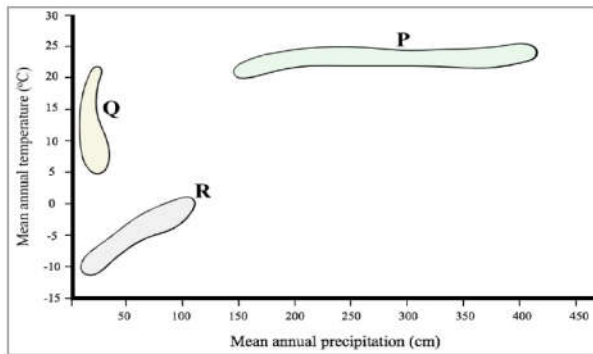
Ans ✗ 1.

Regulators tend to have a large body size in **P**, whereas they tend to have a small body size in **R**

✓ 2.

Regulators with both large and small body size can be found in P, but only those with large body size can be found in **R**

✗ 3.

Conformers with large body size do not survive in **P**, but can only do so in **Q**

✗ 4.

Conformers with large body size do not survive in **Q**, but can only do so in **R**

Question Type : **MCQ**
Question ID : **414664526**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.4 A student was given three unlabelled permanent slides. In an effort to identify these specimens, she places the slides under the microscope and marks the following features:

slide 1: Unicellular, two well-defined nuclei, ciliated, without a cell wall

slide 2: Unicellular, chloroplast, one nucleus, biflagellated, with a cell wall

slide 3: Unicellular, one nucleus, non-flagellate, with a cell wall

The organisms likely to be present on the slides 1, 2 and 3 respectively, are _____.

Ans

✗ 1.
Chlamydomonas, Paramoecium, Saccharomyces

✔ 2.
Paramoecium, Chlamydomonas, Saccharomyces

✗ 3. *Amoeba, Euglena, Candida*

✗ 4. *Amoeba, Spirogyra, Aspergillus*

Question Type : **MCQ**

Question ID : **414664520**

Status : **Answered**

Chosen Option : **1**

Marks : **-1**

Q.5 If the mature egg cell of a diploid organism has 6 chromosomes, then the total number of chromatids in the Anaphase I of meiosis would be _____.

Ans

✗ 1. 6

✔ 2. 24

✗ 3. 12

✗ 4. 3

Question Type : **MCQ**

Question ID : **414664517**

Status : **Answered**

Chosen Option : **3**

Marks : **-1**

Q.6 A cross was performed between two parent plants of unknown genotypes. The off-spring were segregated based on two flower characteristics *i.e.* flower colour [magenta (M) or white] and flower position [axillary (A) or terminal] and counted. The two genes responsible for these characters are not linked and segregate independently. Based on the information given in the table, predict the genotypes of the parents.

phenotype	magenta and axillary	magenta and terminal	white and axillary	white and terminal
number of offspring	615	198	605	211

Ans

✗ 1. $MMaa \times mmAA$

✔ 2. $MmAa \times mmAa$

✗ 3. $MmAa \times MmAa$

✗ 4. $mmAa \times MMaa$

Question Type : **MCQ**
Question ID : **414664521**
Status : **Answered**
Chosen Option : **3**
Marks : **-1**

Q.7 A bird species **X** is restricted to Narcondam island (NI) in Andaman and bird species **Y** is restricted to Middle Andaman Islands (MAI). NI has an area of 8 km^2 and MAI has an area of 1500 km^2. Based on the fossil record, a researcher found a common ancestor of species **X** and **Y** in Myanmar, which had a long and pointed beak. Almost all members of the population of species **X** have a long and pointed beak that is specialized to feed larvae of the beetle *Wallacea*, found only on coconut trees in NI. Most population of species **Y** either have a very short and blunt beak to break open nuts or long and blunt beak to feed on small lizards. Very rarely members of species **Y** are found with long pointed beaks. Given this scenario, choose the correct statement from the following.

Ans

✗ 1. Species **X** has undergone directional selection in NI.

✗ 2. Species **Y** has undergone directional selection in MAI.

✗ 3. Species **Y** has undergone stabilizing selection in MAI.

✔ 4. Species **X** has undergone stabilizing selection in NI.

Question Type : **MCQ**
Question ID : **414664525**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.8 During fertilisation in plants the male and female gametes unite, triggering the process of cell division followed by seed formation. A gene *BBM1*, expressed only in the male gamete, is responsible for eliciting rapid cell division. A researcher over-expressed the *BBM1* gene in the female gamete that resulted in the multiplication of the female gamete into an embryo and then the seed. The plants obtained from these seeds were genetically identical to the parent. This phenomenon is commonly seen in a few select plants naturally, and is known as _____.

Ans

✗ 1. Aneuploidy

✗ 2. Polyembryony

✗ 3. Autogamy

✔ 4. Apomixis

Question Type : **MCQ**
Question ID : **414664518**
Status : **Answered**
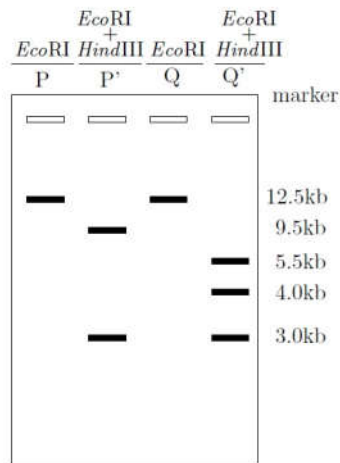Chosen Option : **3**
Marks : **-1**

Q.9 An epidemic of milk-borne gastroenteritis caused by *Salmonella* was reported in an Indian city in 1985. Faecal samples from suspected individuals were inoculated into Selenite broth (high Selenium concentration) and incubated. After a thorough investigation, it was found that only *Salmonella*, and not the common gut bacterium *Escherichia coli* could grow in this medium. The basis of growth of *Salmonella* in Selenite broth is_____.

Ans

✗ 1. Amensalism

✗ 2. Synergism

✗ 3. Adaptation

✔ 4. Selection

Question Type : **MCQ**
Question ID : **414664523**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.10 A pure culture of *Escherichia coli* was streaked on a plate to get single isolated colonies. The plasmid DNA from two such colonies was individually isolated. The DNA were then individually treated with *Eco*RI (**P** and **Q**) or double digested with *Eco*RI + *Hind*III (**P'** and **Q'**). The digested DNA were electrophoresed on an agarose gel and the pattern of the linear DNA so obtained is depicted in the figure below. Patterns **P** and **P'** are obtained for DNA from colony 1 and are as expected for the original DNA sequence of the plasmid. The best reason for the differing pattern in **Q'** is because the plasmid DNA from colony 2 has a mutation _____.

Ans

✔ 1. resulting in another *Hind*III site

✘ 2. at its original *Eco*RI site

✘ 3. at its original *Hind*III site

✘ 4. resulting in another *Eco*RI site

Question Type : **MCQ**
Question ID : **414664524**
Status : **Answered**
Chosen Option : **3**
Marks : **-1**

Q.11 Gibberellins (GA) are hormones required for stem elongation and thereby the overall height of the plant. Bioactive GA binds to its receptor and subsequently activates the gene expression leading to stem growth. In the absence of GA, the SLR1 repressor blocks transcription of GA-inducible genes. GA binds to a receptor GID1 in the nucleus and the GA-GID1 complex then binds to the SLR1 repressor. Formation of GA-GID1-SLR1 complex leads to degradation of SLR1. This event unlocks the transcriptional activator allowing it to transcribe the GA-inducible genes. Based on this information, the correct statement(s) is(are) _____.

Ans ✔️ 1.

SLR1 RNAi plants are tall in the presence of bioactive GA

❌ 2.

Mutation of transcriptional activator binding site on SLR1 will result in short plants even in the presence of bioactive GA

❌ 3.

In absence of bioactive GA, SLR1 remains bound to the transcriptional activator resulting in growth of plants

✔️ 4.

Plants mutant for *GID1* gene result in dwarf plants even in presence of bioactive GA

Question Type : **MSQ**
Question ID : **414664528**
Status : **Answered**
Chosen Option : **1,3**
Marks : **0**

Q.12 Genotypes along with their corresponding phenotypes for flower colour is given below.

Genotype	Phenotype
$C^B C^B$	Blue color
$C^B c$	Blue color
$C^R c$	Red color
$C^R C^R$	Red color
$C^B C^R$	Blue color
cc	White color

Considering the inheritance is Mendelian, the correct statement(s) is(are) _____.

Ans 1.

A cross between $C^B C^B$ and $C^B C^R$ will result in offspring with all blue color flowers.

2.

A cross between $C^B C^R$ and $C^B C^R$ will result in 75% blue color flowers.

3.

A cross between $C^R c$ and $C^B c$ will give at least 25% red color flowers.

4.

A cross between $C^B C^R$ and cc will result in 50% red and 50% blue color flowers.

Note: For this question, discrepancy is found in question/answer. So, This question is ignored for all candidates.

Question Type : **MSQ**
Question ID : **414664527**
Status : **Answered**
Chosen Option : **1,2,3,4**
Marks : **0**

Q.13 Scientists find a gene P that helps human peripheral neurons to sense temperature less than 13°C and induce a physiological signal of avoidance. This gene is present in almost all vertebrates. Considering that gene P has role only in detection of low temperature, the correct statement(s) is(are) _____.

Ans ✔ 1.

Gene P is beneficial for humans as it warns the body against low temperature.

✔ 2.

Loss-of-function mutant of gene P most likely survive in ambient temperature in laboratory conditions.

✔ 3.

Gene P may be lost in fish that live in cold waters.

✘ 4.

Gene P must be hyperactivated in fish that live in cold water.

Question Type : **MSQ**
Question ID : **414664529**
Status : **Answered**
Chosen Option : **1,3**
Marks : **0**

Q.14 Monomeric subunits of proteins can sometimes assemble into higher order assemblies. Two such related human proteins P and Q assemble into hexamers by sequential assembly of their subunits. However, while P assembles into a hexameric ring, Q assembles into a linear hexameric arrangement as shown in the figure. Only hexameric assemblies of the proteins are functional.
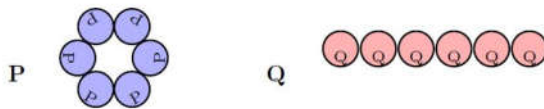
The equilibrium constants for association (K_1, K_2, K_3, and K_4) of subunits at each step until pentamers are assembled, both for P and Q, are the same (10^5). However, the equilibrium association constant of the final step of assembly into a hexamer is drastically different, 10^{10} for P and 10^5 for Q. Based on this information, choose the statement(s) that is(are) likely to be true.

Ans ✘ 1.

For Q, $\Delta G°$ at the final step of assembly is half as much as the earlier step.

✔ 2.

Cellular concentration of Q must be higher than that of P.

✘ 3.

For all steps in assembling P and Q, $\Delta G°$ remains the same.

✔ 4.

For P, $\Delta G°$ at the final step of assembly is twice that of the earlier step.

Question Type : **MSQ**
Question ID : **414664530**
Status : **Answered**
Chosen Option : **1,2,4**
Marks : **0**

Q.15

SARS-CoV-2 is a novel corona virus that causes COVID-19. The disease, in most cases, starts with mild symptoms such as fever and cough that may aggravate to pneumonia and severe acute respiratory distress (breathing difficulty). In majority of the infected, the disease is limited to only mild symptoms and the virus is cleared (negative in viral diagnostic test) in 6-8 days after symptoms appear. In such cases, the most likely immune mechanism(s) responsible for clearance of the viral infection is(are) _____

Ans

✔ 1.

Cellular barriers such as macrophages and natural killer cells.

✘ 2.

Specific antibodies against the virus developed by humoral immune response.

✘ 3.

Physiological barriers such as saliva and tears, and physical barriers such as mucus in nasal passage.

✔ 4.

Cytokine response such as interferon production.

Question Type :	**MSQ**
Question ID :	**414664531**
Status :	**Answered**
Chosen Option :	**1,2,3,4**
Marks :	**0**

Section : **Chemistry**

Q.1

A certain gaseous reaction, carried out in an insulated sealed container results in an increase in temperature from 200 K to 400 K, with the pressure remaining constant. The correct equation that describes the reaction is:

Ans
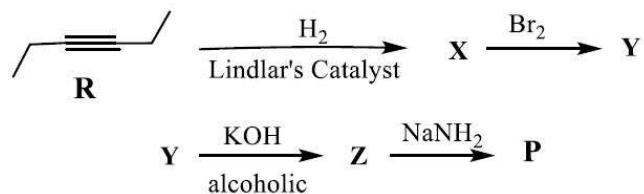
✘ 1. $2XY(g) + Y_2(g) \rightarrow 2XY_2(g)$

✘ 2. $2XY_2(g) \rightarrow X_2(g) + 2Y_2(g)$.

✔ 3. $X(g) + Y_2(g) \rightarrow XY_2(g)$

✘ 4. $X_2(g) + Y_2(g) \rightarrow 2XY(g)$

Question Type :	**MCQ**
Question ID :	**414664533**
Status :	**Answered**
Chosen Option :	**4**
Marks :	**-1**

Q.2

$$R \xrightarrow[\text{Lindlar's Catalyst}]{H_2} X \xrightarrow{Br_2} Y$$

$$Y \xrightarrow[\text{alcoholic}]{KOH} Z \xrightarrow{NaNH_2} P$$

For the above reaction sequence, **R** and **P** are

Ans

✗ 1. geometrical isomers

✔ 2. the same compound

✗ 3. positional isomers

✗ 4. non-isomeric different compounds

Question Type : **MCQ**
Question ID : **414664539**
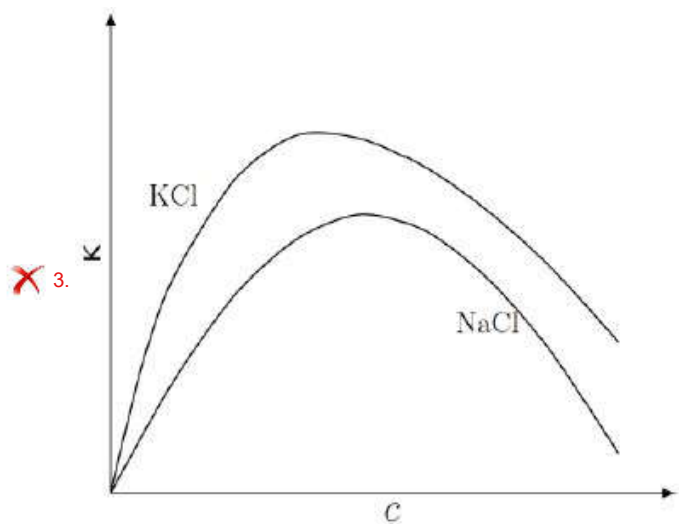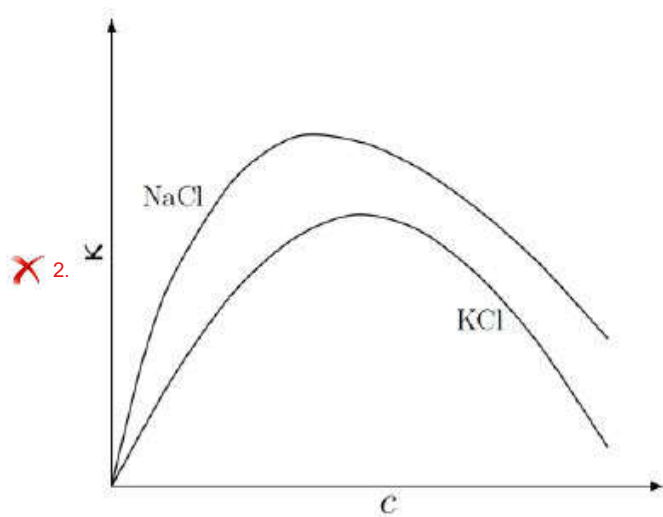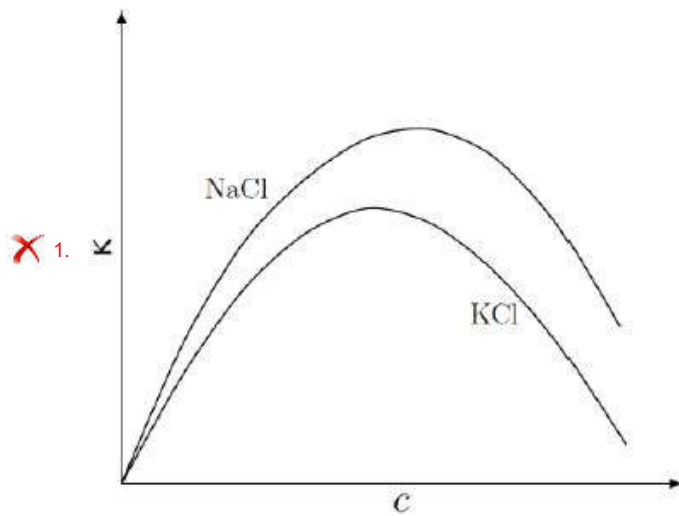Status : **Answered**
Chosen Option : **2**
Marks : **3**

Q.3 Aldehydes and ketones react with hydrogen cyanide to form cyanohydrins. It is an addition reaction catalysed by a base. The correct statement with respect to this reaction is:

Ans

✔ 1.
The base reacts with hydrogen cyanide to form a conjugate base that is the nucleophile.

✗ 2.
Pure hydrogen cyanide alone can react completely with the carbonyl group.

✗ 3.
The base is also a nucleophile and attacks the carbonyl group.

✗ 4.
Hydrogen cyanide first protonates the carbonyl group to form the conjugate acid which reacts further.

Question Type : **MCQ**
Question ID : **414664541**
Status : **Answered**
Chosen Option : **1**
Marks : **3**

Q.4 The equivalent conductance (Λ) of an aqueous solution of a strong electrolyte of concentration [X] is given by $\Lambda = \Lambda_o - Ac^{1/2}$, where A is a constant and c is the concentration of the electrolyte. The specific conductance κ (with $\Lambda = 1000\kappa/c$) of NaCl and KCl salt solutions (aqueous) are plotted against c. The correct figure is: (The plots are not drawn not to scale.)

Ans
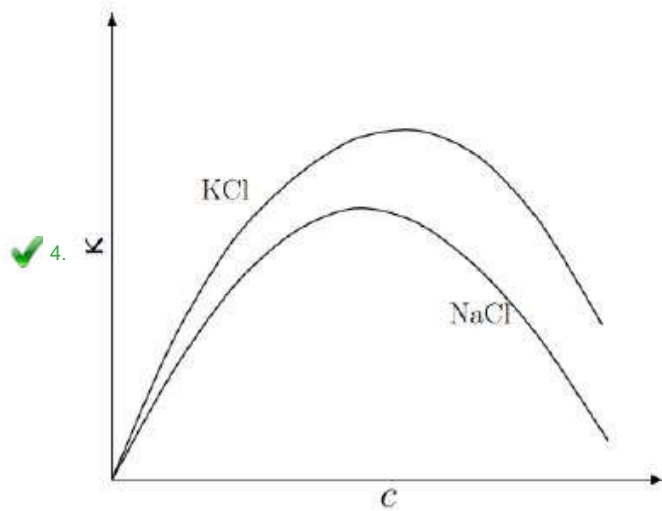
✗ 1.

✗ 2.

✗ 3.

✓ 4.

Q.5 The Lyman series corresponds to the emission lines of hydrogen atom due to the transitions of the type $n \to 1$ ($2 \to 1$, $3 \to 1$, $4 \to 1$, etc) where n is the principal quantum number of the excited state. The ionization energy of the hydrogen atom can be determined by plotting:

Ans ✓ 1.
Frequency differences between successive emission lines vs emission frequencies
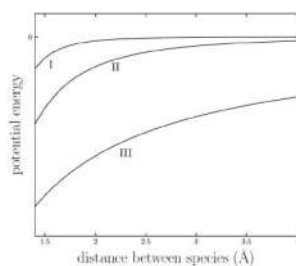
✗ 2. Emission frequency vs n^2

✗ 3. Emission frequency vs $1/n^2$

✗ 4.
Frequency differences between successive emission lines vs n

Q.6 Three types of potential energy due to attractive interaction between two species **X** and **Y** are represented by the curves I, II, and III in the figure below.

Consider the dominating interaction between non-rotating species (**X...Y**) for **X** = Na$^+$, $(CH_3)_2CO$, C_6H_6, CH_4 and **Y** = $(CH_3)_2CO$, Cl$^-$, C_2H_6, $CHCl_3$. The correct assignment of the **X...Y** interactions to the types I, II, and III is:

Ans ✗ 1.
Na$^+$...Cl$^-$ = III; (C_6H_6)...$(CH_3)_2CO$ = I; (CH_4)...(C_2H_6) = II; $(CH_3)_2CO$...$CHCl_3$ = III.

✓ 2.
Na$^+$...Cl$^-$ = III; (C_6H_6)...$(CH_3)_2CO$ = I; (CH_4)...(C_2H_6) = I; $(CH_3)_2CO$...$CHCl_3$ = II.

✗ 3.
Na$^+$...Cl$^-$ = II; (C_6H_6)...$(CH_3)_2CO$ = II; (CH_4)...(C_2H_6) = III; $(CH_3)_2CO$...$CHCl_3$ = I.

✗ 4.
Na$^+$...Cl$^-$ = I; (C_6H_6)...$(CH_3)_2CO$ = III; (CH_4)...(C_2H_6) = II; $(CH_3)_2CO$...$CHCl_3$ = II.

Question Type : **MCQ**
Question ID : **414664532**
Status : **Not Answered**
Chosen Option : **--**
Marks : **0**

Q.7 The pair of species having trigonal pyramidal geometry is:

Ans ✗ 1. ClF_3 and NO_3^-

✓ 2. AsF_3 and SO_3^{2-}

✗ 3. ClF_3 and SO_3^{2-}

✗ 4. SO_3^{2-} and NO_3^-

Question Type : **MCQ**
Question ID : **414664538**
Status : **Answered**
Chosen Option : **4**
Marks : **-1**

Q.8 For the synthesis of the compound *n*-propyl *tert*-butyl ether, the most suitable method is the reaction of

Ans ✅ 1.

tert-butanol with sodium followed by 1-bromopropane

❌ 2.

tert-butanol with 1-propene in the presence of conc. sulphuric acid.

❌ 3.

1-propanol with sodium followed by *tert*-butyl bromide

❌ 4.

tert-butanol and 1-propanol at high temperature in the presence of conc. sulphuric acid

Question Type :	**MCQ**
Question ID :	**414664540**
Status :	**Answered**
Chosen Option :	**2**
Marks :	**-1**

Q.9 Alkali metals are highly reactive towards air and water and are generally kept in kerosene oil. Glove box is a sealed container filled with nitrogen gas used to handle such chemicals that are air sensitive and hazardous. Of the four pure metals - lithium, sodium, potassium, and rubidium the ones that can be stored in a glove box are:

Ans ✅ 1. Sodium, potassium, and rubidium

❌ 2. Lithium, sodium, and rubidium

❌ 3. Lithium, sodium, and potassium

❌ 4. Lithium, potassium, and rubidium

Question Type :	**MCQ**
Question ID :	**414664537**
Status :	**Answered**
Chosen Option :	**3**
Marks :	**-1**

Q.10 The species which possesses the highest spin angular momentum (S) is:

Ans ✅ 1. $[Ni(NH_3)_6]Cl_2$

❌ 2. $[Co(NH_3)_6]Cl_2$

❌ 3. $[Fe(NH_3)_6]Cl_2$

❌ 4. $[Cu(NH_3)_6]Cl_2$

Question Type :	**MCQ**
Question ID :	**414664536**
Status :	**Answered**
Chosen Option :	**4**
Marks :	**-1**

Q.11 For a hydrogenic quantum system, the probability of finding the electron $D_{n,l}(r)dr$ in a spherical shell of radius r (with nucleus at its center) and thickness dr, is plotted against r (in units of a_0) for three sets of values of n and l (plots I, II, and III). The principal quantum number (n), azimuthal quantum number (l) and area under the curve (A) corresponding to the three plots are denoted by subscripts I, II and III respectively. (The plots are not drawn to scale.)
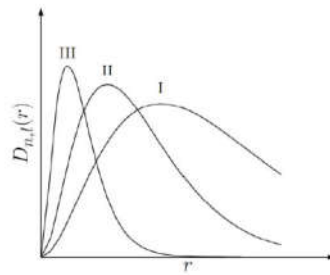
The correct statement(s) is(are):

Ans

✔ 1. $l_{\mathrm{I}} > l_{\mathrm{II}} > l_{\mathrm{III}}$

✔ 2. Energy of the system corresponding to each plot depends on the respective l value.
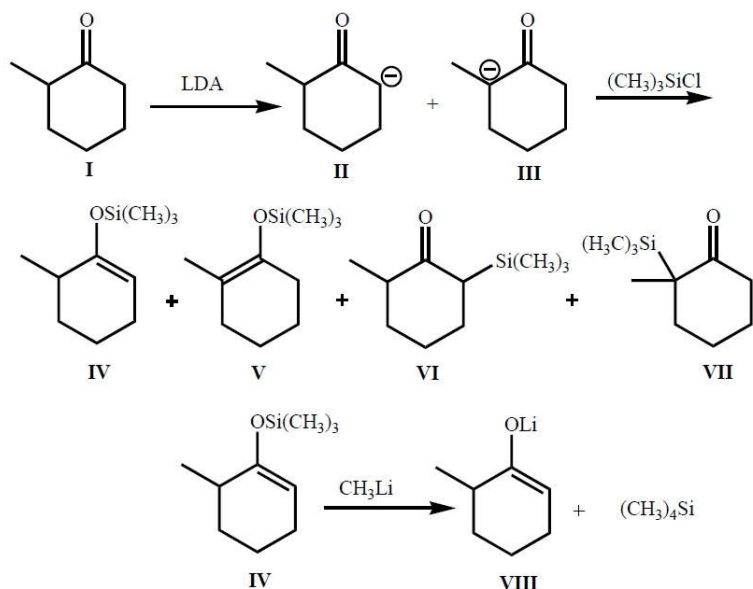
✔ 3. $A_{\mathrm{I}} = A_{\mathrm{II}} = A_{\mathrm{III}}$

✔ 4. $l_{\mathrm{I}} + l_{\mathrm{II}} + l_{\mathrm{III}} \geq 3$

Question Type :	**MSQ**
Question ID :	**414664543**
Status :	**Answered**
Chosen Option :	**1,2,3,4**
Marks :	**4**

Q.12 Carbanions derived from aldehydes/ketones are called enolates, as they represent anions (conjugate bases) of the enol forms. Enol ethers can be prepared and are synthetically important. These anions react with an alkyl halide at the carbon or oxygen atom.
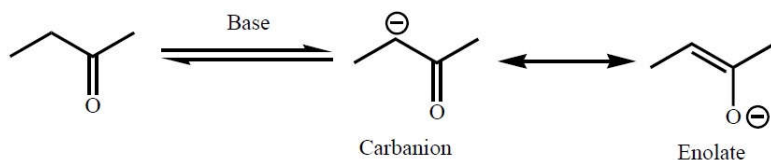
Trimethylsilylchloride (Me_3SiCl) reacts almost exclusively with enolates. One such reaction is shown below, where ketone **I** is treated with LDA, followed by Me_3SiCl to obtain trimethylsilyl derivative of **I**. The possible intermediate carbanions (**II** and **III**) and the possible products (**IV** to **VII**) are shown. [LDA = lithium diisopropylamide (Li $N(isoC_3H_7)_2$), is a strong base but a very poor nucleophile].

The correct statement(s) is(are):

Ans

✔ 1. III is more stable than II.

✔ 2. The activation energy for the formation of IV is lower than that of VI.

✔ 3. In the conversion of IV to VIII, CH_3Li function as a nucleophile.

✔ 4. The activation energy for the formation of II is lower than that of III.

Q.13 Potassium dichromate is a very important chemical used in industry and extensively used as an oxidizing agent in organic chemistry. Dichromates are generally prepared from chromate, which in turn is obtained from chromite ore ($FeCr_2O_4$). Reaction of potassium dichromate with concentrated HCl and zinc powder forms octahedral $CrCl_3.nH_2O$ **(Y)**. **Y** on reaction with concentrated NH_3 solution forms a compound **Z** having a color different from that of **Y**. Compounds **Y** and **Z** on reaction with $AgNO_3$ yields one and three equivalents of silver chloride respectively.
The correct statement is/are:

Ans ✓ 1.
$ZnCl_2$ is formed during the reaction of potassium dichromate with con. HCl.

✓ 2.
The oxidation number of Cr in potassium dichromate and in the chromite ore are +6 and +3 respectively.

✗ 3. **Y and Z exhibit geometrical isomerism.**

✓ 4.
Z absorbs light at shorter wavelength compared to Y.

Question Type :	**MSQ**
Question ID :	**414664544**
Status :	**Answered**
Chosen Option :	**1,2,4**
Marks :	**4**

Q.14 A patient receives a drug **X**, 100 mg, intravenously. The concentration of the drug in the blood measured at 1 and 8 hours after the dose are 9 mg/L and 3 mg/L respectively. If the decrease in the concentration of the drug follows

Ans ✓ 1.
first-order kinetics, the rate constant is $0.156 \ h^{-1}$.

✗ 2.
first-order kinetics, and the next dose of the drug is to be administered when [X] = 1 mg/L, then the next dose of the drug should be given at 14 hours.

✓ 3.
zeroth-order kinetics, and if the next dose of the drug is to be administered when [X] = 1 mg/L and after 12 hours, then the initial dose to be administered is 11.3 mg.

✓ 4.
first-order kinetics, the half-life of the drug is ~ 4 hours.

Question Type :	**MSQ**
Question ID :	**414664542**
Status :	**Answered**
Chosen Option :	**1,2,3,4**
Marks :	**0**

Q.15 An alkyl halide with β-hydrogen atom, when treated with a nucleophile/base, undergoes a substitution reaction or an elimination reaction, depending on the strength and size of the nucleophile/base and the reaction conditions.
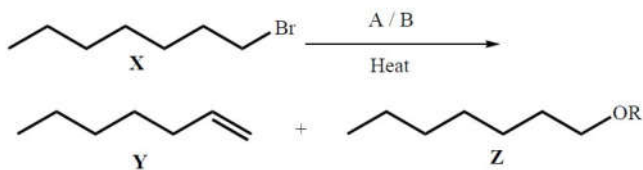
For the above reaction, the correct statement(s) is(are):

Ans ✗ 1.
When A = CH_3ONa and B = HOH, Z with R = $-CH_3$ is the major product.

✔ 2.
When A = $(CH_3)_3CONa$ and B = $(CH_3)_3COH$, Y is the major product.

✔ 3.
When A = CH_3COONa and B = CH_3COOH, Z with R = $-COCH_3$ is the major product.

✗ 4.
When A = CH_3ONa and B = CH_3OH, Y is the major product.

> Question Type : **MSQ**
> Question ID : **414664545**
> Status : **Answered**
> Chosen Option : **1,4**
> Marks : **0**

Section : **Mathematics**

Q.1 Let T be a set of n elements. It is defined that

- a relation R on T is symmetric if $(a, b) \in R$ then $(b, a) \in R$ for $a, b \in T$;
- a relation R on T is antisymmetric if $(a, b), (b, a) \in R$ then $a = b$ for $a, b \in T$.

Let $\mathcal{S}$ and $\mathcal{A}$ be the set of all symmetric and antisymmetric relations on T respectively. Then

Ans ✗ 1. $\mathcal{S} \cap \mathcal{A} = \emptyset$

✔ 2. $|\mathcal{S} \cap \mathcal{A}| = 2^n$

✗ 3. $|\mathcal{S}| = |\mathcal{A}|$

✗ 4. $\mathcal{S} \cup \mathcal{A} = T \times T$

> Question Type : **MCQ**
> Question ID : **414664548**
> Status : **Answered**
> Chosen Option : **4**
> Marks : **-1**

Q.2 Let M be the set of all 2×2 matrices with integer entries. The function $f : M \to M$ given by $f(x) = x^2$ is

Ans

✔ 1. neither injective nor surjective

✘ 2. injective but not surjective

✘ 3. bijective

✘ 4. surjective but not injective

Question Type : **MCQ**
Question ID : **414664554**
Status : **Answered**
Chosen Option : **3**
Marks : **-1**

Q.3 Let X be a regular n-gon with vertices $A_1, A_2, \cdots, A_n$ for $n > 6$. Suppose the sides A_1A_2 and A_5A_4 are extended externally to meet at a point P, outside X. If $\angle A_2 P A_4 = \dfrac{2\pi}{3}$, the value of n is

Ans

✘ 1. 12

✘ 2. 20

✘ 3. 24

✔ 4. 18

Question Type : **MCQ**
Question ID : **414664556**
Status : **Answered**
Chosen Option : **2**
Marks : **-1**

Q.4

For $n \in \mathbb{N}$, let

$$f(n) = \begin{cases} 3n+1 & \text{if } n \text{ is odd} \\ \frac{n}{2} & \text{if } n \text{ is even.} \end{cases}$$

Define $f^{(1)}(n) = f(n)$ and $f^{(i)}(n) = f(f^{(i-1)}(n))$ for $i > 1$. Suppose l is an even number greater than or equal to 2020. Then the least value of i for which

$$f^{(i)}\left(\frac{2^{\ell}(2^{\ell}-1)}{3}\right) = 1$$

is

Ans

✗ 1. $2\ell - 1$

✗ 2. $2\ell + 2$

✔ 3. $2\ell + 1$

✗ 4. 2ℓ

Question Type : **MCQ**
Question ID : **414664550**
Status : **Answered**
Chosen Option : **3**
Marks : **3**

Q.5

Let α and β be two nonzero complex numbers. For $z \in \mathbb{C}$, $\overline{z}$ denotes the complex conjugate of z. If the lines $\alpha\overline{z} + \overline{\alpha}z = -1$ and $\beta\overline{z} + \overline{\beta}z = 1$ are mutually perpendicular then

Ans

✗ 1. $\overline{\alpha}\beta - \alpha\overline{\beta} = 0$

✗ 2. $\alpha\beta - \overline{\alpha}\overline{\beta} = 0$

✔ 3. $\overline{\alpha}\beta + \alpha\overline{\beta} = 0$

✗ 4. $\alpha\beta + \overline{\alpha}\overline{\beta} = 0$

Question Type : **MCQ**
Question ID : **414664551**
Status : **Answered**
Chosen Option : **3**
Marks : **3**

Q.6 Let A be a 2×2 matrix with real entries such that zero is the only solution of the equation $\det(A - x\mathbf{I}) = 0$. Then

Ans

✓ 1. $A^2 = 0$

✗ 2. $A = \mathbf{I}$

✗ 3. $A^2 = A$

✗ 4. $A = 0$

> Question Type : **MCQ**
> Question ID : **414664549**
> Status : **Answered**
> Chosen Option : **2**
> Marks : **-1**

Q.7 For $a, b \in \{0, 1, \cdots, 9\}$, a two digit number ab is defined for $10a + b$. A two digit number ab is called a special prime if both ab and ba are primes. Then the total number of special primes is

Ans

✗ 1. 8

✗ 2. 7

✗ 3. 6

✓ 4. 9

> Question Type : **MCQ**
> Question ID : **414664547**
> Status : **Answered**
> Chosen Option : **2**
> Marks : **-1**

Q.8 Let $f \colon [-1, 1] \to \mathbb{R}$ be a function such that $|f(x)| \leq x^2$ for all $x \in [-1, 1]$. Then

Ans

✗ 1. $f'(0)$ exists and $f'(0) < 0$

✗ 2. $f'(0)$ does not exist

✓ 3. $f'(0)$ exists and $f'(0) = 0$

✗ 4. $f'(0)$ exists and $f'(0) > 0$

> Question Type : **MCQ**
> Question ID : **414664552**
> Status : **Answered**
> Chosen Option : **4**
> Marks : **-1**

Q.9 For $\mathbf{x} = (x_1, x_2, x_3) \in \mathbb{R}^3$, define $|\mathbf{x}| = \sqrt{x_1^2 + x_2^2 + x_3^2}$. For $\mathbf{a} = (1, 4, 4)$ and $\mathbf{b} = (1, 0, 1)$, the maximum value of $|\mathbf{x}|$ satisfying $|\mathbf{x} - \mathbf{a}| = 2|\mathbf{x} - \mathbf{b}|$ is

Ans

✗ 1. $\dfrac{5}{3}$

✓ 2. 5

✗ 3. $\dfrac{\sqrt{13}}{3} + 5$

✗ 4. $\dfrac{2\sqrt{13}}{3} + 5$

Question Type :	**MCQ**
Question ID :	**414664555**
Status :	**Answered**
Chosen Option :	**1**
Marks :	**-1**

Q.10 Let $f \colon \mathbb{R} \to \mathbb{R}$ be a nonconstant differentiable function such that $\lim_{x \to \infty} f(x) = 1$ and $\lim_{x \to \infty} f'(x) = \alpha$ for some $\alpha \in \mathbb{R}$. Then

Ans

✗ 1. $\alpha > 1$

✗ 2. $\alpha < -1$

✗ 3. $\alpha \neq 0$ but $|\alpha| < 1$

✓ 4. $\alpha = 0$

Question Type :	**MCQ**
Question ID :	**414664553**
Status :	**Answered**
Chosen Option :	**3**
Marks :	**-1**

Q.11 Let f be a twice differentiable function on $\mathbb{R}$ such that

$$f(0) = 1,\ f(1) = 2,\ f'(0) = -1,\ f'(1) = 5 \text{ and } f''(x) \geq 0 \text{ for } x \in [0, 1].$$

Here, $f'(x)$ and $f''(x)$ denote the first and second order derivative of f at x respectively. Then

Ans

✓ 1. $f(x) \geq -x + 1$ for $x \in [0, 1]$

✓ 2. $f(x) \geq \dfrac{1}{3}$ for $x \in [0, 1]$

✓ 3.

$$f'(x_1) \leq f'(x_2) \text{ if } x_1 < x_2 \text{ for } x_1, x_2 \in [0, 1]$$

✓ 4. $f(x) \geq 5x - 3$ for $x \in [0, 1]$

Question Type :	**MSQ**
Question ID :	**414664560**
Status :	**Answered**
Chosen Option :	**1,2,3,4**
Marks :	**4**

Q.12 For a positive integer k, let P_k be the parabola given by

$$y = \frac{x^2}{k} - 5$$

and let C be the circle given by

$$x^2 + y^2 = 25.$$

Then

Ans

✓ 1.

there is a k such that P_k and C intersect each other at three distinct points

✓ 2.

P_k and C intersect each other at least once for all k

✗ 3.

there are infinitely many values of k such that P_k and C intersect each other at more than one point

✓ 4.

there is a k such that P_k and C intersect each other exactly once

Question Type :	**MSQ**
Question ID :	**414664559**
Status :	**Answered**
Chosen Option :	**1,3**
Marks :	**0**

Denote Area($\triangle$XYZ), P($\triangle$XYZ) and |XY| by area of the triangle $\triangle$XYZ, perimeter of the triangle $\triangle$XYZ and length of the line segment XY respectively.

Let ABCD be a convex quadrangle and the diagonals AC and BD intersect at O. Then

Ans ✔️ 1.

Area($\triangle$ABO) × Area($\triangle$CDO) = Area($\triangle$BCO) × Area($\triangle$ADO)

✔️ 2.

P($\triangle$ABO) + P($\triangle$CDO) = P($\triangle$BCO) + P($\triangle$ADO) if |AB| + |CD| = |BC| + AD

❌ 3.

P($\triangle$ABO) × P($\triangle$CDO) = P($\triangle$BCO) × P($\triangle$ADO)

✔️ 4.

Area($\triangle$ABO) + Area($\triangle$CDO) = Area($\triangle$BCO) + Area($\triangle$ADO) if one diagonal is bisected by the other diagonal

Question Type : **MSQ**
Question ID : **414664557**
Status : **Answered**
Chosen Option : **1,2,3,4**
Marks : **0**

Q.14 Let P be a polynomial whose coefficients are real numbers. Suppose the roots of $P(x) = 0$ are real. Then

Ans ✔️ 1.

the repeated roots of $P(x) = 0$ are also roots of $P(x) + P'(x) = 0$

❌ 2.

the roots of $P(x) + P'(x) = 0$ are real and distinct

✔️ 3.

the roots of $P(x) + P'(x) = 0$ are distinct if the roots of $P(x) = 0$ are distinct

✔️ 4.

the roots of $P(x) + P'(x) = 0$ are real

Question Type : **MSQ**
Question ID : **414664561**
Status : **Answered**
Chosen Option : **1,4**
Marks : **0**

Q.15 Let A, B and C be three events with non-zero probabilities. Then

Ans

✗ 1.

$$P(A \mid B) = P(B \mid A) \text{ if and only if } P(A) = P(B)$$

✔ 2.

$$P(A^c \mid B) = 1 - P(A \mid B) \text{ where } A^c \text{ is the complement of A}$$

✗ 3.

$P(A) = P(A \mid B) + P(A \mid B^c)$ where B^c is the complement of B with non-zero probability

✔ 4.

$$P(A \mid B)P(B \mid C)P(C \mid A) = P(B \mid A)P(C \mid B)P(A \mid C)$$

Question Type : **MSQ**
Question ID : **414664558**
Status : **Answered**
Chosen Option : **1,2,4**
Marks : **0**

Section : **Physics**

Q.1 A particle of mass m moves under the influence of the potential $V(x) = P/x^2 - Q/x$. Here P, Q are real positive constants. The angular frequency of small oscillations of the particle around the equilibrium point is

Ans

✗ 1. $\sqrt{\dfrac{4Q^4}{mP^3}}$
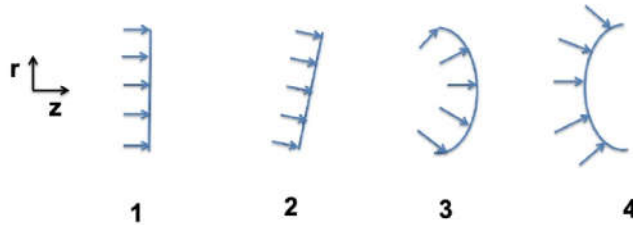
✗ 2. $\sqrt{\dfrac{Q^4}{mP^3}}$

✗ 3. $\sqrt{\dfrac{Q^4}{16mP^3}}$

✔ 4. $\sqrt{\dfrac{Q^4}{8mP^3}}$

Question Type : **MCQ**
Question ID : **414664562**
Status : **Answered**
Chosen Option : **4**
Marks : **3**

Q.2

The refractive index (η) of certain material is given by $\eta = \sqrt{1 - \frac{\rho}{\rho_c}}$ where ρ represents density of the material such that $\rho < \rho_c$ and ρ_c is a constant. A planar wavefront of light propagating along z direction enters this material from left whereas the density of the material increases in the radial distance (r) in the plane perpendicular to the propagation axis. Select the wavefront that correctly describes the propagation of light in this medium.

Ans

✗ 1. 1

✗ 2. 3

✗ 3. 2

✔ 4. 4

Question Type : **MCQ**
Question ID : **414664571**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.3 One can express power in terms of the fundamental constants $\{G, c, h\}$ using dimensional analysis. Assuming that the associated dimensionless constant is unity, the magnitude of the power so obtained is
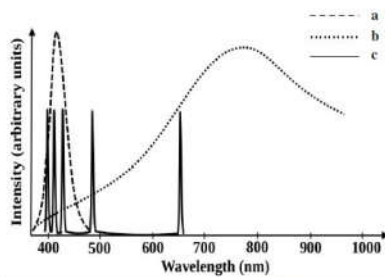
Ans

✗ 1. 10^{26} W

✗ 2. 10^{10} W

✗ 3. 10^{70} W

✔ 4. 10^{52} W

Question Type : **MCQ**
Question ID : **414664568**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.4 The figure shows the emission spectra recorded for three different light sources a, b and c using a spectrometer (note that the intensities are not to scale). Select the most appropriate statement regarding the identity of the source.

Ans ✅ 1.

a: Blue LED, b: Incandescent bulb, and c: Atomic Hydrogen gas.

❌ 2.

a: Incandescent bulb, b: Blue LED, and c: Atomic Hydrogen gas .

❌ 3.

a: Atomic Hydrogen gas, b: Blue LED, and c: Incandescent bulb.

❌ 4.

a: Blue LED, b: Atomic Hydrogen gas, and c: Incandescent bulb.

Question Type : **MCQ**
Question ID : **414664566**
Status : **Answered**
Chosen Option : **2**
Marks : **-1**

Q.5 A spherical bob hangs from a light inextensible string and moves in a horizontal circle with string making angle θ with the vertical. The length l of the string is then very slowly increased so that the motion is circular at all times to a good approximation. If h is the height from center of the circle to the pivot and r is the radius of the circle then $h \propto r^a$. The value of a is

Ans

✗ 1. 3

✗ 2. 1

✗ 3. 2

✔ 4. 4

Question Type : **MCQ**
Question ID : **414664563**
Status : **Answered**
Chosen Option : **3**
Marks : **-1**

Q.6 Standing waves of frequency 225 Hz are set up in a monoatomic gas kept in a cylindrical chamber closed at both ends and at temperature 27^0C. The distance between the adjacent anti-nodes of the wave is 1 m. The atomic weight of the gas in $kg \cdot mol^{-1}$ is closest to

Ans

✗ 1. 0.01

✗ 2. 0.04

✗ 3. 0.06

✔ 4. 0.02

Question Type : **MCQ**
Question ID : **414664567**
Status : **Answered**
Chosen Option : **2**
Marks : **-1**

Q.7 Two circular coils, each having 1000 turns and radius R=0.25 m, are placed co-axially. Each coil is separated by a distance 1.0 m from the point P as shown in the figure. The coils carry equal currents 2.0 A in the same direction. An identical configuration of coils is placed perpendicular to the previous arrangement as shown in the figure. The magnitude of magnetic field at point P is closest to
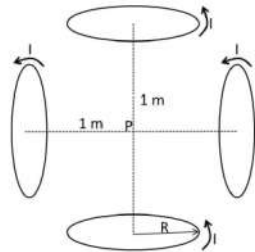
Ans

✗ 1. 1.4×10^{-4} T.

✗ 2. 3.0×10^{-4} T.

✔ 3. 1.7×10^{-4} T.

✗ 4. 0.7×10^{-4} T.

Question Type : **MCQ**
Question ID : **414664570**
Status : **Answered**
Chosen Option : **1**
Marks : **-1**

Q.8 A free particle with initial kinetic energy E and de Broglie wavelength λ enters a region in which it has potential energy $-V$. The new de Broglie wavelength of the particle is

Ans

✔ 1. $\lambda \left(1 + V/E\right)^{-1/2}$

✗ 2. $\lambda \left(1 - V/E\right)^{1/2}$

✗ 3. $\lambda \left(1 + V/E\right)^{1/2}$

✗ 4. $\lambda \left(1 - V/E\right)^{-1/2}$

Question Type : **MCQ**
Question ID : **414664565**
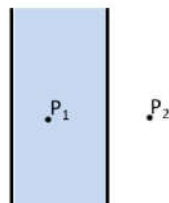Status : **Answered**
Chosen Option : **4**
Marks : **-1**

Q.9 Two metal rods made of steel and copper have coefficients of linear expansion $1.1 \times 10^{-5} K^{-1}$ and $1.7 \times 10^{-5} K^{-1}$ respectively. At room temperature (300 K), the steel rod is 4 cm longer than the copper rod. If the difference in their lengths remains same at all temperatures, then the lengths of the steel and copper rods respectively (at 300 K) are

Ans

✔ 1. 11.33 cm and 7.33 cm

✘ 2. 9.10 cm and 5.22 cm

✘ 3. 15.66 cm and 11.66 cm

✘ 4. 12.56 cm and 8.53 cm

Question Type : **MCQ**

Question ID : **414664564**

Status : **Answered**

Chosen Option : **4**

Marks : **-1**

Q.10 Consider a parallel plate capacitor filled with a dielectric of relative permittivity 2. One of the plates has charge density $+\sigma$ while other has charge density $-\sigma$. Assume that the points are not too near the edges of the plates. The magnitudes of the electric field at points P_1 and P_2 respectively are

Ans

✘ 1. $0, \sigma/2\epsilon_0$

✘ 2. $\sigma/\epsilon_0, 0$

✘ 3. $\sigma/2\epsilon_0, -\sigma/\epsilon_0$

✔ 4. $\sigma/2\epsilon_0, 0$

Question Type : **MCQ**

Question ID : **414664569**

Status : **Answered**

Chosen Option : **3**

Marks : **-1**

Q.11 An element of atomic number Z is in the ionized hydrogenic ground state. The largest wavelength that can convert it to a fully ionized state is 3.65 nm. Select the correct statement(s). (1 nm = 10^{-9} m and take the ionization energy of the hydrogen atom to be 13.60 eV.)

Ans ✗ 1.

Its potential energy is 680 eV.

✔ 2. $Z = 5$

✔ 3. Its kinetic energy is 340 eV.

✗ 4. Its Bohr radius is 0.1 nm.

Q.12 A small source of sound is in uniform circular motion of radius R and angular speed $\pi/10$ rad·s^{-1}. It emits continuous sound of fixed frequency f_0. A detector placed at a distance $\sqrt{2}R$ from the centre and in the plane of the circle records frequencies with maximum value 1200 Hz and minimum value 800 Hz. Take the speed of sound to be 330 m.s^{-1}. Select the correct statement(s).

Ans ✗ 1. $R = 240$ m

✔ 2. $f_0 = 960$ Hz.

✔ 3.

The distance of the source from the detector when it emits the signal which is detected to be 800 Hz is 210 m.

✔ 4.

The speed of source is 66 m·s^{-1}.

Q.13 The electric field due to an extended charge distribution spread over all space is given by

$$\vec{E} = \frac{q}{4\pi\epsilon_0 r^2}\left(1 + \frac{r}{\lambda}\right)e^{-\frac{r}{\lambda}}\hat{r}$$

Here λ and q are positive constants and the electrostatic potential is taken to be zero at infinity. Select the correct statement(s).

Ans ✓ 1.

The electrostatic potential is $qe^{-\frac{r}{\lambda}}/4\pi\epsilon_0 r$.

✓ 2. The total charge is zero.

✗ 3.

The flux through a Gaussian sphere centred at the origin and of radius R decreases as we decrease R.

✓ 4.

There is a positive charge at the origin.

Q.14 The coefficient of static friction between a small block and the surface of a horizontal turntable is 0.09. The block is placed at a distance of 0.1 m from the centre of the turntable. At time $t = 0$ s the turntable starts rotating from rest with a constant angular acceleration of 0.5 rad·s^{-2}. The time at which the block starts sliding is t_s. Select the correct statement(s).

Ans ✗ 1.

The angle between the net linear acceleration and radial vector is $\pi/4$ radians.

✓ 2. t_s is 6 s.

✗ 3.

At t_s the angular speed of the turntable is 6 rad·s^{-1}.

✓ 4.

The turntable has rotated through 9 radians.

Q.15 An ice cube of mass 30 g at 0^0 C is left sitting on the kitchen table where it gradually melts and reaches the kitchen temperature of 25^0 C. The latent heat of fusion for ice is 333 J·g^{-1} and the specific heat of water is 4.2 J·g^{-1}·K^{-1}. Select the correct statement(s) about this process. (All numerical values in the answers are rounded to the closest integer.)

Ans ✗ 1.

The entropy of the kitchen does not change.

✓ 2.

When the ice at 0^0C melts to water at 0^0C its entropy change is 37 J·K^{-1}.

✗ 3.

The entropy change of the kitchen is -48 J·K^{-1}.

✓ 4.

The entropy of ice increases.