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 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 quantity x is given by (IFv^2/WL^4) in terms of Moment of Inertia(I), Force(F), Velocity(v), Work(W) and Length L. The dimensional formula of x is same as that of

a) Coefficient of Viscosity

b) Force Constant

c) Energy Density

d) Planck's Constant

2) A physical quantity 'y' is represented by the formula $y=m^2r^{-4}gl^{-1.5}$. If the percentage errors found in y,m,r,l,g are 18,1,0.5,4 and p respectively then the value of x and pare

a) 16/3 and ±3/2 b) 8 and ±2

c) 4 and ±3 d) 5 and ±2

3) A body is thrown vertically upward with velocity u. The distance travelled by it in the 7^{th} and 8^{th} second are equal. The displacement in the 8^{th} second is equal to n metre. The value of n is: (Take $g=10m/s^2$)

a) 7 b) 5.6

c) 6 d) 5.0

4) A helicopter rises from rest on the ground vertically upwards with a constant acceleration g. A food packet is dropped from the helicopter when it is at a height h.The time taken by the packet to reach the ground is close to [g is the acceleration due to gravity]

a) $t=3.4\sqrt{(h/g)}$ b) $t=1.8\sqrt{(h/g)}$

c) $t=\sqrt{0.67(h/g)}$ d) $t=0.67\sqrt{(h/g)}$

5) The position of a particle as a function of time t is given by

$x(t)=at+bt^2-ct^3$

where, a, b, c are constants. When the particle attains zero acceleration the velocity at that time will be:

a) $a+(b^2/4c)$ b) $a+(b^2/3c)$

c) $a+(b^2/2c)$ d) $a+(b^2/c)$

6) A particle is performing circular motion in a circle of radius R in such a way that at every moment magnitude of its tangential and radial acceleration is equal. If initial velocity of particle is v_0 then time period of first revolution is:

a) R/v_0 b) $R/v_0(1-e^{-2\pi})$

c) $R/v_0(e-^{2\pi})$ d) $2\pi R/v_0$

7) A ball is thrown upward with initial velocity v_0 from the surface of the earth.The motion of the ball is affected by a drag force equal to $m\alpha v^2$ (where m is the mass of the ball, v is the instantaneous velocity and α is a constant).Time taken by the ball to reach to its zenith:

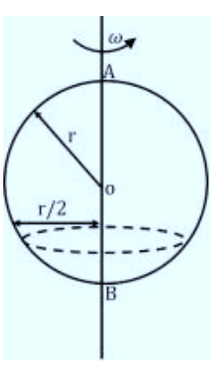
a) $1/\sqrt{\alpha g}\sin^{-1}(\sqrt{(\alpha/g)}v_0)$

b) $1/\sqrt{\alpha g}\ln(1+\sqrt{(\alpha/g)}v_0)$

c) $1/\sqrt{\alpha g}\tan^{-1}(\sqrt{(\alpha/g)}v_0)$

d) $1/\sqrt{2\alpha g}\tan^{-1}(\sqrt{(2\alpha/g)}v_0)$

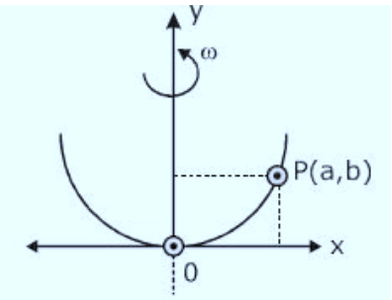
8) A smooth wire of length 2πr is bent into a circle and kept in a vertical plane. A bead can slide smoothly on the wire. When the circular frame is rotating with angular speed ω about the vertical diameter AB, the bead is at rest with respect to the circular frame at the position shown in the figure. Then, the value of ω^2 is equal to:



a) $(g\sqrt{3})/r$ b) $2g/r$

c) $2g/(r\sqrt{3})$ d) $\sqrt{3}g/2r$

9) A bead of mass m stays at point P(a,b) on a wire bent in the shape of a parabola $y=4Cx^2$ and rotating with angular speed ω (see figure). The value of ω is (neglect friction):



a) $2\sqrt{2gC}$ b) $2\sqrt{GC}$

c) $\sqrt{(2g/C)}$ d) $\sqrt{(2gC/ab)}$

10. In the determination of Young's modulus ($Y=4MLg/\pi Ld^2$) by using Searle's method, a wire of length L = 2 m and diameter d = 0.5 mm is used) For a load M = 2.5 kg, an extension λ = 0.25 mm in the length of the wire is observed. Quantities d and λ are measured by using a screw gauge and a micrometer, respectively. They have the same pitch of 0.5 mm. The number of divisions on their circular scale is 100. The contributions to the maximum probable error of the Y measurement

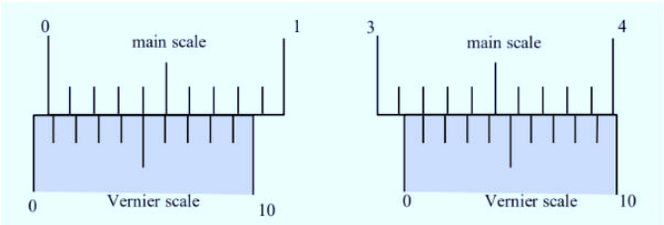
a) due to the errors in the measurements of d and λ are the same.

b) due to the error in the measurement of d is twice that due to the error in the measurement of λ.

c) due to the error in the measurement of λ is twice that due to the error in the measurement of d.

d) due to the error in the measurement of d is four time that due to the error in the measurement of λ.

11. The smallest division on the main scale is 0.1 cm. Ten divisions of the Vernier scale correspond to nine divisions of the main scale. The figure below on the left shows the reading of this calipers with no gap between its two jaws. The figure on the right shows the reading with a solid sphere held between the jaws. The correct diameter of the sphere is



a) 3.07 cm b) 3.11 cm

c) 3.15 cm d) 3.17 cm

12. One mole of an ideal gas at 300 K in thermal contact with surroundings expands isothermally from 1.0 L to 2.0 L against a constant pressure of 3.0 atm. In this process, the change in entropy of surrounding (ΔS_{surr}) in JK^{-1} is (1L atm = 101.3 J)

a) 5.763 b) 1.013

c) −1.013 d) −5.763

13. Hydrogen gas will not reduce

a) heated cupric oxide

b) heated ferric oxide

c) heated stannic oxide

d) heated aluminium oxide

14. Dissolving 120 g of urea (mol. wt. 60) in 1000 g of water gave a solution of density 1.15 g/mL. The molarity of the solution is

a) 1.78 M b) 2.00 M

c) 2.05M d) 2.22 M

15. LIST-I contains compounds and LIST-II contains reactions

List-I	List-II
(I) H_2O_2	(P) $Mg(HCO_3)_2+Ca(OH)_2\rightarrow$
(II) $Mg(OH)_2$	(Q) $BaO_2+H_2SO_4\rightarrow$
(III) $BaCl_2$	(R) $Ca(OH)_2+MgCl_2\rightarrow$
(IV) $CaCO_3$	(S) $BaO_2+HCl\rightarrow$
	(T) $Ca(HCO_3)_2+Ca(OH)_2\rightarrow$

Match each compound in LIST-I with its formation reaction(s) in LIST-II, and choose the correct option

a) $I \rightarrow Q; II \rightarrow P; III \rightarrow S; IV \rightarrow R$

b) $I \rightarrow T; II \rightarrow P; III \rightarrow Q; IV \rightarrow R$

c) $I \rightarrow T; II \rightarrow R; III \rightarrow Q; IV \rightarrow P$

d) $I \rightarrow Q; II \rightarrow R; III \rightarrow S; IV \rightarrow P$

16. Assuming 2s – 2p mixing is NOT operative, the paramagnetic species among the following is

a) Be_2 b) B_2

c) C_2 d) N_2

17. Stability of the species Li_2, Li_2- and Li^{2+} increases in the order of :

a) $Li_2 < Li_2^+ < Li_2^-$

b) $Li_2^- < Li_2^+ < Li_2$

c) $Li_2 < Li_2 - < Li_2^+$

d) $Li_2^- < Li_2 < Li_2^+$

18. Which of the following set of molecules will have zero dipole moment?

a) Boron trifloride, hydrogen fluoride, carbon dioxide, 1, 3-dichlorobenzene.

b) Nitrogen trifluoride, beryllium difluoride, water, 1,3-dichlorobenzene

c) Boron trifluoride, beryllium difluoride, carbon dioxide, 1,4-dichlorobenzene

d) Ammonia, beryllium difluoride, water, 1,4-dichlorobenzene.

19. A mixture of potassium chlorate, oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number?

a) S b) H

c) Cl d) C

20. (I) $H_2O_2 + 0_3 \rightarrow H_2O + 2O_2$

(ii) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$ Role of hydrogen peroxide in the above reactions is respectively:

a) Oxidizing in (i) and reducing in (ii)

b) Reducing in (i) and oxidizing in (ii)

c) Reducing in (i) and (ii)

d) Oxidizing in (i) and (ii)

SECTION B

ADVANCED PHYSICS AND CHEMISTRY

21. An ideal gas is expanding such that PT^2 = constant. The coefficient of volume expansion of the gas is

a) 1/T b) 2/T

c) 3/T d) 4/T

22. STATEMENT-1 Two cylinders, one hollow (metal) and the other solid (wood) with the same mass and identical dimensions are simultaneously allowed to roll without slipping down an inclined plane from the same height. The hollow cylinder will reach the bottom of the inclined plane first.

STATEMENT-2 By the principle of conservation of energy, the total kinetic energies of both the cylinders are identical when they reach the bottom of the incline.

a) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is a correct explanation for STATEMENT-1

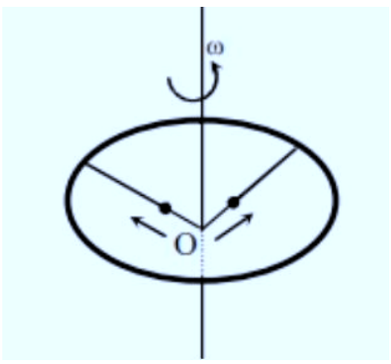
b) STATEMENT-1 is True, STATEMENT-2 is True; STATEMENT-2 is NOT a correct explanation for STATEMENT-1

c) STATEMENT -1 is True, STATEMENT-2 is False

d) STATEMENT -1 is False, STATEMENT-2 is True

23. A ring of mass M and radius R is rotating with angular speed ω about a fixed vertical axis passing through its centre O with two point

masses each of mass M/8 at rest at O. These masses can move radially outwards along two massless rods fixed on the ring as shown in the figure. At some instant the angular speed of the system is 8/ 9 ω and one of the masses is at a distance of 3 R /5 from O. At this instant the distance of the other mass from O is



a) 2 R /3 b) 1 R/ 3

c) 3 R /5 d) 4 R/ 5

24. A uniform capillary tube of inner radius r is dipped vertically into a beaker filled with water. The water rises to a height h in the capillary tube above the water surface in the beaker. The surface tension of water is σ. The angle of contact between water and the wall of the capillary tube is ϑ. Ignore the mass of water in the meniscus. Which of the following statements is true?

a) For a given material of the capillary tube, h decreases with increase in r

b) For a given material of the capillary tube, h is independent of σ

c) If this experiment is performed in a lift going up with a constant acceleration, then h does not change

d) h is proportional to contact angle

25. Two satellites P and Q are moving in different circular orbits around the Earth (radius R). The heights of P and Q from the Earth surface are hP and hQ, respectively, where hP = R/3. The accelerations of P and Q due to Earth's gravity are gP and gQ, respectively. If gP/gQ = 36/25, what is the value of hQ

a) 3R/5 b) R/6

c) 6R/5 d) 5R/6

26. A bar of mass $M = 1.00\ kg$ and length $L = 0.20\ m$ is lying on a horizontal frictionless surface. One end of the bar is pivoted at a point about which it is free to rotate. A small mass m = 0.10 kg is moving on the same horizontal surface with 5.00 $m\ s^{-1}$ speed on a path perpendicular to the bar. It hits the bar at a distance L/2 from the pivoted end and returns back on the same path with speed v. After this elastic collision, the bar rotates with an angular velocity ω. Which of the following statements is correct?

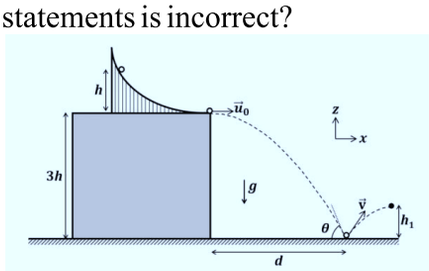
a) $\omega = 6.98\ rad\ s^{-1}$ and $v = 4.30\ m\ s^{-1}$

b) $\omega = 3.75\ rad\ s^{-1}$ and $v = 4.30\ m\ s^{-1}$

c) $\omega = 3.75\ rad\ s^{-1}$ and $v = 10.0\ m\ s^{-1}$

d) $\omega = 6.80\ rad\ s^{-1}$ and $v = 4.10\ m\ s^{-1}$

27. A slide with a frictionless curved surface, which becomes horizontal at its lower end, is fixed on the terrace of a building of height 3h from the ground, as shown in the figure. A spherical ball of mass m is released on the slide from rest at a height h from the top of the terrace. The ball leaves the slide with a velocity $u_0 = u_0\hat{x}$ and falls on the ground at a distance d from the building making an angle 0 with the horizontal. It bounces off with a velocity $\vec{v}$ and reaches a maximum height $h1$. The acceleration due to gravity is g and the coefficient of restitution of the ground is $1/\sqrt{3}$. Which of the following statements is incorrect?



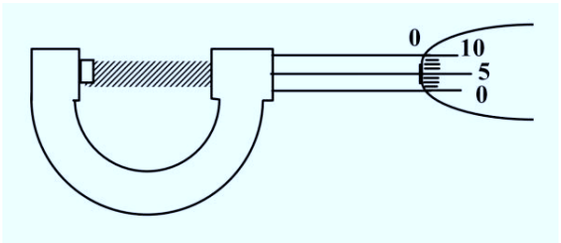
a) $\vec{u_0} = \sqrt{2}gh\hat{x}$

b) $\vec{v} = gh(\hat{x} - \hat{z})$

c) $\theta = 60°$

d) $d/h = 2\sqrt{3}$

28. The circular divisions of the shown screw gauge are 50. It moves 0.5 mm on the main scale in one rotation. Main scale reading is 2. The measured diameter of a ball using this screw gauge is:



a) 2.25 mm b) 2.20 mm

c) 2.01 mm d) 1.25 mm

29. A solid cylinder of mass m and radius r is rolling on a rough inclined plane of inclination θ. The coefficient of friction between the cylinder and incline is μ. Then find the incorrect statement.

a) frictional force is always μmg cos θ

b) friction is a dissipative force

c) by decreasing θ, frictional force decreases

d) friction opposes translation and supports rotation.

30. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be

a) −2.55 eV b) −5.1 eV

c) −10.2 eV d) +2.55 eV

31. Number of oxygen atoms in the formula of fuming sulphuric acid is:

a) 5 b) 8

c) 7 d) 6

32. A closed vessel contains 10 g of an ideal gas X at 300 K, which exerts 2 atm pressure. At the same temperature, 80 g of another ideal gas Y is added to it and the pressure becomes 6 atm. The ratio of root mean square velocities of X and Y at 300 K is

a) $2\sqrt{2} : \sqrt{3}$ b) $2\sqrt{2} : 1$

c) 1 : 2 d) 2 : 1

33. Aqueous solutions of HNO_3, KOH, CH_3COOH, and CH_3COONa of identical concentrations are provided) The pair (s) of solutions which form a buffer upon mixing is(are)

a) HNO_3 and CH_3COOH

b) KOH and CH_3COONa

c) HNO_3 and CH_3COONa

d) CH_3COOH and CH_3COONa

34. A student performs a titration with different burettes and finds titre values of 25.2 mL, 25.25 mL and 25.0 mL. The number of significant figures in the average titre value is

a) 3 b) 2

c) 4 d) 5

35. Based on VSEPR theory, the number of 90 degree F−Br−F angles in BrF_5 is

a) 1 b) 2

c) 3 d) 4

SECTION C

BIOLOGY

36. Match Column-I with Column-II for housefly classification and select the correct option using the codes given below:

Column I	Column II
a) Family	(I) Diptera
b) Order	(ii) Arthropoda
c) Class	(iii) Muscidae
d) Phylum	(iv) Insecta

a) (iii) (i) (iv) (ii)

b) (iii) (ii) (iv) (i)

c) (iv) (iii) (ii) (i)

d) (iv) (ii) (I) (iii)

37. Out of 'X' pairs of ribs in humans only 'Y' pairs are true ribs. Select the correct option that correctly represents values of X and Y and provides their explanation.

a) X=12, Y=5 True ribs are attached dorsally to to vertebral column and sternum on the two ends.

b) X=24, Y= 2 The true ribs are dorsally attached to vertebral column but are free on ventral side

c) X= 24, Y= 12 True ribs are dorsally attached to vertebral column but are free on ventral side

d) X=12, Y= 7 True ribs are attached dorsally to vertebral column and ventrally to the sternum

38.

LIST - I	LIST - II
a) Unicellular glandular epithelium	i. Salivary gland
b) Compound	ii. Pancreas
c) Multicellular glandular epithelium	iii. Goblet cells of alimentary canal
d) Endocrine glandular epithelium	iv. Moist surface of buccal cavity

Choose the correct answer from the options given bellow:

a) a-ii, b-i, c-iii, d-iv

b) a-iv, b-iii, c-i, d-ii

c) a-iii, b-iv, c-i, d- ii

d) a-ii, b-i, c- iv, d- iii

39. The organelles that are included in the endomembrane system are:

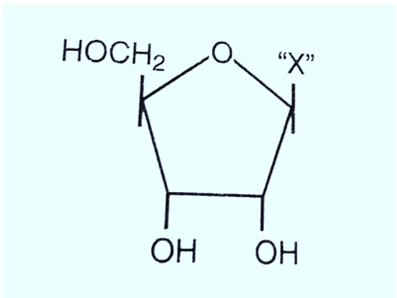
a) Endoplasmic reticulum, Golgi complex, Lysosomes and Vacuoles.

b) Golgi complex, Mitochondria, Ribosomes and Lysosomes.

c) Golgi complex, Endoplasmic reticulum, Mitochondria and Lysosomes.

d) Endoplasmic reticulum, Mitochondria, Ribosomes and Lysosomes.

40. The given diagrammatic representation shows one of the categories of small molecular weight organic compounds in the living tissues. Identify the category shown and the one blank component 'X' in it.



a) Cholesterol: Guanine

b) Amino acid: Nh_2

c) Nucleotide: Adenine

d) Nucleoside: Uracil

41. Once the undigested and unabsorbed substances enter the caecum, their backflow is prevented by:

a) Gastro-oesophageal sphincter

b) Pyloric sphincter

c) Sphincter of Oddi.

d) Ileo-caecal valve

42. Which of the following gastric cells indirectly help in erythropoiesis?

a) Chief cell b) Mucous cells

c) Goblet cells d) Parietal cells

43. Bulk of carbon dioxide released from the body tissues into the blood is present as

a) Bicarbonate in blood plasma and RBC

b) Free CO_2 in blood plasma

c) 70% carbamino-haemoglobin and 30 % as bicarbonate

d) As carbamino-haemoglobin in RBCs

44. The maximum number of electrolytes and water (70-80%) from the glomerular filtrate is reabsorbed in which part of the nephron?

a) Ascending limb of Henle's loop

b) Distal convoluted tubule

c) Proximal Convoluted Tubule

d) Descending limb of Henle's loop

45. Which of the following joints would allow any movement?

a) Cartilaginous joint

b) Synovial joint

c) Ball and socket joint

d) Fibrous joint

46. A person entering an empty room suddenly finds a snake right in front on opening the door. Which one of the following is likely to happen in his neuro-hormonal control system?

a) Sympathetic nervous system is activated releasing epinephrin and norepinephrine from adrenal medulla

b) Neurotransmitters diffuse rapidly across a cleft and transmit the nerve impulse.

c) Hypothalamus activates the parasympathetic division of the brain.

d) A Sympathetic nervous system is activated releasing epinephrin and norepinephrine from adrenal medulla

47. Alzheimer's disease in humans is associated with the deficiency of:

a) Glutamic acid

b) Acetylcholine

c) Gamma amino butyric acid

d) Dopamine

48. Identify the hormone with its correct source of matching and function.

a) Oxytocin-posterior pituitary, growth and maintenance of mammary glands.

b) Melatonin-pineal gland, maintains the normal rhythm of sleep-wake cycle.

c) Progesterone-corpus luteum, stimulation of growth and activities of female secondary sex organs.

d) Atrial natriuretic factor-ventricular wall, increases the blood pressure.

49. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalysed by:

a) Aldolase b) Hexokinase

c) Enolase d) Phosphofructokinase

50. There is no DNA in:

a) Mature RBCs

b) A mature spermatozoan

c) Root hair

d) Non-nucleated ovum

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