SMART SOCIETY INTERNATIONAL SCIENCE OLYMPIAD (SSISO)

Organized by

Department of Basic Science and Humanities
INSTITUTE OF ENGINEERING & MANAGEMENT,
IEM-UEM GROUP and SMART SOCIETY, USA

TOTAL QUESTIONS: 50

DURATION: 1 HOUR

INSTRUCTIONS TO THE CANDIDATES:

1. The question booklet is divided into 3 sections.
   Section A - Physics and Chemistry (20 Questions)
   Section B - Advanced Physics and Chemistry (15 Questions)
   Section C - Biology (15 Questions)
2. In section A, each question carries 2 marks. In Section B, each question carries 2 marks. In section C, each question carries 2 marks.
3. All questions are compulsory. There is no negative marking. Use of a calculator is not permitted.
4. There is only one correct answer.
5. To mark your choice of correct answers, darken the circles on the OMR sheet. For this purpose, use HB pencil or black ball point pen.
6. Rough work should be done in the blank space provided at the end of the booklet.
7. Return the OMR sheet to the invigilator at the end of the examination.
8. Please fill in your personal details in the space provided below.

NAME: .....

SCHOOL NAME: .....

CONTACT DETAILS OF GUARDIAN: .....

SECTION A

PHYSICS AND CHEMISTRY

1. A closed coil having 50 turns, area 300 cm^2, is rotated from a position where its plane makes an angle of 45° with a magnetic field of flux density 2.0 T to a position perpendicular to the field in a time of 0.1 s. What is the average EMF induced in the coil?

   a) 6.10 V b) 9.56 V

   c) 8.80 V d) 1 V

2. The magnetic field at a point on the magnetic equator is found to be 3.1 x 10 T. Taking the earth's radius to be 6400 km, calculate the magnetic moment of the assumed dipole at the earth's centre.

   a) $8.1 \times 10^{22}\ Am^2$

   b) $9.0 \times 10^{25}\ Am^2$

   c) $6.7 \times 10^{24}\ Am^2$

   d) None of these

3. If the polarizing angle of a piece of glass for green light is 54.74°, then the angle of minimum deviation for an equilateral prism made of same glass is :

   a) 45° b) 60°

   c) 54.74° d) 30°

4. A parallel beam of light passes parallel to the principal axis and falls on one face of a thin convex lens of focal length f and after two internal reflections from the second face forms a real image. The distance of the image from the is lens if the refractive index of material of lens is 1.5:

   a) f/7 b) f/2

   c) 7f d) f/5

5. An experiment is done to determine the half life of a radioactive substance that emits one beta particle of each decay process. Measurements show that an average of 8.4 beta particles are emitted each second by 2.5 milligram of the substance. The atomic weight of the substance is 230 a. m. u Find the half life of the substance.

   a) 6.78×10^{20} years

   b) 1.71×10^{10} years

   c) 6.78×10^{18} years

   d) 7.46×10^{18} years

6. A magnetic flux through a stationary loop with a resistance R varies during the time interval tau as $\varphi = a.t(\tau - t)$ Find the amount of heat generated in the loop during that time. The inductance of the loop is to be neglected.

   a) $a^3\tau^4/(2R)$ b) $a^3\tau^3/(3R)$

   c) $a^2\tau^3/(3R)$ d) $a^3\tau^2/(4R)$

7. In order to increase the resistance of a given wire of uniform cross section to four times its value, a fraction of its length is stretched uniformly till the full length of the wire becomes 1.5 times the original length. What is the value of this fraction?

   a) ¼ b) 1/8

   c) 1/16 d) 1/6

8. A prism is found to produce a minimum deviation of 38°. It produces a deviation of 44° when the angle of incidence is either 42° or 62°. What will be the angle of incidence when it undergoes minimum deviation?

   a) 45° b) 40°

   c) 49° d) 55°

9. A speech signal of 3 kHz is used to modulate a carrier signal of frequency 1 MHz, using amplitude modulation. The frequencies of the side bands will be

   a) 1.003 MHz and 0.997 MHz.

   b) 1003 kHz and 1000 kHz.

c) 3001 kHz and 2997 kHz.

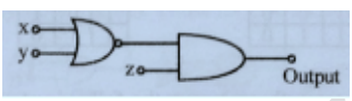
d) 1 MHz and 0.997 MHz.

10. A conducting circular loop made of a thin wire, has area 3.5×10^{-3} m^2 and resistance 10π. It is placed perpendicular to a time dependent magnetic field $B(t) = (0.4T)\ \sin(50\pi t)$. The field is uniform in space. Then the net charge flowing through the loop during t = 0 s and t = 10 ms is close to :

a) 14 mC b) 21 mC

c) 6 mC d) 7 mC

11. In which of the following cases, we would obtain an output of one.



a) $X = 1, Y = 1, Z = 1$

b) $X = 1. Y = 1, Z = 0$

c) $X = 0, Y = 1, Z = 1$

d) $X = 0, Y = 0, Z = 1$

12. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at one atm pressure. The oxidation potential of the electrode would be

a) 0.118 V b) 1.18 V

c) 0.059 V d) 0.59 V

13. 0.5 molal aqueous solution of a weak acid (HX) is 20% ionized. If K_f for water is 1.86 K kg mol^{-1}, the lowering in freezing point of the solution is

a) 0.56 K b) 1.12 K

c) -0.56 K d) -1.12 K

14. If 60% of a first order reaction was completed in 60 minutes, 50% of the same reaction would be completed in approximately (log 4 = 0.60, log 5 = 0.69)

a) 45 minutes b) 60 minutes

c) 40 minutes d) 50 minutes.

15. Red precipitate is obtained when ethanol solution of Dimethylglyoxime is added to ammoniacal Ni(II). Which of the following statements is not true?

a) Red complex has a square planar geometry.

b) Complex has symmetrical H-bonding.

c) Red complex has a tetrahedral geometry.

d) Dimethylglyoxime functions as bidentate ligand

16. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of ∞-hydroxy acid. The carbonyl compound is

a) Formaldehyde b) Acetaldehyde

c) Acetone d) Diethyl ketone.

17. The oxidation of glucose is one of the most important reactions in a living cell. What is the number of ATP molecules generated in cells from one molecule of glucose?

a) 28 b) 38

c) 12 d) 18

18. For the four successive transition elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order?

a) Mn > Fe > Cr > Co

b) Fe > Mn > Co > Cr

c) Co > Mn > Fe > Cr

d) Cr > Mn > Co > Fe

19. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal (at 25°c) For this process, the correct statement is

a) The adsorption requires activation at 25°C

b) The adsorption is accompanied by a decrease in enthalpy

c) The adsorption increases with increase of temperature

d) The adsorption is irreversible

20. When the first electron gain enthalpy (ΔH) of oxygen is -141 kJ/ mol, its second electron gain enthalpy is

a) a positive value

b) a more negative value than the first

c) almost the same as that of the first

d) negative, but less negative than the first

SECTION B

ADVANCED PHYSICS AND CHEMISTRY

21. A metal surface is illuminated by light of two different wavelengths 248 nm and 310 nm. The maximum speeds of the photoelectrons corresponding to these wavelengths are u_1 and u_2, respectively. If the ratio $u_1 : u_2 = 2 : 1$ and hc = 1240 eV nm, the work function of the metal is nearly :-

a) 3.7 eV b) 3.2 eV

c) 2.8 eV d) 2.5 ev

22. Three concentric conducting spherical shells carry charges +4Q on the inner shell, -2Q on the middle shell and +6Q on the outer shell. The charge on the inner surface of the outer shell is:

a) 0 b) 4Q

c) -Q d) -2Q

23. All electrons ejected from a surface by incident light of wavelength 2000 Å can be stopped before travelling 1 m in the direction of uniform electric field of 4 N/c) The work function of the surface is:

a) 4 eV b) 6.2 eV

c) 2 eV d) 2.2 eV

24. Two short electric dipoles having dipole moment P_1 and P_2 are placed co-axially and uni-directionally, at a distance r apart. Calculate the nature and magnitude of force between them.

a) Attraction, $1/(4\pi€_0) .(6p1p2/r^4)$

b) Repulsion, $1/(4\pi€_0) .(6p1p2/r^4)$

c) Repulsion, $1/(4\pi€_0) .(2p1p2/r^4)$

d) Attraction, $1/(4\pi€_0) .(3r^4/p1p2)$

25. The eyepiece and objective of a microscope, of focal lengths 0.3 m and 0.4 m respectively, are separated by a distance of 0.2 m. The eyepiece and the objective are to be interchanged such that the angular magnification of the instrument remains same. What is the new separation between the lenses?

a) 0.7750 m b) 0.3565 m

c) 0.3 m d) 2.7750 m

26. In a Young's Double Slit Experiment, 12 fringes are observed to be formed in a certain segment of the screen when light of wavelength 600 nm is used. If the wavelength of light is changed to 400 nm, number of fringes observed in the same segment of the screen is given by

a) 12 b) 18

c) 24 d) 30

27. Two coils have mutual inductance of 0.005 H. The current changes in the first coil according to equation I = I sin ωt, where I = 10A and ω = 100π rad/s. The maximum value of EMF induced in the second coil is:

a) 2π b) 5π

c) π d) 4π

28. Two slits are separated by 0.3 mm. A beam of 500 nm light strikes the slits producing an interference pattern. The number of maxima observed in the angular range $-30° < 0 < 30°$.

a) 300 b) 150

c) 599 d) 602

29. Thermal decomposition of a Mn compound (X) at 513 K results in compound (Y), MnO_2 and a gaseous product. MnO_2 reacts with NaCl and concentrated H_2SO4 to give a pungent gas Z. X, Y and Z respectively, are

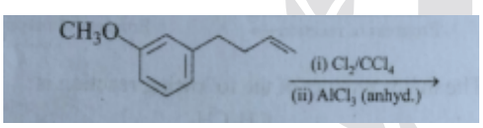
a) K_3MnO_4, K2MnO_4 and Cl_2

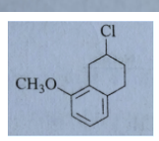
b) $KMnO_4$, K2MnO_4 and Cl_2

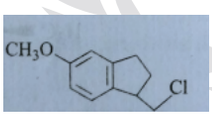
c) K_2MnO_4, $KMnO_4$ and So_2

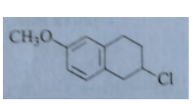
d) K_2MnO_4, $KMnO_4$ and Cl_2

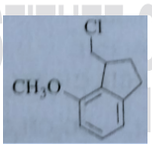
30. The major product of the following reaction is



a) 

b) 

c) 

d) 

31. Given below are two statements:

Statement-I: The boiling points of aldehydes and ketones are higher than hydrocarbons of comparable molecular masses because of weak molecular association in aldehydes and ketones due to dipole-dipole interactions.

Statement-II: The boiling points of aldehydes and ketones are lower than the alcohols of similar molecular masses due to the absence of H-bonding.

In the light of the above statements, choose the most appropriate answer from the options given below:

a) Both statement-I and statement-II are correct.

b) Both statement-I and statement-II are incorrect.

c) Statement-I is correct but statement-II is incorrect.

d) Statement-I is incorrect but statement-II is correct.

32. A solution has a 1:4 mole ratio of pentane to hexane. The vapor pressures of the pure hydrocarbons at 20 °C are 440 mm Hg for pentane and 120 mm Hg for hexane. The mole fraction of pentane in the vapor phase would be

a) 0.200 b) 0.549

c) 0.786 d) 0.478

33. The half-life of a substance in a certain enzyme-catalyzed reaction is 138 s. The time required for the concentration of the substance to fall from 1.28 mg L^{-1} to 0.04 mg L^{-1} is

a) 414 s b) 552 s

c) 690 s d) 276 s

34. For a reaction scheme, A→B at rate k_1 and B→C at rate k_2 then, if the rate of formation of B is set to be zero then the concentration of B is given by

a) $k_1k_2[A]$ b) $(k_1/k_2)[A]$

c) $(k_1-k_2)[A]$ d) $(k_1+k_2)[A]$

35. Given below are two statements:

Statement I: In Lucas test, primary, secondary and tertiary alcohols are distinguished on the basis of their reactivity with conc. HCl + $ZnCl_2$, known as Lucas Reagent.

Statement II: Primary alcohols are most reactive and immediately produced turbidity at room temperature on reaction with Lucas Reagent. In the light of the above statements, choose the most appropriate answer from the options given below.

a) Both statements I and statement II are

correct.

b) Both statement I and statement II are incorrect.

c) Statement I is correct but statement II is incorrect.

d) Statement I is incorrect but statement II is correct.

SECTION C

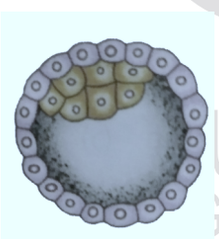
BIOLOGY

36. Transmission tissue is a characteristic feature of

a) Dry stigma b) hollow style

c) wet stigma d) Solid style.

37. Identify the human developmental stage and select the right option that shown in the given figure:



Developmental stage	Site of occurrence
a) Late morula	Ampulla
b) Blastula	Cervix
c) Blastocyst	Uterine wall
d) 8 celled morula	Infundibulum

38. Capacitation occurs in

a) Epididymis

b) Female reproductive tract

c) Rete testis.

d) Vas deferens

39. During parturition, a pregnant woman is having prolonged labour pain and childbirth has to be fastened. It is advisable to administer a hormone that can:

a) Increase the metabolic rate

b) Release glucose in the blood

c) Stimulate the ovary

d) Activate smooth muscles

40. How many different types of genetically different gametes will be produced by a heterozygous plant having the genotype AABbCc?

a) Six b) Two

c) Nine d) Four

41. The recombination frequency between the genes a & c is 5%, b & c is 15%, b & d is 9%, a & b is 20%, c & dis 24% and a & d is 29%. What will be the sequence of these genes on a linear chromosome?

a) A, d, b, c b) a, b, c, d

c) D, b, a, c d) A, c, b, d

42. What will be the sequence of mRNA produced by the following stretch of DNA?

3'ATGCATGCATGCATG5'TEMPLATE STRAND

5' TACGTACGTACGTAC3' CODING STRAND

a) 3'AUGCAUGCAUGCAUG5'

b) 5'UACGUACGUACGUAC 3'

c) 3'UACGUACGUACGUAC 5'

d) 5'AUGCAUGCAUGCAUG 3'

43. A patient brought to a hospital with myocardial infarction is immediately given

a) Penicillin b) Streptokinase

c) Cyclosporin-A d) Statins.

44. Gause's principle of competitive exclusion states that

a) no two species can occupy the same niche indefinitely for the same limiting resources

b) larger organisms exclude smaller ones through competition

c) more abundant species will exclude the less abundant species through competition

d) Competition for the same resources exclude species having different food preferences.

45. What triggers the activation of protoxin to active toxin of Bacillus thuringiensis in bollworm?

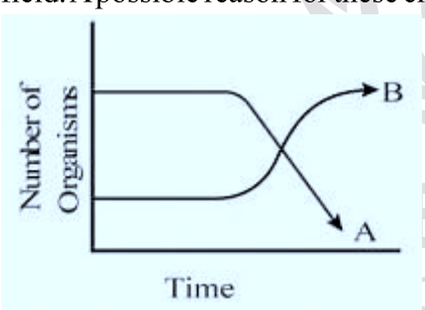
a) Acidic pH of stomach

b) Body temperature

c) Moist surface of midgut

d) Alkaline pH of gut

46. The following graph depicts changes in two population A and B of herbivores in a grassy field. A possible reason for these changes is that:



a) Population A produced more offspring than population b)

b) Population A consumed the members of population b)

c) Both plant populations in this habitat decreased.

d) Population B competed more successfully for food than population a)

47. The population of an insect species shows an explosive increase in numbers during rainy season followed by its disappearance at the end of the season. What does this show?

a) The food plants mature and die at the end of the rainy season.

b) Its population growth curve is of J-type.

c) The population of its predators increases enormously.

d) S-shaped or sigmoid growth of this insect.

48. Statements related to human insulin are given below. Which statement(s) is/are correct about genetically engineered insulin?

a) A-peptide and B-peptide chains of insulin were produced separately in E.coli, extracted and Combined by creating disulphide bond between them.

b) Pro-hormone insulin contains extra stretch of C-peptide

c) Insulin used for treating diabetes was extracted from cattle and pigs.

d) Pro-hormone insulin needs to be processed for converting into a mature and functional hormone.

e) Some patients develop allergic reactions to the foreign insulin.

Choose the most appropriate answer from the Options given below:

a) (A), (B) and (D) only

b) (B) only

c) (C) and (D) only

d) (C), (D) and E only

49. Given below are two statements:

Statement I: Restriction endonucleases recognize Specific sequence to cut DNA known as palindromic nucleotide sequence.

Statement II: Restriction endonucleases cut the DNA strand a little away from the centre of the palindromic site.

In the light of the above statements, choose the most appropriate answer from the options given below:

a) Both Statement I and Statement II are

correct.

b) Both Statement I and Statement II are incorrect.

c) Statement I is correct but Statement II is incorrect.

d) Statement I is incorrect but Statement II is correct

50. Which of the following statements is correct regarding evolution of mankind?

a) Homo erectus is preceded by Homo habilis.

b) Neanderthal man and cro-magnon man were living at the same time.

c) Australopithecus was living in Australia.

d) None of these

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