Previous Year

Solved Question Paper

of

JGEEBILS GS BIOLOGY 2010

BIOLOGICAL SCIENCE

Examination

(Original Question Paper with Answer Key)

Joint Graduate Entrance Exam in Biology and Interdisciplinary Life Sciences

For more question papers, please visit: www.easybiologyclass.com

TATA INSTITUTE OF FUNDAMENTAL RESEARCH
GS2010 NATIONWIDE DBS/NCBS WRITTEN TEST
Subject: Biology [Instructions]

Hall Ticket Reference Code:

1. Please provide all the information requested on both sides of the answer sheet. The address and email id provided will be used in all future correspondence. Please make sure the information provided is valid till May-June 2010.

2. This is an objective type test in 4 parts. All 4 parts are to be attempted. All questions are Multiple Choice Questions (MCQs). Each question has only one correct answer and must be indicated by completely blackening the appropriate circle by **pencil**. Blackening of more than one circle will be regarded as invalid/improper. Fill out the one you choose as shown in the example below:

if your choice is b

3. Answers are to be indicated in the answer sheet provided and NOT in this set of question papers.

4. Use only **HB Pencils** to mark your answers on the answer sheet. If you have forgotten to bring one, please request the invigilators to give you one.

5. Do not write below the line drawn on the answer sheets. You will be given paper for rough work. The last page of the question paper can also be used for rough work.

6. Note that there is negative marking. Each correct answer gets you one mark for questions 1-10 and two marks for questions 11-15. Each wrong answer costs you ½ a mark.

7. Calculators may be used for the examination.

8. The time allowed for the exam is **2 hours.** You may submit your answer sheets earlier if you finish earlier.

9. The Answer sheet should not be folded.

10. This set of question papers and extra sheets requested for rough work must be returned along with your answer sheet. **Do not use the Hall Ticket for rough work as it would have to be turned in with your answer sheet**.

GS2010 TEST PAPER FOR BIOLOGY
SECTION A: GENERAL

1. Enzymes act by
    a. Increasing the activation energy for a reaction
    b. Lowering the activation energy for a reaction
    c. Increasing the free energy of the system
    d. decreasing the free energy of the system

    Ans. b

2. Where would you expect to find chemosynthetic organisms?
    a. Deep-sea thermal vents
    b. Hypersaline lakes, like the Dead Sea
    c. Streams polluted with domestic sewage
    d. Polar ice-caps

    Ans. a

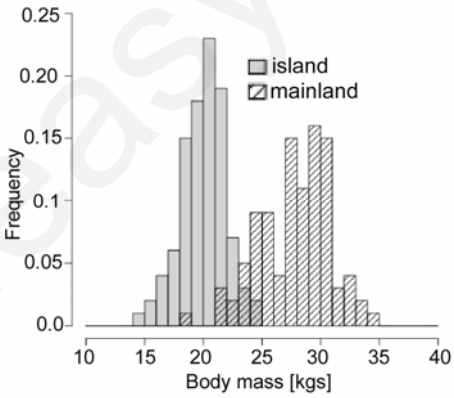
3. A carbon footprint is
    a. a greenhouse gas emission
    b. a way to make accurate tracings of animal track
    c. the amount of carbon stored within a living thing
    d. the total amount of circulating carbon in the biosphere

    Ans. a

4. If the frequency of having light colored hair in the human population is 0.4, and that of having dimples is 0.5, then what is the probability that any given individual will have either light colored hair or dimples or both? (Assume that these traits are independent of one another.)
    a. 0.7
    b. 0.3
    c. 0.6
    d. 0.2

    Ans. a

5. The figure shows frequency distributions of body weights of island and mainland Spotted Deer. Based on this, which of the following statements is NOT true?



    a. Island deer are smaller than mainland deer
    b. A deer with a weight of 26Kg is likely to be from the mainland
    c. Island deer have larger variance in weight than mainland deer
    d. A deer with a weight of 22 Kg is likely to be from the island

    Ans. c

6. We want to know whether two groups of infants are different in birth weight. After analysing the data, our conclusion should depend on
   a. how different the mean birth weight is between the groups
   b. the degree of within-group variation in birth weight
   c. both a and b
   d. neither

   Ans. c

7. Of two balls of identical mass and diameter one is hollow and the other solid. The moment of inertia of the hollow sphere compared to that of the solid sphere is:
   a. Higher
   b. Lower
   c. The same
   d. Cannot be determined with the information provided

   Ans. a

8. How many numbers between 100 and 300 begin or end with 2?
   a. 40
   b. 110
   c. 120
   d. 25

   Ans. b

9. Which of the following statements about operons is correct?
   a. Operons always contain a minimum of three genes
   b. Operons sometimes contain more than one promoter
   c. Genes in eukaryotic cells are organized into operons
   d. Operons function to suppress gene activity

   Ans. b

10. You and your friend are traveling on a spacecraft which moves with respect to the stars at close to the speed of light. Compared to the situation when you were both on Earth, you will observe the following:

    a. Your friend's mass would increase
    b. Your friend's heart rate will increase
    c. Both (a) and (b) will happen simultaneously
    d. Neither (a) nor (b) will happen.

    Ans. d

11. Suppose a long metal wire girdles the equator and that the earth is girdled with a second wire that has a 16 feet clearance from the ground. If the circumference of the earth at the equator is 25,000 miles, how much longer will the second wire be compared to the first?
    a. 32 feet
    b. 100 feet
    c. 100 miles
    d. 32 miles

    Ans. b

12. In an experiment with "treatment" and "control", the "control" is important because
    a. it tells us what happens when the intervention of interest is not carried out
    b. the response from the treatment and control must be added together
    c. the control is the main variable of interest; the treatment is subsidiary
    d. it is a traditional part of experimentation

    Ans. a

13. During World War II, the Commander of the Allied Air Force was tasked with bombing a Japanese shipping convoy. The Japanese could sail by one of two possible routes, but the Allies had only enough aircraft to concentrate on one of these. The number of days Japanese ships would be exposed to Allied bombs is given in the following table:

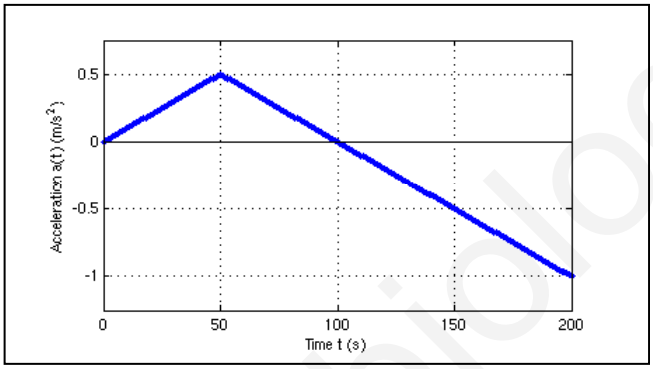
		Japanese choice	
		Sail Northern route	Sail Southern route
Allied choice	Patrol Northern route	2 days	2 days
	Patrol Southern route	1 day	3 days

Assuming that the Japanese want to minimize their exposure, and that the Allies want the reverse, what should the Allied Commander do?

a. Patrol the Northern route
b. Patrol the Southern route
c. Patrol either route the outcome will be the same on average
d. This question cannot be answered without knowing what the Japanese choice is.

Ans. a

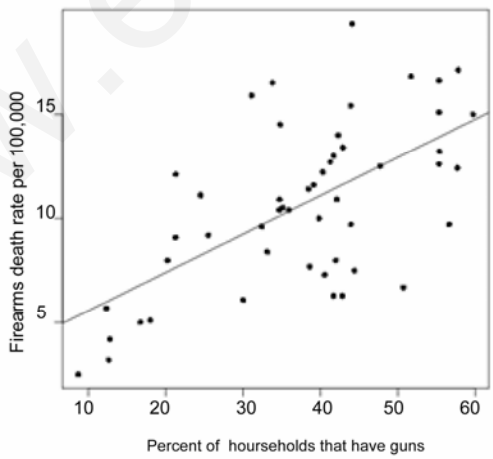
14. A car starts from rest, and undergoes acceleration as shown on the graph below:
At what time is the velocity of the car maximal?



a. At $t = 50$s
b. At $t = 100$s
c. At $t = 150$s
d. At $t = 200$s

Ans. b

15. The figure shows the relationship between gun ownership levels and deaths caused by firearms. Which of the following must be true?



a. Increasing the number of guns in circulation results in an increased rate of death from guns
b. Increasing the death rate from guns results in an increase in the number of guns in circulation
c. A third variable is independently causing an increase in gun ownership and in firearms death rate.
d. More information is needed to establish the interplay between gun ownership and death rates.

Ans. d

SECTION B: PHYSICS

1. A 1000 Kg car is moving with a velocity of 100 metre/sec. How fast should a 250 Kg motorcycle move to have the same kinetic energy as the truck?
   a. 400 metre/sec
   b. 200 metre/sec
   c. 100 metre/sec
   d. None of the above

   Ans. b

2. The magnitude of root mean square velocity of oxygen atoms in an oxygen cylinder kept at zero degrees Centigrade is
   a. Lesser than the average velocity of the atoms
   b. Greater than the average velocity
   c. Equal to the average velocity
   d. There is no correlation between these two quantities

   Ans. b

3. Two resistances R1 and R2 yield the same equivalent resistance when they are connected in parallel or in series. If R1 = 3 Ohms, the value of R2 is
   a. 3 Ohms
   b. 6 Ohms
   c. 1/3 Ohms
   d. 1/6 Ohms

   Ans. c

4. For sound waves, decibel (dB) is a measure of
   a. Wavelength
   b. Frequency
   c. Amplitude
   d. Intensity

   Ans. d

5. Ramesh comes to your house to buy back old newspapers every month. He uses a spring balance to weigh the newspapers and then pays you at the rate of 10 Rupees/kg. He bought this spring balance two years ago. You advice Ramesh to change the spring balance because:
   a. You are losing money
   b. Ramesh is losing money
   c. Depends on the rate at which Ramesh is buying back the newspapers
   d. Reason cannot be determined from the information given

   Ans. b

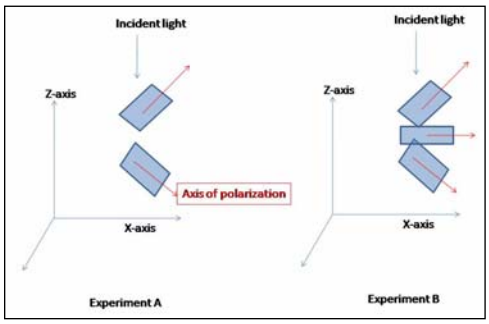
6. Four 100 Watt bulbs connected in series will approximately consume in ten hours an energy of
   a. Four commercial units of electricity
   b. Four hundred watts
   c. Four Kilowatts
   d. 250 watt-hours

   Ans. d

7. If you see a person traveling through space at half the velocity of light, clocks with him will run
   a. At half the normal speed
   b. Slower than half the normal speed
   c. Slower but not slowed down to half the speed
   d. backwards

   Ans. c

8. Consider two experimental set-ups 'A' and 'B', with stacks of polarizers. In both cases we start with two polarizers stacked over each other and separated by 2 cm distance. The lower polarizer has the plane of polarization aligned along -45 degreed to x-axis. The upper polarizer has the plane of polarization aligned along +45 degrees to x-axis. In experiment 'B' we introduce another polarizer between the existing two polarizers, with plane of polarization aligned along the x-axis. Incident light source is an ordinary incandescent light bulb. Which of the following is true, about the intensity of transmitted light onto XY-plane, in the two experiments?



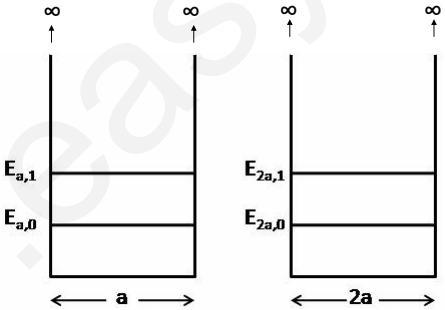
   a. Transmitted light intensity in 'A' is higher than that in 'B'.
   b. Transmitted light intensity in 'A' is lower than that in 'B'.
   c. Transmitted light intensity in 'A' is equal to that in 'B'.
   d. Transmitted light intensity in both 'A' and 'B' is zero.

Ans. c

9. Take a metallic sphere with radius R and a charge Q. What is the electric field just inside the surface and just outside the surface?
   a. Q/4πR2 inside and zero outside
   b. Zero inside and Q/4πR2 projecting outwards
   c. Uniform fields inside and outside of Q/4πR2 projecting outwards
   d. Zero everywhere since the charge is symmetrically distributed over the sphere.

Ans. b

10. Consider the problem of a particle in a one dimensional box as shown. Compare the ground state energies



   a. $E_{a,0} = E_{2a,0}$
   b. $E_{a,0} > E_{2a,0}$
   c. $E_{a,0} < E_{2a,0}$
   d. $2E_{a,0} = E_{2a,0}$

Ans. b

11. An archaeologist discovers a collection of radioactive chemicals in bottles in a shipwreck from 200 years ago. Which among the compounds containing following isotopes is more likely to be chemically pure?
    a. C14 is 2500 years Half Life
    b. Cobalt 60 Half life 5. 26 years
    c. Radon 220 Half Life 3.8 days
    d. It is only a Radioactive decay and does not affect chemical properties.

    Ans. c

12. A large hollow sphere filled with water is tied to the end of a 2 feet long string and the other end is tied to a beam. The sphere is now allowed to swing and the period of oscillation determined. If during the course of this experiment the sphere springs a leak the period of oscillation will:
    a. Remain constant even as the water drains of completely
    b. Increase continuously till all water drains and remain constant at the highest value.
    c. Increase continuously till it reaches a maximum and then abruptly decrease to the initial value
    d. Decrease continuously till it reaches a minimum and then abruptly increase to the initial value

    Ans. c

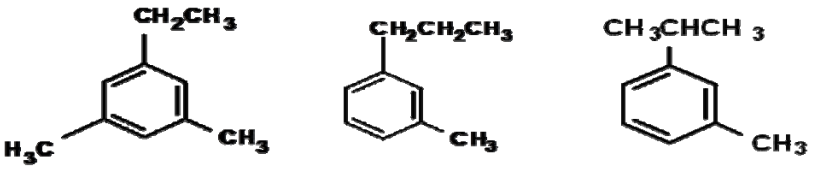
13. Consider the following situations: A large block of ice with a big bubble of air trapped inside (I); Ice with a ball of steel trapped inside (II); Ice with an amount of water trapped inside (III) are floating in buckets of water separately. Water levels were marked at the beginning. When all ice is melted:
    a. Water level in all three will rise above the initial mark
    b. Water level in (II) will go up while (I) and (III) will go down
    c. Water level in (II) will go down while that in (I) will go up
    d. Water level in (II) will go down and other two remain the same ***Ans. d***

14. A 1 metre radius ring spins around its axis at 10 revolutions per second. It is now dropped to the ground, where it rolls steadily in a straight line. Assuming it does not lose any energy to friction, what is its final speed?
    a. 1.5 m/sec
    b. 2.5 m/sec
    c. 3.5 m/sec
    d. 4.5 m/sec ***Ans. d***

15. A satellite moves at 8 Km/sec at an altitude of 200 Km. How long does it take to pass from horizon to horizon, if its orbit takes it directly overhead? Radius of earth = 6400 Km. Hint: Altitude is much less than Radius of earth, so you can make useful approximations.
    a. 150 sec
    b. 400 sec
    c. 650 sec
    d. 800 sec ***Ans. b***

SECTION C: CHEMISTRY

1. In a mass spectrometer, small organic molecules often fragment. The base peak appears at m/z=105 for one of the following compounds and at m/z =119 for the other two. Match the m/z values with the molecules.



I II III

   a. m/z(II, III)=119, m/z (I) = 105
   b. m/z(I, II)=119, m/z (III) = 105
   c. m/z(I, III)=119, m/z (II) = 105
   d. m/z(I)=119, m/z (II, III) = 105

Ans. c

2. The product of reacting Hexene with Br_2 is:
   a. $Br\text{-}CH_2\text{-}CHBr\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$
   b. $CH_3\text{-}CH_2\text{-}CBr_2\text{-}CH_2\text{-}CH_2\text{-}CH_3$
   c. $CH_3\text{-}CH_2\text{-}CHBr\text{-}CHBr\text{-}CH_2\text{-}CH_3$
   d. They do not react in the absence of a catalyst

Ans. a

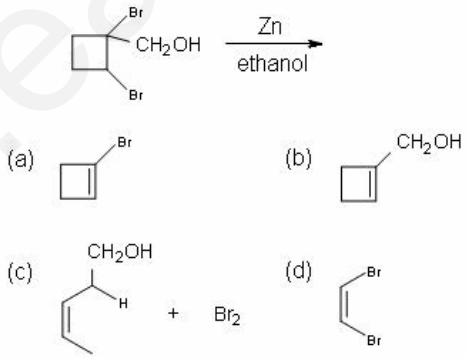
3. Which of the following statements is true for CH_3+ and CH_3
   a. Both have trigonal planar geometry
   b. Both have tetrahedral geometry
   c. CH_3+ is trigonal planar and CH_3- is tetrahedral
   d. CH_3- is trigonal planar and CH_3+ is tetrahedral

Ans. c

4. Which of the following is the most stable form of bromocyclohexane?
   a. Chair form with Br in the equatorial position
   b. Chair form with Br in the axial position
   c. Boat form with Br in the equatorial position
   d. Boat form with Br in the axial position

Ans. a

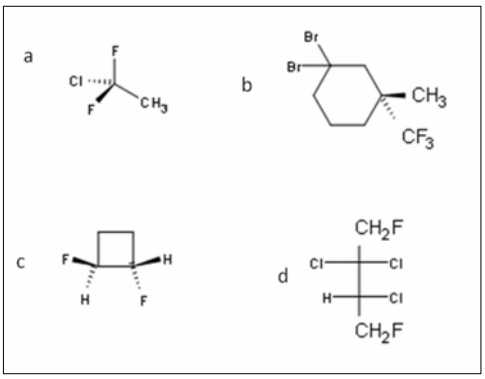
5. Identify the product of this reaction:



   a. Molecule (a) is the product
   b. Molecule (b) is the only product
   c. Molecules (a) and (c) are products
   d. Molecule (c) is the only product

Ans. b

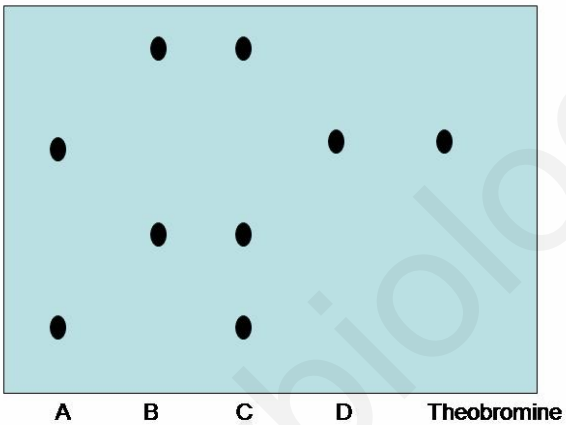
6. Which of the following molecules is **achiral**?



a. Molecules b and c
b. Molecule a
c. Molecules c and d
d. Molecules a and c

Ans. b

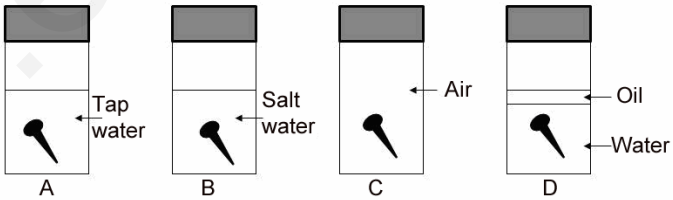
7. Four food samples were tested using a chromatogram for the presence of theobromine. Which of the following foods contain the substance?



a. Foods A and D
b. Food A
c. Foods C and D
d. Food C

Ans. a

8. In which of the following will the nail rust the fastest?



a. In C
b. C and B will be equal
c. In B
d. In A

Ans. c

9. A mixture of KCl and $KClO_3$ weighing 1.8 gms was heated. After the reaction, the dry oxygen gas generated occupied 140 ml at STP. What percent of original mixture was $KClO_3$?
   a. 28.4%
   b. 37.5%
   c. 42.6%
   d. 64.8%

   Ans. a

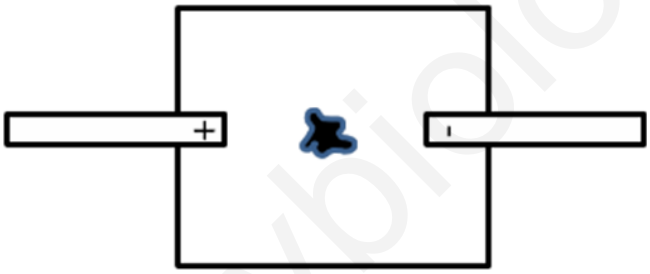
10. The pKa of Xanthine monophosphate (XMP) is 5.5. A certain experiment can detect all forms of a solute molecule present in solution at greater than 10% of the total solute concentration. At pH 7, the experiment will detect presence of:
   a. Neutral XMP and deprotonated XMP
   b. Deprotonated XMP
   c. Neutral XMP
   d. None of the above

   Ans.b

11. Using molecular orbital theory or otherwise, arrange the molecules KO_2, O_2, and $O_2[AsF_6]$ in decreasing order of the O-O bond length
   a. $KO_2 > O_2 > O_2\ [AsF_6]$
   b. $O_2 > O_2\ [AsF_6] > KO_2$
   c. $O_2\ [AsF_6] > O_2 > KO_2$
   d. $KO_2 > O_2[AsF_6] > O_2$

   Ans. a

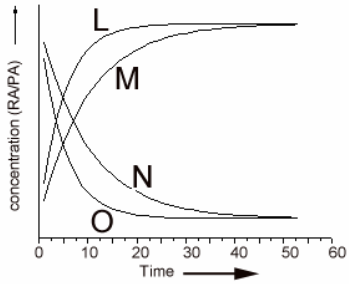
12. In an experiment 'E-A' potassium chromate was placed in the centre of a wet filter paper and electrodes were connected as shown. Which of the following do you expect to observe?



   a. Yellow color at positive terminal
   b. Purple color at negative terminal
   c. Yellow color at negative terminal
   d. Purple color at positive terminal

   Ans. c

13. In a reaction RA converts to PA in the presence of a catalyst. Two experiments were carried out and the concentration of RA and PA were followed in time. In one experiment, the catalyst was 100 µM and in another it was doubled. The data is shown in the graph below. Which of the following is not true?



a. Curves M and N represent experiment one and curves L and O represent experiment two.
b. L and M represent product concentration and N and O represent reactant concentration.
c. Steady state concentration in both experiments is the same.
d. Curves L and N result from experiment one and curves M and O result from experiment two.

Ans. c

14. The lattice energy of solid NaCl is 180 kcal/mole. The dissolution of the solid in water in the form of ions is endothermic to the extent of 1 kcal/mole. If the hydration energies of Na+ and Cl^- ions are in the ratio 6:5, what is the enthalpy of hydration of sodium ion?
a. -85.6 kcal/mole
b. -97.5 kcal/mole
c. 82.6 kcal/mole
d. none of the above

Ans. b

15. When one drop (0.20 cm^3 say) of 1.0 mol dm^{-3} HCl (aq) is added to 25 cm^3 of pure water, the resulting hydronium ion concentration rises to 0.0080 mol dm^{-3} and so the pH changes from 7.0 to 2.1, a big change. Now suppose the drop is added to 25 cm^3 of an acetate buffer solution that is 0.040 mol dm^{-3} NaCH3CO2 (aq) and 0.080 mol dm^{-3} CH3COOH(aq). What will be the change in pH?
a. 0.14
b. 4.9
c. 4.45
d. 0.2

Ans. a

SECTION D: BIOLOGY

1. When Mathew was a boy he hammered a nail into the trunk of a young Ashoka tree (10 feet tall) 3 inches above the ground. He found the tree last year grown to a height of 30 feet. Where should he look for the nail?

   a. 10 feet above the ground.
   b. 3 inches above the ground
   c. 9 inches above the ground
   d. 7.5 feet above the ground.

   Ans. b

2. A messenger RNA is 336 bases long including the initiation and terminator codons. The number of amino acids in the polypeptide translated from this is:
   a. 110
   b. 333
   c. 111
   d. 600

   Ans. c

3. A mutation occurs in the lac repressor protein such that it can no longer bind to lactose. What effect will this mutation have on expression of proteins of the lac operon in the presence of lactose?
   a. It will have no effect since lactose shuts off the operon.
   b. It will decrease expression of the lac operon proteins.
   c. It will increase the expression of lac operon proteins.
   d. It will have no effect since the operon is modulated by another protein.

   Ans. b

4. If mammals rely on their cellular metabolism to generate enough heat to keep warm, how would you expect the mass-specific metabolic rate (ie, metabolic rate per unit mass) to change:
   a. The mass-specific metabolic rate of large mammals should be higher than that of small mammals
   b. The mass-specific metabolic rate of small mammals should be higher than that of large mammals
   c. Mass-specific metabolic rate should be independent of size
   d. None of the above

   Ans. b

5. A honeybee colony consists of:
   a. equal numbers of males and females, with all able to reproduce
   b. mostly males, with only a single male being able to reproduce
   c. mostly females, with only a single female being able to reproduce
   d. equal numbers of males and females, with none able to reproduce

   Ans. c

6. Which process reverses the greenhouse gas effect in the atmosphere?
   a. photosynthesis
   b. transpiration
   c. enteric fermentation in livestock
   d. burning fossil fuels

   Ans. a

7. If a species contains 23% adenine in its DNA, then the percentage of guanine in it's DNA would be:
   a. 23%
   b. 46%
   c. 54%
   d. 27%

Ans. d

8. A frameshift mutation undergoes reversion to wildtype. What are the ways in which reversion could occur?
   a. deletion of two bases
   b. a missense mutation next to the original mutation
   c. an inversion within the mutated gene
   d. insertion of two bases

Ans. a

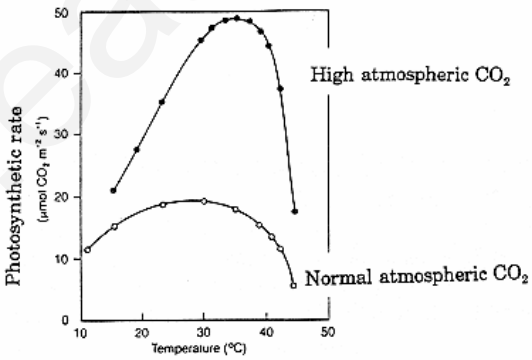
9. If an affected male marries a normal female and produces affected daughters and sons in about the same number as unaffected daughters and sons, the trait is likely to be an
   a. X-linked dominant trait
   b. Autosomal recessive trait
   c. Autosomal dominant trait
   d. X-linked recessive trait

Ans. c

10. Mustansir is carrying out an enzyme reaction in the laboratory and obtains a Km and Vmax value. He repeats the experiment but this time uses only 1/10th (one tenth) of the enzyme. What would he find?
    a. He would get the same result because the enzyme is the same and hence the properties are unchanged.
    b. the Vmax would change but Km would remain the same
    c. The Vmax is fixed but the Km would be 1/10th the original value.
    d. There would be a long lag in the start of the reaction because the enzyme concentration is less, but finally the enzyme would achieve the same Km and Vmax given sufficient time.

Ans. b

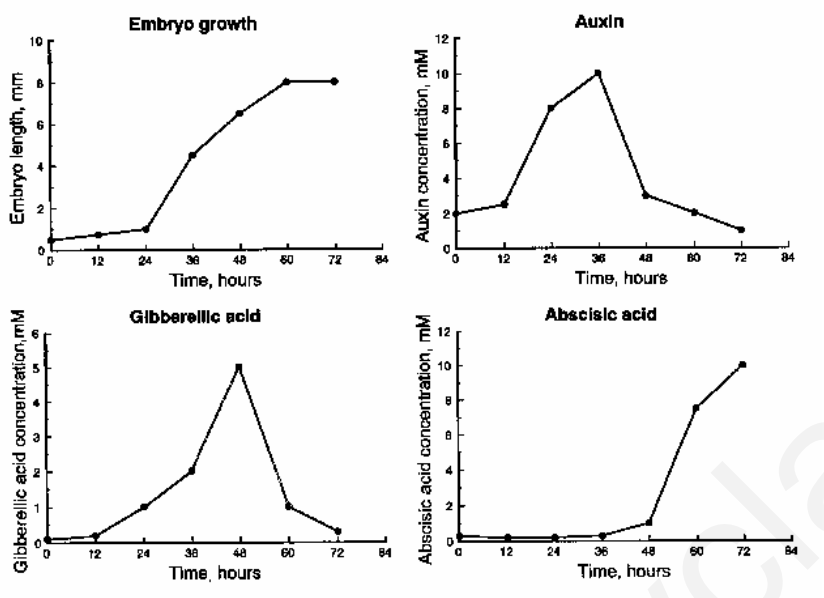
11. Increased levels of atmospheric CO2 result in the "greenhouse effect" and thus global climatic warming. The graph below shows the effect of these changes on photosynthesis. Which of the following statements about these processes is FALSE?



   a. At temperatures below 20°C, high atmospheric CO2 concentrations reduce photosynthesis to values below those seen for plants growing in normal CO2 concentrations.
   b. One result of increased levels of atmospheric CO2 will be to increase rates of photosynthesis in most plants.
   c. At high CO2 concentrations, the highest rates of photosynthesis are measured at temperatures between 30° and 35°C.
   d. CO2 concentration is normally rate-limiting for photosynthesis.

Ans.c

12. Plant hormones play a role in regulating the development of plant seeds. The graphs below plot embryo growth and the changes in hormone concentration over time. Based on these results, which hormone(s) most likely regulate(s) embryo growth?



a. Auxin alone
b. Gibberellic acid alone
c. Abscisic acid alone
d. Both Auxin and Gibberellic acid

Ans.d

13. A biologist studied the environmental impact of a herbicide on squirrel reproduction. He selected two small islands with similar vegetation and similar-sized squirrel populations (about 200 squirrels) with equal reproductive rates. One island, selected at random, was sprayed with herbicide, and the other was used as a control. Squirrel reproduction rates were measured on both islands before and after the treatment. What is the greatest flaw in this investigation?

a. Lack of controls.
b. Lack of replication.
c. Lack of randomization.
d. Lack of variables

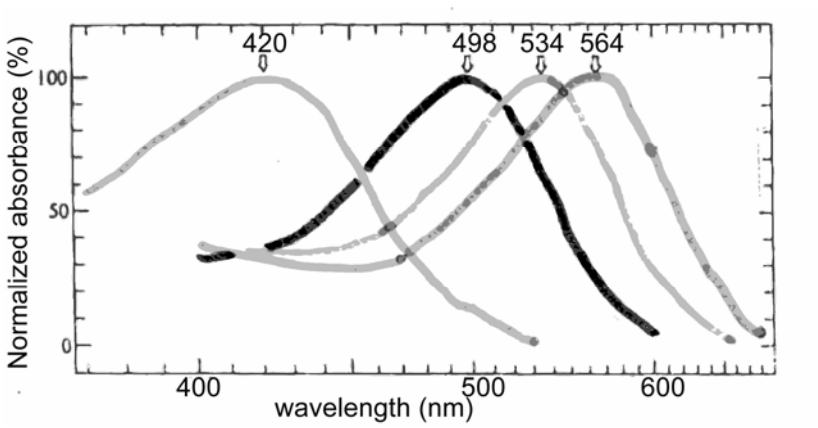
Ans.b

14. Soumya was purifying an enzyme from a homogenate of muscle cells. She went through seven steps of purification and found that the enzyme activity was the same as the homogenate value. On the eighth step, when the protein was highly pure, the enzyme activity rose to five times that of the homogenate value. Can you suggest a possible reason?

a. The homogenate assays are wrong
b. Step eight has co-purified an activator of the enzyme
c. The enzyme has an inhibitor present in the muscle cell homogenate
d. The temperature at step eight was just right for the enzyme activity

Ans. c

15. An organism has 4 visual pigments with spectra as shown. This organism will have colour vision all through the displayed spectrum except that colours of objects reflecting light in the following spectral regions cannot be distinguished from each other:



a. Between 350 nm and 400 nm
b. Between 450 nm and 500 nm
c. Between 498 nm and 564 nm
d. Between 600 nm and 650 nm

Ans. a