JGEEBILS General

(1 MARK QUESTIONS)

1. What is the closest estimate of the volume of an adult human in cubic meters?
   a. 2.5
   b. 1.25
   c. 0.1
   d. 0.75

   (ans. c)

2. Indicate all points where graph of $y=x^2$ and $y=x^3$ intersect?
   a. At x=y=0
   b. At x=y=1
   c. At x=y=0 and x=y=1
   d. At x=y=-1

   (ans: c)

3. ChatGPT told me how to write a program to analyze a data file. It was able to do this because:
   a. It has understood both how to interpret my question, and how to write a program to solve my problem.
   b. Somewhere on the internet there is a post which does exactly what I want, and it has read this post.
   c. It has digested enough of the internet to form a representation of word sequences and how they map to code structure.
   d. It is intelligent and runs on supercomputers.

   (ans: c)

4. A clock shows the time as 2:30. Which of the following is an angle, in degrees, between the hour and minute hands of the clock?
   a. 120 degrees
   b. 110 degrees
   c. 180 degrees
   d. 105 degrees

   (ans. d)

5. This question was removed.

6. Which of the following diseases is NOT caused by bacterial infection?
   a. Anthrax
   b. Tetanus
   c. Shingles
   d. Syphilis

   (ans. c)

7. Earth's temperature is increasing as an effect of Green-house effect. Which of the following gas does not participate in the Green-house effect.
   a. Methane
   b. Nitrogen
   c. Carbon dioxide
   d. Ozone

(ans. b)

8. A bacterial population doubles every 2 hours. If the population size is N at this moment, what will be the size of population after 2 days?

N * (2^{48})
N * (2^{24})
N^4
N * (2^{23})

(ans. b)

9. Chandrayaan-3 is the first lunar mission to place a lander
a. at the lunar south pole
b. 60 km from the lunar south pole
c. 600 km from the lunar south pole
d. 2000 km from the lunar south pole

10. At a cricket match between Mumbai Indians (MI) and Chennai Super Kings (CSK), 28% of the spectators are young while the rest are old. If 65% of the spectators are fans of CSK, and 25% of the CSK fans are young, then the percentage of old people among the MI fans is nearest to

a. 66
b. 55
c. 62
d. 59

(2 MARK QUESTIONS)

11. Consider a function $y = x^5 - 4$, then the slope of y vs. x curve will be

a. always positive
b. linearly increasing with increasing x value
c. always an integer
d. increases logarithmically

(ans. a)

12. There are two clocks in a room. One of them loses 5 minutes each hour, while the other gains 5 minutes each hour. Assuming the two clocks were set at 12:00pm on Tuesday, how much time needs to elapse before the two clocks show exactly the same time again?

a. 6 days
b. 5 days
c. 4 days
d. They will never show the same time again

(ans. a)

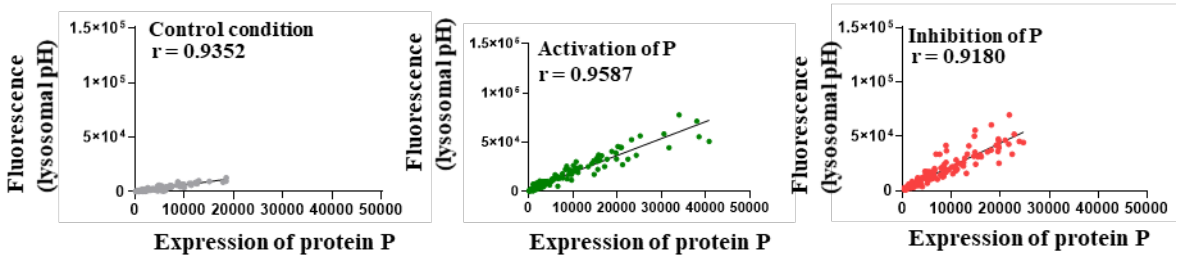
13. If a pair of 6-faced dice is rolled, what sum of the two numbers are you most likely to get:

a. 9
b. 12
c. 7
d. 8

(ans. c)

14. This question was removed.

15. Protein P function can be activated as well as inhibited by adding specific ligands. In an experimental set up, a student measured the expression level of protein P (in arbitrary units) and lysosomal pH of individual cells in different conditions. These values are plotted where relative expression of protein P in plotted in X axis and lysosomal pH is plotted in Y axis (values from each cell is represented by dots). The corresponding correlation coefficient (r) values were also calculated. Based on this information, which statement is most correct?

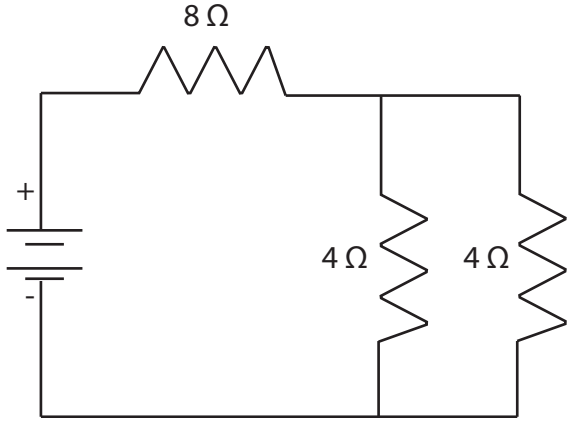


a) Protein P may function as a regulator of lysosomal pH irrespective of its expression
a) Protein P may function as a regulator of lysosomal pH irrespective of its activation or inhibition
c) Protein P may function as a regulator of lysosomal pH irrespective of its expression, activation or inhibition
d) Protein P is less-likely to be involved in the regulation of lysosomal pH in any conditions.

(ans. c)

JGEEBILS Physics

1. The total resistance of the electrical circuit, depicted below, is



a. 18 Ω
b. 12 Ω
c. 10 Ω
d. 8 Ω

(ans. c)

2. When a monochromatic light passes from air into water, which statement is true?
a. Its speed and frequency decrease
b. Its frequency stays the same and its wavelength decreases
c. Its speed decreases and its wavelength increases
d. Its frequency, speed and wavelength stay the same

3. A giant refracting telescope has an objective lens with a focal length of 15 m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope?
a. 15
b. 150
c. 1500
d. 1.5

(ans. c)

4. Near-sightedness (myopia) is caused by the length of the eyeball becoming too long. Therefore, it can be corrected by
a. A convex lens
b. A concave lens
c. Either concave or convex as long as it has the right focal length
d. A lens that is convex on one side and concave on the other

5. If a simple pendulum with mass m, length L has a time-period T on Earth, its time-period when moved to a planet with one-fourth the acceleration due to gravity will be
a. 2*T
b. 4*T
c. T/2
d. T/4

(ans. a)

6. Consider filling water up to a height h cm in a cylindrical bottle which has height 10cm, radius 3cm and mass 20g and is sitting on flat ground. At what approximately what height h will the centre of mass of the bottle+water be closest to the ground?

a. 0 cm
b. 2 cm
c. 8 cm
d. 10 cm

(ans. b)

7. If a 100 bp DNA molecule is stretched by 1 bp, what is the stress and strain acting on the molecule? Given: Young's modulus of elasticity of DNA is 1 Gigapascal

a. Strain is 1% and stress is 10^6 Pa
b. Strain is 1% and stress is 10^7 Pa
c. Strain is 10% and stress is 10^7 Pa
d. Strain is 10% and stress is 10^6 Pa

(ans. b)

8. Kirchoff's first law ($\sum i = 0$) and second law ($\sum iR = \sum E$), where the symbols have their usual meanings, are based on which laws respectively:

a. Conservation of charge, conservation of energy
b. Conservation of charge, conservation of momentum
c. Conversation of energy, conservation of momentum
d. None of the above

9. Two wires are made of the same material and have the same volume. However, wire 1 has a cross-sectional area A, and wire-2 has a cross-sectional area 3A. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

a. 9F
b. 4F
c. 6F
d. F

10. If a charged particle with charge q Coulombs and mass m moves with a speed v perpendicular to a magnetic field of B $kg/s^2/A$, then mv/(qB) is proportional to:

a. the radius of its circular path
b. the pitch of its helical path
c. the volume swept by the trajectory
d. the current due to the moving charge

11. Consider a system of two point particles with particles having distinct masses m1 and m2. If the first particle is pushed towards the centre of mass through a distance d, by what distance should the second particle be moved, so as to keep the centre of mass at the same position?

a. (m1/m2)*d
b. d
c. ((m1+m2)/m2)*d
d. (m2/m1)*d

(2 marks)

12. This question was removed.

13. Which of the following statements is correct about the energy required for spectroscopic transitions?

a. Electronic transition>Rotational transitions>Vibrational transitions> Nuclear spin transition
b. Rotational transition>Electronic transition>Vibrational transition>Nuclear spin transition

c. Nuclear spin transition>Rotational transition>Vibrational transition>Electronic transition
d. Electronic transition>Vibrational transition>Rotational transition>Nuclear spin transition

(ans. d) 2 marks

14. Consider a spherical bacterial cell which has a diameter 2 μm. The density of the cell is 1 g/mL, the dry weight of the cell is roughly 30 percent of its total, and half of that mass is protein. Calculate the protein mass in this cell.

a. 62 pg
b. 0.62 pg
c. 6.2 pg
d. 620 pg

2 marks

15. A car starting from rest accelerates at the rate R through a distance S, then continues at a constant speed for time t and then decelerates at rate R/2 to come to rest. If the total distance travelled is 15S, then:

a. $S= 1/72\ Rt^2$
b. $S= 1/12\ Rt^2$
c. $S= 1/36\ Rt^2$
d. None of above

2 marks

CHEMISTRY

1. An organic compound contains C, H and S. If it contains 4% Sulphur by weight, the minimum molecular mass of the compound is

a. 200
b. 400
c. **800**
d. 600

2. Arrange the following compounds in increasing order of C-OH bond length: Methanol, phenol, *p*-ethoxyphenol

a. Phenol<*p*-ethoxyphenol<methanol
b. Phenol<methanol<*p*-ethoxyphenol
c. *p*-ethoxyphenol< Methanol<phenol
d. Methanol<phenol<*p*-ethoxyphenol

3. Which enzyme can be a catalyst like perchloric acid in Baeyer-Villiger reaction

a. trypsin
b. flavin monoxygenase
c. chymotrypsin
d. alcohol dehydrogenase

4. The pKa of the amino group of a zwitterion is 9.6. In a 0.1 M solution of the zwitterion at pH=9.0, what percentage of the amino group of the zwitterion is protonated?

a. 80%
b. 40%
c. 20%
d. 1%

5. During the process of oxidative phosphorylation, which molecule acts as the terminal electron acceptor.

a. Hydrogen
b. Phosphate
c. Water
d. Oxygen

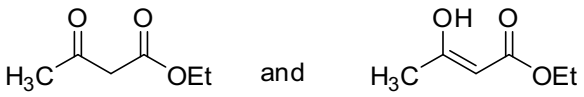
6. Which is a better electrophilic center?

a. $CH_3(CO)CH_3$
b. $CH_3(CO)Cl$
c. $CH_3(CO)H$
d. $CH_3(CO)Br$

7. The two strands of DNA double helix are linked to each other by

a. Hydrogen bonds between sugar
b. Phosphodiester bond between sugar
c. Hydrogen bonds between bases
d. Phosphodiester bond between bases

8. The pair of following compounds is an example of



a. Functional isomers
b. Positional isomers
c. Stereo isomers
d. None

9. What does allosteric inhibition of an enzyme by a ligand mean?

a. The binding of a ligand to the enzyme inhibits the binding of cognate substrate at the same binding site

b. The binding of a ligand to the enzyme inhibits the binding of the cognate substrate at the different binding site

c. Ligand binds with protein covalently

d. All the binding sites are occupied by the ligand

10. In the case of a Fluorescence Resonance Energy Transfer, the

a. The "Energy donor" has a smaller excitation wave-length and "Energy acceptor" has a larger excitation wave-length

b. The "Energy donor" has a larger excitation wave-length and "Energy acceptor" has a smaller excitation wave-length

c. Both the "Energy donor" and "Energy acceptor" have same excitation wave-length

d. Both the "Energy donor" and "Energy acceptor" have same emission wave-length

2 marks

11. Protein 'X' contains 192 amino acids and mono-ubiquinated at two residues. What could be the probable molecular weight of the protein? [Molecular weight of ubiquitin is 8 kDa]

a. 11 kDa

b. 20 kDa

c. 37 kDa

d. 28 kDa

12. A kinesin motor moves at 1.8 μm/sec. If it is walking on a microtubule of 10 mm in length, how long will it take to cover the entire distance?

a) 30 min

b) 90 min

c) 5 min

d) 55 min

13. The molecular formula for amino acid, glycine is $C_2H_5O_2N$. What would be the molecular formulae for a linear peptide made by linking ten glycine molecules by condensation synthesis?

a. $C_{20}H_{50}O_{20}N_{10}$

b. $C_{20}H_{48}O_{18}N_{10}$

c. $C_{20}H_{32}O_{11}N_{10}$

d. $C_{20}H_{50}O_{10}N_{10}$

14. In a unidirectional reaction, the conversion of molecules X to Y follows second-order rate kinetics. If the concentration of X increases by 3 times, what will be the change in the rate of formation of Y?

a. Increase by 6 times

b. Decrease by 6 times

c. Increase by 9 times

d. Decrease by 9 times

15. Some carbonated beverages are made by forcing carbon dioxide gas into a beverage solution. When a bottle of one kind of carbonated beverage is first opened, the beverage has a pH value of 3. After the beverage bottle is left open for several hours, the hydronium ion concentration in the beverage solution decreases to 1/100th of the original concentration. What is the new pH of the beverage solution

a. 5

b. 10

c. 3

d. 6

1. A dachshund is a type of dog with short stature. Beagles are normal-sized. The progeny of a dachshund/beagle mating are all short-statured. Half of the puppies that are produced with the beagle/dachshund progeny when mated with a beagle have short legs; the other half are normal-sized. What does this tell you about short stature?

a. There is a complex non-mendelian mode of inheritance for short stature in dachshund.
b. Short stature is a recessive trait
c. Normal stature is a dominant trait
d. Short stature is a dominant trait

2. Which of the following options regarding an mRNA formed by bacterial transcription is correct?

a. The transcription start site occurs a few bases before the start codon.
b. The first 3 bases of the mRNA have to be $^{5'}$AUG$^{3'}$.
c. The transcription start site occurs a few bases after the start codon.
d. The last 3 bases of the mRNA always correspond to one of the three stop codons.

3. The number of alleles possible for a gene is:

a. 2
b. Infinite
c. 4
d. 1

4. How does an adaptation, such as better running speed, evolve with natural selection?

a. Natural selection directionally produces better adaptation over time, gradually leading to better running speed.

b. Natural selection makes individuals with favourable traits such as better running speed more attractive, ensuring they produce more offspring

c. Natural selection involves random mutations, some of which are beneficial adaptations. Heritable beneficial adaptations lead to offspring with higher survival.

d. Natural selection produces individuals with favourable traits, such as better running speed, who survive better. Individuals with unfavourable traits do not survive, ensuring that all individuals in future populations have better running speeds.

5. Despite the large number of unique mutations described in the LDL-R gene that cause familial hypercholesterolemia, certain mutations are found in high frequency in specific populations, e.g., the 9.5 kb 3' deletion is found in 35% of Finnish patients. This is an example of:

a. Variable expressivity
b. Allelic heterogeneity
c. Founder effect
d. Locus heterogeneity

6. In our body skin cells and muscle cells share the same DNA. Which of the following is true

a. Although they share the same DNA, both have a different genetic code so the proteins expressed are different.
b. The statement is incorrect, they are different tissues so there is a difference in their DNA.
c. The statement is true, they differ though in the genes they transcribe and translate.
d. The statement is true, the skin cells and muscle cells differ in how many copies of DNA they have.

7. Which of the following techniques **cannot** be used to quantify affinity between an enzyme and its peptide substrate?

a. X-ray crystallography
b. Isothermal calorimetry

c. Surface plasmon resonance
d. Fluorescence anisotropy

8. Which of the following statements is correct regarding the increase in molecular weight of proteins due to each of these post-translational modifications?

a. Methylation<Acetylation<Phosphorylation<Myristoylation
b. Methylation<Acetylation<Myristoylation<Phosphorylation
c. Myristoylation<Phosphoryalation<Acetylation<Methylation
d. Acetylation<Methylation<Phosphorylation<Myristoylation

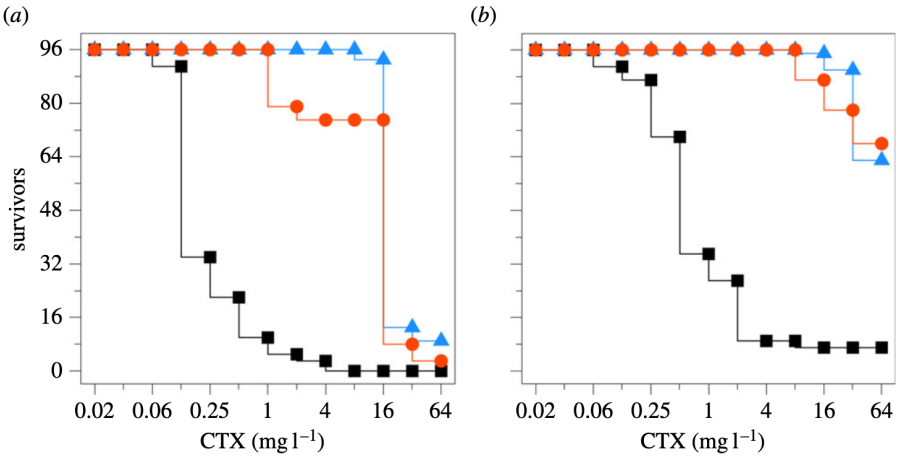
9. You are carrying out an enzyme reaction in the lab and obtain Km and Vmax values. While repeating the experiment, you use only 1/10th of the enzyme. What would you observe?

a. You would get the same result because enzyme is the same and hence properties are unchanged
b. Vmax would change but Km remains the same
c. Vmax would remain same and Km would be 1/10th of the original value
d. Both Vmax and Km would decrease

10. Rich fishing grounds (that is those that have high species diversity and population), such as those found in Northern Japan or around Iceland, occur where cold and warm ocean currents mix. This is because:

a. Upwelling of cold currents bringing nutrients to the surface supporting phytoplankton blooms, providing food for many fish.
b. Warm currents bring nutrients from river run-offs. Cold currents carry fish. Eddies set up where the currents mix form marine habitats for many fish
c. Cold water sinks, leaving warmer water closer to the surface allowing algae to bloom.
d. Ocean currents act as highways for many fish species, where two or more currents meet one would expect increased marine life.

11. Researchers passaged three different strains of *E. coli* (black squares = WT, red circles and blue triangles = mutants) for several days, gradually increasing concentration of the antibiotic cefotaxime (CTX) (n=96 replicate populations per strain). Some populations went extinct during the experiment. The plots below show the number of surviving populations of each strain (y axis) as a function of antibiotic concentration (x axis). Panel A shows data for strains carrying one copy of the beta lactamase gene, and panel B shows data for strains carrying multiple copies of this gene. Given these results, which statement is incorrect?



a. 0.25 mg/L CTX is sufficient to kill half the WT bacteria
b. Adaptation to CTX is enhanced by the beta-lactamase gene
c. Copy number of beta-lactamase changes the probability of extinction
d. Beta lactamase is not the only factor affecting population survival

12. The mitochondrial F-Type ATPase is a remarkable protein machine in which a subunit rotates during H+ transport, and 1 ATP is generated for 120 degrees of revolution. ATP hydrolysis releases ~50kJ/mol, and the transport of H+ costs about 19 kJ/mol. While the exact number depends on cell conditions, approximately how many protons need to cross the membrane to achieve a full revolution?

a. 1/3
b. 1
c. 3
d. 9

13. A peptide has the following sequence ATHMARAMEN. At pH 3.7, the net charge of the peptide is likely to be

a. +1
b. +2
c. -1
d. -2

14. A neuron makes three synapses on a muscle cell to produce a sudden movement. However, each synapse is unreliable and only conveys a signal with a probability of 0.5. Successful signal propagation by any one of the three synapses will result in muscle contraction. What is the probability that the muscle will contract when the neuron fires?

a. 7/8
b. 3/2
c. 3/8
d. 1/8

15. In an in vitro transcription experiment, the transcript and both the strands of DNA were separated and analyzed for their base composition. The result obtained is shown in the following table. Determine which DNA strand is serving as the template for mRNA synthesis.

	G	**A**	**T**	**C**	**U**
DNA Strand 1	23.8	30	26	20	0
DNA Strand 2	20	26.2	30	24.1	0
mRNA	24	29.6	0	20	25.8

a. Strand 1
b. Both strands 1 and 2.
c. Strand 2.
d. Inconclusive data