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Max. Time : $3\frac{1}{2}$ Hrs

Max. marks : 200

PART I. PHYSICS

1. The amount of heat measured in calories needed to raise the temperature of 1 gram of substance by 1 degree centigrade is known as

(1) heat of fusion (2) specific heat
(3) coefficient of expansion
(4) latent heat.

2. What is the potential energy of a 10 kg steel ball which has been raised vertically 9 m above the floor ?

(1) 441 joules (2) 98 joules
(3) 90 joules (4) 882 joules.

3. The volume of a confined gas varies inversely with the absolute pressure provided that the temperature remains unchanged. This statement is known as

(1) Dalton's law (2) Bernoulli's law
(3) Avagadro's law (4) Boyle's law.

4. What is the work done in joules if a 100-kg ball is raised to 3 m above the floor in 1 second ?

(1) 1960 joules (2) 980 joules
(3) 2940 joules (4) 3240 joules.

5. You are standing 1000 m from the point where a steel block strikes the sidewalk. How long will it take the sound to reach your ears if the speed of sound in air at 0° C is about 333 m/sec. ?

(1) 3 seconds (2) 2 seconds
(3) 1 second (4) 5 seconds.

6. Shadows consist of two portions, the umbra and the penumbra. Which statement below applies ONLY to the umbra?

(1) It receives no light from any part of the source
(2) It receives light from part of the source
(3) It is a partial shadow
(4) It is circular in shape.

7. If a force of 30.6 kg acts on a 60 kg mass, calculate the resulting acceleration. (1 kg of force = 9.8 newtons)

(1) $5 m/sec^2$ (2) $2 m/sec^2$
(3) $0.5 m/sec.^2$ (4) $9.8 m/sec.^2$.

8. If the uniform acceleration near the surface of the earth is about $9.8 m/sec.^2$ for a free-fall, what is the velocity at the end of 2 seconds of fall (neglect friction) ?

(1) 14.6 m/sec (2) 17.0 m/sec
(3) 19.6 m/sec (4) 9.8 m/sec.

9. If the mass of a moving projectile is tripled and its velocity is doubled, the kinetic energy will be multiplied by

(1) 8 (2) 6 (3) 2 (4) 12.

10. Which ratio below best defines the efficiency of simple machines ?

(1) $\frac{\text{useful work output}}{\text{work input}} \times 100\%$

(2) $\frac{\text{work input}}{\text{work output}} \times 100\%$

(3) $\frac{\text{theoretical mechanical advantage}}{\text{actual mechanical advantage}} \times 100\%$

(4) $\frac{\text{useful work input}}{\text{useful work output}} \times 100\%$.

11. If an object is moving with a constant acceleration, the net force acting on that body is

(1) increasing (2) decreasing
(3) constant (4) zero

12. The direction of the force exerted on a surface by a liquid at rest is

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(2) parallel to the surface
(3) tangential to the surface
(4) 30° to the surface.

13. In simplest terms, the energy of a wave is directly proportional to the square of its

(1) height (2) refraction
(3) reflection (4) length.

14. A good floor lamp has a wide heavy base to increase its stability through

(1) banking
(2) lowering the center of gravity
(3) raising the center of gravity
(4) None of the above.

15. A resultant force of 45 kg is acting on a body whose acceleration is 10 m/sec^2. Calculate the mass of the body.

(1) 450 kg (2) 44.1 kg
(3) 4.5 kg (4) 1960 kg.

16. Two forces of 45 kg-*f* and 40 kg-*f* act on a body in opposite directions. What is the resultant force ?

(1) 45 *kg-f* (2) 40 *kg-f*
(3) 5 *kg-f* (4) 90 *kg-f*.

17. $F = Gm_1, m_2/d_2$ is the equation representing Newton's law of universal gravitation. Which of the statements below is true ?

(1) G is called the gravitation constant
(2) The law can be used to calculate the mass of an object on another planet if the mass and radius of that planet are known
(3) Knowing the value of G, one can easily calculate the mass of the earth.
(4) All of the above are true.

18. Which of the statements below is correct ?

(1) The angle of bank for a road is obtained from a consideration of the centripetal force required
(2) There is no tendency for the vehicle to skid if a road is banked for the speed at which the vehicle is moving
be that which maintains it in a circular path.
(4) All of the above statements are correct.

19. How far will a body free-fall in 1 second if released from rest ?

(1) 0.0 m (2) 4.9 m
(3) 9.8 m (4) 19.6 m.

20. Which statement below is true ?

(1) Radiant energy is propagated as a wave motion
(2) Positrons have the same mass as an electron
(3) When a nucleus emits a beta particle, its mass number is unchanged.
(4) All of the above.

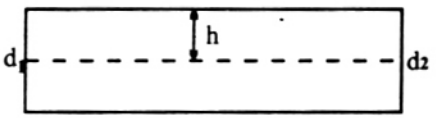
21. Radium Ra^{236} has a half-life of 1590 years. How much of the original amount of Ra^{236} would remain after 6360 years ?

(1) $\frac{1}{8}$ (2) $\frac{1}{4}$
(3) $\frac{1}{16}$ (4) $\frac{1}{2}$.

22. A ball is located in a semicircular trough. The ball is moved slightly to one side and returns to its original location. The ball is said to be in

(1) neutral equilibrium
(2) unstable equilibrium
(3) stable equilibrium
(4) all of the above.

23. Using the figure below as a reference, identify the true statement. The large tank is full of water and is exposed to the atmosphere



d_1 = diameter of opening
v_1 = velocity at d_1
v_2 = velocity at d^2
(1) $v_1/v_2 = 1$ (2) $v_2 > v_1$

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(3) $v_1 > v_2$ (4) none of the above.

24. If a color disc composed of red, orange, yellow, green, blue, indigo, and violet pie-shaped sections is rapidly rotated, which color will your eye see ?

(1) red (2) black
(3) brown (4) white.

25. The amount of a liquid's cohesive force per unit of length is called

(1) depression (2) adhesion
(3) apparent weight (4) surface tension.

26. When light is reflected from a surface it can be either regular reflection or diffuse reflection. The essential difference between regularly and diffusely reflecting surfaces is that

(1) regularly reflecting surfaces are smoother than diffusely reflecting surfaces
(2) light can not be reflected from a diffusely reflecting surface
(3) the regularly reflecting surface is coarser than the diffusely reflecting surface
(4) all of the above are essential differences between regularly and diffusely reflecting surfaces.

27. If the density of a given body is 10 gm/cm^3, what is its specific gravity ?

(1) 0.01. (2) 1.0 gm
(3) 1.0 (4) 10.0.

28. When analyzed, most complicated machines are found to consist of a combination of various simple machines. Which machine below is NOT a simple machine ?

(1) lever (2) electric motor
(3) inclined plane (4) pulley.

29. Calculate the velocity of a test sled that is propelled by a device that has 2500 joules of available energy to propel a sled of 50 kg mass

(1) 10 m/sec (2) 25 m/sec
(3) 50 m/sec (4) 1 m/sec.

§ ***30 - 32 (based on this statement or data).***

In uniformly accelerated motira the following equations hold :

$$V = Vo + at$$

$$X = Vot + \tfrac{1}{2} at^2$$

When X = displacement, V = velocity at time t, Vo = initial velocity, t = time, and a = acceleration. A ball is projected directly upward at a velocity of 15 m/sec.

30. What is the highest point this ball will reach ?

(1) 38.66 m (2) 11.48 m
(3) 9.80 m (4) 1.53 m.

31. What is the distance above the ground after 3 seconds ?

(1) 1.8 m (2) 0.9 m
(3) 0 m (4) 3.6 m.

32. What is its velocity at that point ?

(1) 14.4 m/sec. downward
(2) 14.4 m/sec. upward
(3) 29.4 m/sec. downward
(4) 29.4 m/sec. upward.

33. What is the velocity of the light in the medium if
Sin θ_i = 0.707, Sin θ_r = 0.500, and the velocity of light in a vacuum is 3.0×10^8 m/sec. ?

(1) 2.1×10^8 m/sec
(2) 2.8×10^8 m/sec
(3) 1.4×10^8 m/sec
(4) 4.2×10^8 m/sec

34. The ray of light as it enters will

(1) bend away from the normal
(2) be totally reflected
(3) bend toward the normal
(4) do none of the above.

35. The index of refraction can be defined as the velocity of light in a vacuum divided by the velocity in the medium ($N = \frac{C}{S}$). If this is the case, another valid expression for Snell's law is

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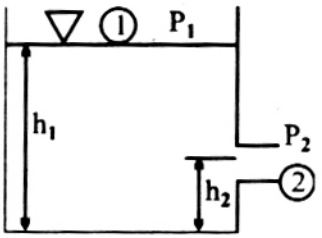
(1) $\frac{\text{Sin}\,\theta_i}{\text{Sin}\theta_r} = \frac{C_i}{S_r}$ (2) $\frac{\text{Sin}\,\theta_i}{\text{Sin}\theta_r} = \frac{C_i}{C_r}$.

(3) $\frac{S_i}{S_r} = \frac{N_r}{N_i}$ (4) $\frac{\text{Sin}\,\theta_i}{\text{Sin}\,\theta_r} = \frac{S_i}{S_r}$

§ ***Directions : Using the illustration when both surfaces 1 and 2 are exposed to the atmosphere, P_1 and P_2 are gauge pressue, and h_1 and h_2 are heights.***



The Bernoulli equation for this situation is

$$h_1 + \frac{P_1}{W} + \frac{V_1^2}{2a} = h_2 + \frac{P_2}{W} + \frac{V_2^2}{2a}$$

36. If an identical outlet were placed at exactly the same point on the left side of the container, the velocity would be

(1) zero (2) computable

(3) $2V_2$ (4) none of the above.

37. The value of P_1 and P_2 are such that

(1) $P_1 = P_2 = 0$ (2) $P_2 < P_1$

(3) $P_1 > P_2$. (4) $P_1/P_2 = 0$.

38. The velocity of the fluid leavening point (2) is constant and can be expressed as

(1) $V_2 = (P_1/P_2)V_1$

(2) $V_2 = (P_1/P_2)a\ h$

(3) $V_2 = [(h_1 - h_2)\ (2a)]^{1/2}$

(4) None of the above.

§ ***DIRECTIONS : Que. (39 - 42) . In the following questions, four words or phrases are presented that have been labeled (1)-(4). For each question, choose the word or phrase that is most closely associated with the given word. You may use a choice more than once, or not at all. Eliminate those choices that you think to be incorrect and mark the letter of your choice on the answer sheet***

Questions

(1) Graham's law of diffusion

(2) Charles' law (3) Ohm's law

(4) Gresham's law

39. $F = \frac{MV^2}{R}$ 40. $I = \frac{E}{R}$

41. $\frac{V}{V_1} = \frac{T}{T_1}$. 42. $R_1/R_2 = \sqrt{M_2/M_1}$

43. An astronaut is accelerated in his spacecraft from rest to 800 mi./hr. in 60 sec. He was subjected to an acceleration of

(1) 4800 ft./sec./sec.

(2) 1200 mi./hr.^{2} (3) 4800 mi./hr.^{2}

(4) 48,000 mi./hr.^{2}.

44. The proposal that no more than two electrons may occupy a particular atomic orbital was made by

(1) Pauli (2) Pauling

(3) Einstein (4) Curie.

45. An object is thrown upward with a vertical velocity of 128 ft./sec. It will return in

(1) 64 seconds (2) 16 seconds

(3) 8 seconds (4) 4 seconds.

46. The particle accelerated at a constant rate from 23 mi/hr. to 58 mi./hr. in 3.5 sec. Its acceleration was

(1) 10 mi./hr. per sec.

(2) 58 mi./hr. per sec.

(3) 23 mi./hr. per sec.

(4) less than 10 mi./hr. per sec.

47. Since speed changed at a uniform rate and the average velocity is equal to the average of the initial and final speeds, how far has the particle traveled while it was accelerating ?

(1) 51 ft (2) 600 ft

(3) 210 ft (4) less than 20 mi.

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48. A particle travels 336 mi in 6 hrs; its average velocity is

(1) 33.6 mi./hr (2) 66 mi./hr.
(3) 56 mi. /hr. (4) 40 mi/km/hr.

49. The volume of the piece of glass is

(1) 166cm^3 (2) 60 cm^3
(3) 1.6 cm^3 (4) 1666 cm^3.

50. If the buoyant force of the water is equal to the weight of the water displaced, then the piece of glass suspended in water weighs

(1) 16 N (2) 100 N
(3) 83 N (4) 50 N.

51. If the piece of glass were suspended in air, it would weight (the buoyancy of air is neglected)

(1) 100 Newtons (2) 50 Newtons
(3) 10 Newtons (4) 600 Newtons

52. Assertion (A). When an electric motor is started the initial current in it is considerably more than the final current

Reasoning : The current falls due to the fall in the back emf

(1) A is true, R is false
(2) A is false, R is true
(3) Both A and R are true and R is the correct explanation of A
(4) Both A and R are true but R is not the correct explanation of A.

53. Assertion(A). A pool of water looks shallower than it actually is

Reasoning (R). Light bends towards the normal while travelling from water to air

(1) Both A and R Correct and R explains A
(2) A is right, R is wrong
(3) Both A and R correct but R does not explains A
(4) A and R are both wrong.

54. Weight of a person can be zero when

1. he is falling freely
2. he is orbiting in a satellite
3. he is in aeroplane flying at a high altitude.
4. he is having ride in a gas filled balloon.

(1) 1, 2, 3 and 4 are correct
(2) 1 and 2 are correct
(3) 1 and 4 are correct
(4) 1, 2 and 4 are correct.

55. Assertion(A) : The earth revolves around the sun an elliptical orbit

Reasoning(R) : The sun always attracts the earth with the same force

(1) both A and R are both are both wrong
(2) A is right, R is wrong
(3) both A and R are correct and R explains A
(4) both A and R are correct, but R does not explain A.

§ ***Directions : - Questions (56 to 60) Consist of two statements, Assertion and reason. Mark a clear cross Corresponding to each question as follows :***

(1). If both assertion and reason are true statements and the reason is a correct explanation of the assertion

(2). If both assertion and reason are true statements but the reason is not a correct explanation of the assertion

(3).If the assertion is true but the reason is a false statement

(4) If both assertion and reason both are false statements.

	Assertion	Reason
56.	The couple acting on a body is not equal to the rotational KE of the body	Couple and KE have different dimensions.
	(1)	(2) (3) (4)
57.	A tiny drops of liquid resist deforming forces better than bigger drops	Excess pressure inside a drop is directly proportional to the surface tension.

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(1) (2) (3) (4)

58. A thin aluminium disc, spinning freely about a centre pivot, is quickly brought to rest when placed between the poles of a strong U-shaped magnet
(1) (2) (3) A current induced in a disc rotating in a magnetic field produces a force which tends to oppose the disc's motion. (4)

59. In Rutherford's experiment, α–particles from a sodium source were allowed to fall on a 10^4 mm thick gold foil. Most of the particles passed straight through the foil.
(1) (2) (3) The entire positive charge and nearly whole of the mass of an atom is concentrated in the nucleus. (4).

60. At ordinary temperatures, the Vibrational degrees of freedom do not contribute to the specific heat of gases
(1) (2) (3) The average charge corresponding to a degree of vibration is not kT and hence the molecular vibrations are not excited. (4).

PART II. CHEMISTRY

1. If one wished to remove substantially all of the chloride ions from an aqueous solution, this could be done by the addition of an aqueous solution of
(1) gelatin (2) starch
(3) $AgNO_3$ (4) Na_2SO_4

2. The basic building block of proteins is (are)
(1) ammonia
(2) amino acids
(3) nitrogenous bases
(4) messenger RNA.

3. If it is known that H_2S is a weak acid that ionizes to form $2H^+$ and S^{2-}, lowering the pH of a solution of H_2S by adding HCl should
(1) lower the S^{2-} concentration
(2) have no effect on S^{2-} concentration
(3) raise the S^{2-} concentration
(4) not be possible.

4. In transcription of RNA from DNA, thymine will form a base pair only with
(1) cytosine (2) guanine
(3) adenine (4) thymine.

5. Theoretically, the ring monobromination of 4-bromo-1, 2 - disopropylbenzene could produce _____ isomers.
(1) 5 (2) 4 (3) 3 (4) 2.

6. Prolonged boiling of animal fat with lye is called
(1) saponification (2) stain removal
(3) ecology (4) conjugation.

7. The hydronium ion is
(1) an uranium byproduct
(2) an ion with the formula of H_2O^+
(3) really a free radial rather than an ion
(4) a protonated water molecule.

8. The smallest organic ring compound that may be synthesized contains _____ carbon atoms
(1) 5 (2) 4 (3) 3 (4) 7.

9. The process of fermentation can be considered to be
(1) dehydration (2) oxidation
(3) anaerobic respiration
(4) aerobic respiration.

10. Without considering stereoisomers the number of possible dibromobutane isomers is

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(1) 5. (2) 4. (3) 3. (4) 8.

11. Consider this reaction

$$Fe^{++} \rightleftarrows Fe^{+++} + e^-$$

(1) The reaction toward the left is a reduction
(2) The reaction toward the right is a reduction
(3) The reaction toward the right is an oxidation.
(4) One and three are correct

12. The neutralization of 50 ml of 0.25 NH_2SO_4 will require ---------- ml of 0.50 N NaOH.

(1) 2.5 (2) 0.25
(3) 50 (4) 25

13. Of the compounds listed below, which has the greatest affinity for combining with hemoglobin ?

(1) helium
(2) carbon monoxide, CO
(3) oxygen, O_2
(4) carbon dioxide, CO_2.

14. Below are listed the major differences between compounds and mixtures. Which one is an incorrect pairing ?

	MIXTURE	COMPOUND
(1)	Physical union	Chemical union
(2)	No new substances are formed	New substances are formed
(3)	Can be separated by physical means	Can be separated by physical means
(4)	Elements form no definite proportions	Elements form definite proportions

15. Which of the following reactions is a decomposition reaction ?

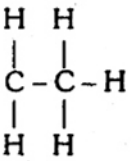
(1) $HCl + NaOH \longrightarrow NaCl + H_2O$
(2) $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$
(3) $2HgO \xrightarrow{\Delta} 2\,Hg + O_2$
(4) $CO_2 + H_2O \longrightarrow H_2CO_3$.

16. The neutron was discovered by

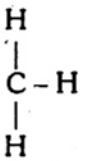
(1) James Chadwick
(2) Ernest Rutherford
(3) Marie and Pierre Curie
(4) Albert Einstein.

17. Which of the following structural formulas is not properly identified ?

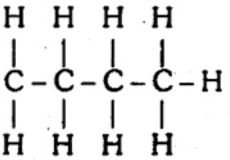
(1) Ethane



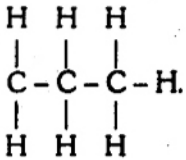
(2) Methane



(3) Pentane



(4) Propane



18. An inorganic cation has been precipitated from water by the addition of NaOH. When we find that the precipitate may be redissolved upon the addition of NaOH or dilute HNO_3, we may conclude that the precipitate was

(1) amphoteric (2) colloidal
(3) amorphous (4) anthropomorphic.

19. The inorganic cation in the question above could be

(1) nickel (2) ferric
(3) silver (4) aluminium.

20. 2,4-D (2,4-dichlorophenoxyacetic acid) is a potent stimulator of plant metabolism. Most sensitive to it is (are)

(1) phytoplankton
(2) dicotyledons
(3) monocotyledons

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(4) Kentucky fescue grass.

21. Transuranium elements are

(1) elements that have been postulated but not found naturally or produced artificially

(2) man-made elements with more than 92 protons in the nucleus

(3) found naturally in abundance greater than that of uranium isotopes

(4) found on earth as a result of bombardment by particles from the planet Uranus.

22. Black and white photographic film is based on the light-catalyzed chemical reaction

(1) $\text{quinone}_1 \longrightarrow \text{quinone}_2 \longrightarrow \text{hydroquinone}$

(2) $Ag^+ He \longrightarrow Ag^o$

(3) $Cd^{++}He \longrightarrow Cd^+$

(4) $\text{gelatin}_c \longrightarrow \text{gelatin}_B + H_2O$.

23. Solids

(1) are rigid and have a definite form

(2) possess molecules which vibrate very slowly in a fixed position

(3) possess molecules which are close together

(4) have all of the above characteristics.

24. In order to produce polyvinyl alcohol we would expect to

(1) ask for another task. This one has not been done successfully

(2) hydroxylate polyethylene

(3) polymerize another vinyl monomer and convert the polymer to polyvinyl alcohol

(4) polymerize the monomer, vinyl alcohol.

25. Ethyl bromide, methyl bromide, and sodium will react to form

(1) propane (2) butane

(3) ethane (4) all of the above.

26. If acetylene is reacted with an excess of sodium metal in hexane and the reaction product is treated with 1-bromopropane, the final product will be

(1) 3-octene (2) 4-octyne

(3) 8-octane (4) none of the above.

27. Reaction of propanal with HCN followed by acid hydrolysis of the reaction product will produce

(1) propanoic acid

(2) 1-butylamine

(3) α–hydroxybutanoic acid

(4) all of the above.

28. A Grignard reagent, such as (CH_3MgBr) will react with C_2H_5OH and then with acidified water to produce

(1) a secondary or tertiary alcohol

(2) an aldehyde (3) a ketone

(4) none of the above.

29. The predominant ring structure of glucose in aqueous solution is called

(1) cyclopentyl (2) furanose

(3) pyranose (4) none of the above.

30. When two free radicals collide

(1) termination of the free radical reaction results

(2) they explode with the release of a large quantity of energy

(3) ionization results

(4) none of the above is possible.

31. According to the principle of LeChatelier, a higher pressure applied to the reversible reaction

$$N_2 + 3H_2 \rightleftarrows 2NH_3$$

would be expected to result in

(1) shifting the equilibrium to the right

(2) shifting the equilibrium to the left

(3) no change in the equilibrium

(4) increased percentages of NH_3 and H_2.

32. Acetaldehyde, in the presence of NaOH, will

(1) produce 3-hydroxybutanol

(2) be converted to acetic acid

(3) produce ethyl acetate

(4) do none of the above.

33. The pH of a weak solution of ammonium hydroxide has been measured. If ammonium chloride is now added

(1) the pOH will decrease

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(2) the pH will increase
(3) the pH will decrease
(4) the acidity will decrease.

34. Which of the following is an incorrect statement ?

(1) Certain substances break up into ions when dissolved in water
(2) Atoms and ions of the same element have different properties
(3) The fewer ions formed, the greater the electric current carried by an electrolyte
(4) Ions have a charge equal to the number of electrons gained or lost.

35. In a titration of iodine with sodium thiosulphate, the formation of a blue color on the addition of colorless starch solution indicates that

(1) a blue complex of starch, iodine, and sodium thiosulphate has been produced
(2) all of the iodine has not been reduced
(3) the glassware has not been washed sufficiently
(4) all of the iodine has not be oxidized.

36. A negative iodoform test (i.e., no yellow precipitate) will be the result when $NaOH + I_2$ is reacted with

(1) $CH_3 - CH_2 - CH_2 - \overset{\overset{H}{|}}{C} = O$

(2) $H - \overset{\overset{O}{||}}{C} - CH_3$

(3) $CH_3 - \overset{\overset{O}{||}}{C} - CH_2 - CH_3$

(4) $CH_3 - \overset{\overset{OH}{|}}{C} - CH_3$.

37. Factor (s) that influence (s) enzymatic activity is (are)

(1) pH
(2) concentration, substrate, cofactors
(3) enzyme poisons (4) all of the above.

38. The alpha helix in a protein is classified as the

(1) tertiary structure (2) secondary structure
(3) primary structure (4) quaternary structure

39. Methyl iodide and n-propyl iodide may be reacted with sodium metal to produce _____ organic products

(1) 4 (2) 3 (3) 2 (4) 8.

40. In the previous question the compound listed below that would be produced in greatest yield is

(1) hexyl iodide (2) sodium propane
(3) n-hexane (4) n-butane.

41. Catalytic hydrogenation of phenyl diazonium bromide produces

(1) phenylhydrazine (2) bromobenzene
(3) benzene (4) phenylamine

42. Addition of water to metallic sodium produces

(1) hydrogen and sodium hydroxide
(2) sodium hydrate
(3) oxygen and sodium hydride
(4) nitrogen and sodium hydride.

43. The common lead storage battery produces electricity by two hall cell reactions, one of which is (written in the direction of production of electricity)

(1) $Pb + SO_4^{2-} \longrightarrow PbSO_4 + 2e^-$

(2) $PbSO_4 + 2e^- \longrightarrow Pb + SO_4^{2-}$

(3) $PbSO_2 + 2H_2O \longrightarrow PbO_2 + 4H^+ + SO_4^{2-} + 2e^-$

(4) none of the above.

44. Calcium carbide reacts with water to produce

(1) methane (2) carbon dioxide
(3) acetylene (4) carbohydrate.

45. Which of the following aqueous solutions will have the lowest freezing point?

(1) 1.5 M glucose (2) 0.3 M Na_2SO_4
(3) 1 M NaCl (4) H_2O.

46. The reaction of HBr with 1-propene in the presence of peroxides will produce primarily

(1) 2-bromopropane
(2) 1-bromopropane

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(3) 2-bromopropene
(4) 1,2-dibromopropane.

47. A zwitter ion is a molecule containing
(1) more than one cationic or anionic function
(2) polar and nonpolar groups
(3) both cationic and anionic functions
(4) none of the above.

48. Use of helium is preferred over use of hydrogen in airships (e.g., blimps) because
(1) helium is chemically less reactive
(2) helium has a lower density
(3) both of the above
(4) none of the above.

49. Low molecular weight mercaptans are often added to natural gas to
(1) provide a stench which is helpful in the detection of gas leaks
(2) prevent corrosion of the pipelines
(3) produce a pleasant deodorant during burning
(4) slightly retard the burning.

50. Nucleotides are composed of two types of sugars
(1) glucose and ribose
(2) glucose and maltose
(3) ribose and deoxyribose
(4) maltose and deoxyribose.

§ ***Answer questino 51 to 60 according to the given choices***
(1) Assertion is true but the Reason is false
(2) Assertion is false, Reason is true
(3) Both A and R are true and the R is a correct explanation of the R.
(d) Both A and R are true but R is not a correct explanation of the assertion.

51. Assertion : Nobel gas can be liquefied.
Reasoning : Attractive force can exist between non polar molecules.
(1) (2) (3) (4).

52. Assertion : Alkali metal salts give colour to the bunsen flame.
Reasoning : This is due to excitation of valence shell electrons of sodium ions from lower to higher orbitals.
(1) (2) (3) (4).

53. Assertion : Amongst the halogens, fluorine can oxidise the elements to highest oxidation states.
Reasoning : Due to small size of fluoride ion, it is difficult to oxidise fluoride ion to fluorine. Hence reverse reaction takes place more easily
(1) (2) (3) (4).

54. Assertion : A solution of bromine in CCl_4 is decolourised on passing acetylene gas through it
Reasoning : Bromine is expelled from the solution by acetylene gas
(1) (2) (3) (4).

55. Assertion : When transition metal atoms ionises, the 4s orbital electrons electrons are ionised before the 3d orbital electrons.
Reasoning : The energy of 3d orbital electrons is lower than that of 4s orbitals
(1) (2) (3) (4)

56. Assertion : Nitrogen is unreactive at room temperatures but becomes reactive at elevated temperatures (on heating) or in presence of catalysts.
Reasoning : In nitrogen molecules, there is extensive delocalization of electrons
(1) (2) (3) (4).

57. Assertion : Fluorescein is an adsorption indicator.
Reasoning : The indicator fluorescein is a dye.
(1) (2) (3) (4).

58. Assertion : All enzymes are protein, but all proteins are not enzymes
Reasoning : Enzymes are bio-catalysts and Possess a stable configuration having an active site packet.
(1) (2) (3) (4)

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59. Assertion : The alkali metals are strong reducing agents

Reasoning : They have only one electron to be lost from their valence shells.

(1) (2) (3) (4)

60. Assertion : Many endothermic reactions that are not spontaneous at room temperature become spontaneous at high temperature

Reasoning : Entropy of the system increases with increases in temperature.

(1) (2) (3) (4).

PART III. BIOLOGY

1. Suberin in cork cell wall is a

(1) polypeptide (2) polysaccharide
(3) fatty substance (4) none of the above.

2. The sequence of spores produced in the wheat rust life cycle is

(1) basidiospores, aeciospores, pycniospores and teliospores
(2) teliospores, basidiosores, uredospores and pycniospores
(3) teliospores, aeciospores, uredospores and basidiospores
(4)aeciospores, uredospores, teliospores, basidiospores and pycniospores.

3. Heterotrichous habit is shown by

(1) *Ulothrix*
(2) *Oedogonium* (3) *Chlamydomonas*
(4) *Stegeocladium.*

4. Streptomycin is produced by

(1) *Streptomyces scoleus*
(2) *Steptomyces fradie*
(3) *Streptomyces venezuela*
(4) *Streptomyces griseus*

5. Garner and Allard are related with

(1) Photolysis (2) Phototropism
(3) Photo-periodism
(4) Photophosphorylation.

6. Plasmids are

(1) viruses
(2) new type of micro organisms
(3) extra chromosomal genetic element of bacteria
(4) genetic element of bacteria.

7. The fruiting body of *Aspergillus or Penicillium* is

(1) Hypanthodium (2) Peritheium
(3) Apothecium (4) Cleistotheciun

8. The normal or polygonum type embryo sac is

(1) monosporic 8 nucleate
(2) tetrasporic 6 nucleate
(3) monosporic 4 nucleate
(4) bisporic 8 nucleate.

9. A close relation between flower and pollinating agent is best exhibited by

(1) *Salvia* (2) *Avena*
(3) *Cocos* (4) *Yucca.*

10. Spirocyclic (hemicyclic) numerous free stamens and apocarpous carpels are found in the family

(1) *Cucurbitaceae* (2) *Cruciferae*
(3) *Ranunculaceae* (4) *Labiatae.*

11. Plant whose seeds are known to have longest viability period

(1) *Triticum vulgare* (wheat)
(2) *Zizyplius jujuba* (ber)
(3) *Nelumbo nucifera* (lotus)
(4) *Carica papaya* (papaya)

12. Which one of these are necessary conditions for Hardy-Weinberg principle for applying to a genetic population ?

(1) A high mutation rate and random mating
(2) A low mutation rate and a small population
(3) Selective mating and a small population
(4) Non-migrating and a large population.

13. The Singer model of plasma membrane differs from Robertson's model in the

(1) arrangement of proteins
(2) arrangement of lipid layers
(3) number of lipid layers
(4) absence of proteins in Singer model.

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14. Aloe pith is
(1) heart wood (2) sap wood
(3) soft wood (4) none of the above

15. **Padma is a variety of**
(1) millet (2) maize
(3) rice (4) wheat.

16. **Mitochondria are rich in**
(1) iron (2) cobalt
(3) molybdenum (4) manganese.

17. **Velamen is present in**
(1) parasitic roots (2) assimilatory roots
(3) epiphytic roots (4) fusiform roots.

18. **Auxins does not increase the**
(1) rate of photosynthesis
(2) rate of respiration
(3) uptake of water by cells
(4) plasticity of the cell wall.

19. **Foldings of inner membrane of mitochondria are called**
(1) sacs (2) endoplasm
(3) cristae (4) grana.

20. **Ginger is a stem and a root because it**
(1) lacks chlorophyll
(2) grows parallel to soil surface
(3) stores food material
(4) has nodes and internodes.

21. **The largest flower in the world is that of**
(1) Lotus (2) *Rafflesia*
(3) Giant cactus (4) Parasite.

22. **Systematic position of *Cucurbitaceae* according to Bentham and Hooker's system is**
(1) gamopetalae, calyciflorae, cucurbitales
(2) polypetalae, disciflorae cucurbitales
(3) polypetalae, calyciflorae, passiflorales
(4) polypetalae thalamiflorae, cucurbitales.

23. **Spraying of PMA (Phenyl mercuric acetate) on leaves**
(1) increases the rate of guttation
(2) increases the rate of water absorption
(3) decreases the rate of transpiration
(4) increases the rate of transpiration.

24. **Litmus yielding lichen is known as**
(1) *Roccella tintoria*
(2) *Lecanora esculenta*
(3) *Cladonia rangiferina*
(4) *Cetraria islandica.*

25. **One of the following is a source of rubber**
(1) *Cedrus deodara*
(2) *Tectona grandis*
(3) *Hevea brasiliensis*
(4) *Michelia champaca.*

26. **Plica semimularis is found in**
(1) kidney of mammals
(2) heart of rabbit
(3) ear of mammals
(4) eyes of frog.

27. **Which one of the following substances is actively secreted into the glomerular filterate of the kidney tubule ?**
(1) amino acids (2) chloride ions
(3) sodium ions (4) potassium ions.

28. **Holocene is**
(1) golden age of mammals
(2) golden age of reptiles
(3) epoch of human civilization
(4) age of fishes and amphibians.

29. **The present century has witnessed remarkable increase in the population of the world and specially in India. One major factor for this is that**
(1) many children per family begin to reach the reproductive age
(2) more children are born in each family
(3) many people are marrying in younger age group
(4) older people have begin to live longer.

30. **Haeckel's theory of recapitulation (Biogenetic law) means that**
(1) life history of an animal reflects its evolutionary history
(2) progeny of an organism resembles its parents
(3) body parts once lost are regenerated
(4) all organisms start as an egg.

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31. Red - green colour blindness appears due to

(1) over activity of adrenals
(2) deficiency of vitamin A
(3) inheritance through X chromosome
(4) excessive drinking of alcohol.

32. In the development of frog the blastopore forms the future

(1) tympanum (2) mouth
(3) nares (4) anus.

33. In the heart of rabbit the bicuspid (mitral) valve is situated between

(1) right ventricle and pulmonary aorta
(2) left auricle and left ventricle
(3) right auricle and right ventricle
(4) postcaval and right auricle.

34. In what physical form the glycogen is found in cells

(1) Liquid (2) Soluble
(3) Crystallized (4) Insoluble.

35. Pyruvic acid before combining with oxaloacetic acid of citric acid cycle becomes

(1) cis-aconitic acid (2) acetyl Co.-A
(3) lactic acid (4) aceto -acetic acid.

36. The sucker fish (Remora) on a shark is an example of

(1) predation (2) symbiosis
(3) parasitism (4) commensalism.

37. *Blatta orientalis* can be distinguished from *Periplaneta americana* in that the female of *Blatta* is with

(1) smaller wings (2) vestigeal wings
(3) large wings (4) large eyes.

38. *Trypanosoma* **causes sleeping sickness in man, it finally invades**

(1) liver (2) blood
(3) brain (4) cerebro-spinal fluid.

39. The change in mammalian sperm which prepares it to fertilize the ovum is termed

(1) fertilizin (2) caudation
(3) activation (4) capaciation.

40. Demographic studies are related to

(1) soil
(2) human population growth and planning
(3) study of human environment
(3) pertaining to human training and development

41. Graft of an organ like kidney between genetically dissimilar people is known as

(1) demigraft (2) hemigraft
(3) allograft (4) none of the above.

42. The infective stage of Entamoeba histolytica is

(1) premature cyst (2) sporozoite
(3) trophozoite (4) mature cyst.

43. The most important characteristic of a mammal is

(1) a four chambered heart
(2) presence of diaphragm
(3) presence of *corpus callosum*
(4) presence of the codont dentition.

44. In which form CO_2 is carried in the blood ?

(1) Potassium bicarbonate
(2) Potassium carbonate
(3) Sodium bicarbonate
(4) Sodium carbonate.

45. Mendel did not recognise phenomenon of linkage in his experiments because

(1) he studied only pure plants
(2) there were many chromosomes to handle
(3) characters he studied were located on different chromosomes
(4) he did not have powerful microscope.

46. Protective resemblance of animals with their environment and background is

(1) batesian
(2) mimesis (3) Mullerian mimicry
(4) mimicry.

47. Some animals have constant high body temperature. This is because

(1) they can work fast at this temperature
(2) they prefer to live in cold region
(3) they are active animals

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(4) they like this temperature.

48. Gaucher's disease is associated with

(1) abnormal carbohydrate metabolism
(2) abnormal protein metabolism
(3) deficiency of ACTH
(4) abnormal fat metabolism.

49. Sustentacular cells are found in

(1) brain of rabbit and are concerned with memory
(2) liver of vertebrates and are secretory
(3) kidney of frog and are excretory
(4) testis of rabbit and are nutritive.

50. One of the following group deaminates uric acid

(1) fishes (2) amphibians
(3) birds (4) mammals.

§ ***(Directions) Q51 to 60 consists of two statements, one labelled the 'Assertion (1)' and the other labelled the Reason (R)'. Examine these statements carefully and decide if the statements Assertion (1) and the Reason (R) are individually true and if so, whether the reason is a correct explanation of the assertion. Select your answers to these questions from the codes given below***

(1) Both A and R are true and R is the correct explanation of A
(2) Both A and R are true but R is not a correct explanation of A
(3) A is true but R is false
(4) A is false but R is true

	Assertion	Reason	
51.	In a DNA molecule the total quantity of purines equals the total quantity of pyrimidines	Adenine pairs with thymine and cytosine pairs with guanine	(1) (2) (3) (4)
52.	A cholera patient is given glucose electrolytes and water	These plasmalyse the disease causing germs	(1) (2) (3) (4)
53.	Excess consumption of alcohol results in damage to liver	It promotes formation of fatty tissue in the liver	(1) (2) (3) (4)
54.	XXX females are called super females	They often give birth to triplets and quadruplets	(1) (2) (3) (4)
55.	The male Anopheles does not spread malaria	It does not carry plasmodium	(1) (2) (3) (4)
56.	A persons of AB blood group are called universal acceptors	They carry no antibodies	(1) (2) (3) (4)
57.	A doctor advised a patient to take plenty of citrus fruits, guavas, tomatoes and amlas over a period of two months regularly	The patient's complaint was that he had swollen and spongy gums that bleed easily	(1) (2) (3) (4)
58.	Life would have been impossible without green plants	The food we consume and the oxygen we breath are products of their activities	(1) (2) (3) (4)

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59. A man cannot pass on a sex-linked gene to his son.
(1) A male's X-chromosome is inherited from his mother (2) (3) (4)

60. Biomonitoring is reliable for determining the pollutants in air, water and soil
(1) The living organism reacts to minute changes in the environment (2) (3) (4)

GENERAL KNOWLEDGE

1. Which of the following commissioned ranks in the Air Force is higher ?
(1) Group Captain (2) Squadron Leader
(3) Air Commodore (4) Wing Commander.

2. Who said "I have no further territorial claims to make in Europe" ?
(1) Hitler (2) Mussolini
(3) Napoleon (4) Stalin.

3. Name the person associated with Talwandi
(1) Guru Arjan Dev (2) Guru Gobind Singh
(3) Guru Nank (4) Mahatma Gandhi.

4. How many years come between one B.C. and one A.D. ?
(1) 0 (2) 1 (3) $\frac{1}{2}$. (4) $1\frac{1}{2}$.

5. Pulitzer prize is given for
(1) Agriculture (2) Journalism
(3) Literature (4) Social work.

6. Land of white elephants is
(1) Kenya (2) Burma
(3) India (4) Thailand.

7. Jews were originally nomads from
(1) Palestine (2) Sahara desert
(3) Germany (4) North Europe.

8. Which of the following is the largest multipurpose project in India
(1) Hirakund (2) Bhakra Nangal
(3) Beas (4) Damodar Valley.

9. 'Asian' Drama' was written by
(1) Gunnar Myrdal (2) William Shakespeare
(3) Jawaharlal Nehru (4) Mulkh Raj Anand.

10. Which of the following is India's communication satellite ?
(1) APPLE (2) Bhaskara
(3) Aryabhatta (4) Rohini.

11. Galileo was a scientist who belonged to
(1) France (2) Great Britain
(3) Germany (4) Italy.

12. Some personalities and their countries are matched below. Which of these is wrong ?
(1) Pablo Picasso — Spain
(2) Jesus Christ — Bethlehem
(3) Nicolas Copernicus — Italy
(4) Genghis Khan — Mongolia.

13. Skylab was launched into space by the U.S. in
(1) 1975 (2) 1974
(3) 1973 (4) 1979.

14. Which European leader was called the 'man of blood and iron'
(1) Hitler (2) Mussolini
(3) Napoleon Bonaparte
(4) Bismarck.

15. Ludwing Von Beethowen was a
(1) Musician (2) Painter
(3) Poet (4) Sculptor.

16. The highest dam in the world is
(1) Bhakra (2) Grande Dixence
(3) Inguri (4) Nurek.

17. Which of the following languages is spoken by the largest number of people in the world
(1) English (2) Arabic
(3) French (4) Chinese.

18. Official reports of the British government are called as
(1) Blue Books (2) Grey Books

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(3) Green Books (4) White Papers.

19. Who was that ruler of India who transferred his capital from Delhi to Daultabed or Devangir

(1) Feroz Tughlak (2) Mohd. Taughlak
(3) Allauddin Khilji (4) Auranzeb

20. Which Hindi writer is the founder of 'Khari Boli' in Hindi literature

(1) Hazari Prasad Dwivedi
(2) Bhartendu Harish Chandra
(3) Munshi Prem Chand
(4) None of these.

Answers with Explanations

PHYSICS

1. (2)The amount of heat needed to raise the temperature by 1 degree centigrade of 1 gram of substance is known as specific heat

2. (4) PE = Wh when W = 10 kg and h = 9m
PE = (10)(9.8)(9) = 10kg × 9.8n × 9m
= 882 joules.

3. (4) The statement is known as Boyl's law

4. (3) W = force × distance when force
= 100 kg × 9.8n = 980
and distance = 3 m.
W = (980) (3) = 2940 joules.

5. (1) Speed of sound (S) $= \frac{\text{distance(x)}}{\text{time(t)}}$
when x = 1000 m and s = 333 m/sec.
S = x/t therefore t = x/s
$$t = \frac{1000\text{m}}{333\ \text{m/sec}} = 3\ sec.$$

6. (1) The umbra is that portion of a shadow which does not receive light from any part of the light source

7. (1) Use f = ma when m = 60 kg and f = 30.6 kg force (convert to newtons).
f = (30.6) (9.8) = 300 newtons
a = f/m = 300kg/60 a = 5 m/sec^2

8. (3) At a uniform acceleration of 9.8 m/sec^2 the body goes from 0-9.8 m/sec. in the first second and from 9.8 m/sec. to 19.6 m/sec. at the end of the 2nd second of fall.

9. (4) $KE = \frac{1}{2} mv^2$, $KE_o = \frac{1}{2} m_o v_o^2$
Increase m_0 to $3m_o$, increase v_o to $3v_o$ then:
$KE = \frac{1}{2} (3m_o) (2\ v_o)^2$
$KE = \frac{1}{2} (12)(m_o v_o^2)$
Therefore *KE* will be multiplied by 12.

10. (1)
$$\text{Efficiency} = \frac{\text{useful work output}}{\text{work input}} \times 100\%,$$
by definition,
or Efficiency
$$= \frac{\text{actual mechanical advantage}}{\text{theoretical mechanical advantage}} \times 100\%.$$

11. (3) $F = ma$ if m = mass of body and a = constant. Since both m and a are constant, F must be constant.

12. (1) The direction of the force exerted against a surface by a fluid at rest is normal or perpendicular to the surface

13. (1) Energy of a wave is proportional to the square of its height

14. (2) Lowering the center of gravity increases the stability of the table lamp

15. (2) F = ma where F = 45 kg force, m = ?.
and a = 10 m/sec^2
1 kg force = 1kg × 9.8 m/sec^2
45 kg force = 45kg × 9.8 m/sec^2
F = 441 newtons
$$m = F/a = \frac{441\ \text{kg m/sec}^2}{10\ \text{m/sec.}^2} = 44.1\ \text{kg}$$

16. (3) 45 kg–f · 40 kg–f
$\Sigma F_x = 45 - 40 = 5$kg–f
(40 subtracted from 45 because the forces are in direct opposite to one another).

17. (1) All the statements are correct concerning the application and characteristics of Newton's law of universal gravitation.

18. (4) All of the above are true statements regarding the banking of a roadbed.

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19. (2) Use $x = v_0 + \frac{1}{2}at^2$

where x = distance of fall,
v_0 = initial velocity = 0,
a = acceleration, 9.8 m/sec.^{2}, and
t = 1 second

$$x = 0 + \tfrac{1}{2}at^2$$
$$x = (\tfrac{1}{2})(9.8)(1)^2$$
$$x = 4.9 \text{ m.}$$

20. (4) All the statements are true

21. (3) Each 1590 years 1/2 of the remaining element would decay. Therefore, for the 6360 years $(\frac{1}{2})^4$ of the original would remain or 1/16 would remain

22. (3) Stable equilibrium.

23. (1) $v_1/v_2 = 1$ Bernoulli's equation holds here. Since the container is exposed to the atmosphere, the pressures at the surface and outlets are the same and the velocity at the outlet becomes a function of the heat and acceleration due to gravity making $v_1 = v_2$ therefore $v_1/v_2 = 1$.

24. (4) A color disc as described induces the sensation of *white* by integrating its component colors.

25. (4) Definition of surface tension

26. (1) The smoother the surface, the more regularly reflecting the surface is. Mirrors are smooth enough that they reflect in a regular fashion.

27. (4) Specific gravity is numerically equal to density, so long as density is measured in gm/cm^3.

28. (2) The six devices known as simple machines are inclined plane, lever, pulley, screw, wedge, and wheel- and-axle.

29. (3) $KE = \frac{mv^2}{2}$ when $KE = 2500$ joules,

$m = 50$ kg, and $v = ?$

$$2500 = \frac{50}{2}(v^2) \quad i.e.\ 100 = v^2$$

$v = 10$ m/sec.

30. (2) At highest point

$V = 0$, $V_0 = -15$ m/sec., $a = 9.8$ m/sec.^{2}, and $t = ?$

$V = V_0 + at$

$0 = -15 + 9.8t$

$15 = 9.8\,t.$, i.e. $t = 1.53$

$X = (-15)(1.53) + \frac{1}{2}(9.8)(1.53)^2$

$X = -22.95 + (4.9)(2.34)$

$X = -22.95 + 11.47$

$X = -11.48$m above the ground

31. (2) Choose the upward direction as negative and downward as positive.

Then $V_0 = -15$ m/sec and

$a = 9.8$ m/sec.^{2} at $t = 3$ seconds, $X = ?$

$X = V_{ot} + \frac{1}{2}at^2$

$X = (1 - 15)(3) + (\frac{1}{2})(9.8)(3)^2$

$= -45 + 44.1$

$X = -0.9$m above ground.

32. (1) What is V?

$V = V_0 + at$ $V = -15 + (9.8)(3)$

$V = -15 + 29.4$

i.e. $V = 14.4$ m/sec. downward.

33. (1) Using $\frac{\sin\theta_i}{\sin\theta_r} = \frac{S_i}{S_r}$ and knowing that

$S_1 = 3 \times 10^8$ m/sec.

$$S_r = S_i\left(\frac{\sin\theta_r}{\sin\theta_i}\right) = \left(3 \times 10^8\right)\left(\frac{0.500}{0.70}\right)$$

$S_r = (3)(.7)(10^8) = 2.1 \times 10^8$ m/sec

34. (3) *The answer is simple in that we know that* $N_r = 1.5$ and $N_i = 1.0$,

$\therefore \frac{N_r}{N_i} > 1.0$; therefore, the ray of light slows down and bends towards the normal.

35. (4) If $N = \frac{C}{S}$, $\therefore N_r = \frac{C}{S_r}$ and

$N_i = \frac{C}{s_i}$ substituting in the Snell's law given

$$\frac{\sin\theta_i}{\sin\theta_r} = \frac{\frac{C}{S_r}}{\frac{C}{S_i}}$$

where C = speed of light in vacuum and S_i and S_r is speed of light in medium.

Then $n\frac{\sin\theta_i}{\sin\theta_r} = \frac{S_i}{S_r}$

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36. (2) The question is self--explanatory

37. (1) Since pressure is measured in gauge, pressure and P_1 and P_2 are measured at surfaces exposed to the atmosphere $P_1 = P_2 = 0$.

38. (3) $h_1 + \frac{P_1}{W} + \frac{V_1^2}{2a} + h_2 + \frac{P_2}{W} + \frac{V_2^2}{2a}$ at 1 the velocity in all practical purposes = 0 and $P_0 = P_2 = 0$ then the equation above can be written as

$$h_2 + \frac{V_2^2}{2a} = h_1$$

$$V_2^2 = (h_1 - h_2)2a$$

$$V_2 = [(h_1 - h_2)(2a)]^{1/2}$$

39. (3) Mathematical expression of Centripetal force

40. (4) Mathematical expression of Ohm's law

41. (2) Mathematical expression of Charles' law

42. (1) Mathematical expression of Grahams law of diffusion.

43. (4) $V = at$; $t = 60$ sec. $= \frac{60}{3600}$ hr.

$$800 = a\frac{60}{3600} = \frac{a}{60}$$

$$a = 48{,}000 \text{ mi./hr.}^2$$

44. (1) The Pauli exclusion principle states that no more than 2 electrons may occupy a particular atomic orbital. In order for 2 electrons to occupy the orbital they must possess opposite spins.

45. (3) S, the distance, equals zero when the object has returned. V_0, the initial velocity, equals 128 ft./sec. g, the acceleration of gravity equals 32 $^{ft.}/_{sec^2}$.

$$0 = 128t - \frac{32t^2}{2} = 128t - 16t^2$$

$$16t^2 - 128t = 0$$

Factoring, $t(16t - 128) = 0$

When the product equals zero, one of the factors must equal zero

Either $t = 0$ (not valid)

or $16t - 128 = 0$ and $t = \frac{128}{16} = 8$ sec.

46. (1) $a = \frac{v_2 - v_1}{t}$

$$= \frac{58 \text{ mi./hr.} - 23 \text{ mi./hr.}}{3.5 \text{ sec.}} = \frac{35 \text{ mi./hr.}}{3.5 \text{ sec.}}$$

$$= 10 \text{ mi./hr. per sec.}$$

Or, since 35 mi./hr. = 51 ft./sec

$$a = \frac{51 \text{ ft./sec.}}{3.5 \text{ sec.}}$$

$$= 12.7 \text{ ft. per sec.}^2$$

47. (3) $v = \frac{v_1 + v_2}{2}$

$v = \frac{1}{2}(23 + 58)$ mi./hr. $v = 40.5$ mi./hr.

$$v = 40.5 \times \frac{5280 \text{ ft./min.}}{3600 \text{ sec./hr.}} = 59.4 \text{ ft./sec.}$$

$X = 59.4$ ft./sec. $\times$ 3.5 sec $X = 208$ ft.

48. (3) $v = \frac{336}{6} = 56$ mi./hr

49. (4) The volume of the glass may be calculated as follows :

$$10.000 \text{ gm} \times \frac{1 \text{ cm}^3}{6 \text{ gm}} = 1666 \text{ cm}^3$$

50. (3) $1666 \text{ cm}^3 \times \frac{1 \text{gm}}{\text{cm}^3} = 1666$ g of H_2O

$1.7 \text{ kg } H_2O \times 9.8 \text{ m/sec.}^2 = 16.66 \text{N}$

Therefore 100 N – 17 N = 83 N.

51. (1)

$$F = mg. \quad 10 \text{ kg} \times 9.8 \text{ m/sec.}^2$$

$$= 98 \text{ kg} - \text{m/sec.}^2 = 98 \text{ N}$$

The acceleration of gravity is 32 $^{ft.}/_{sec^2}$. This may be converted to acceleration in the Mks system by working out a conversion factor

$\frac{2.54 \text{ cm}}{\text{in.}} \times 12 = 30.48$ cm/ft. $= 0.30$ m/ft.

$32 \times 0.30 = 9.6$ $^{m}/_{sec.^2}$.

The smaller number results from rounding, but this is close enough.

52. (3) 53.(2) 54.(2) 55.(3) 56.(1) 57.(2) 58.(1) 59.(1) 60.(3)

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CHEMISTRY (ANSWERS WITH EXPLANATIONS)

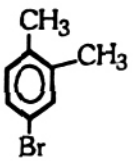
1. (3) Silver ions will react with chloride ions and precipitate as AgCl.

2. (2) The equation is self-explanatory.

3. (1) $H_2S \rightleftarrows 2H^+ + S^{2-}$. By the common ion effect, lowering the pH (increasing the H^+ concentration) will lower the S^{-2} concentration by displacing the reaction to the left. $K_i = \frac{(H^{+2})(S^{2-})}{(H_2S)}$ If H^+ increases, S^{-2} must decrease.

4. (3) In DNA there are principally 4 nitrogen bases: adenine, thymine, guanine, and cytosine. In RNA uracil is present instead of thymine. During transcription of RNA from DNA, the DNA bases of adenine, thymine, guanine, and cytosine will pair with the RNA bases of uracil, adenine, cytosine, and guanine, respectively.

5. (3) The starting compound may be pictured as.



Monobromination in the 3,5 or 6 positions will produce different compounds. The identity of the alkyl groups is not important since ring monobromination was specified.

6. (1) Lye soap was produced in earlier days by boiling animal fat with lye. This process of forming the salt of fatty acids by treating at fat with alkali is called saponification

7. (4) The hydronium ion, H_3O^+, is a protonated water molecule.

$$2H_2O \rightleftarrows H_3O^+ OH^-.$$

8. (3) Cyclopropane, containing 3 carbon atoms, is the smallest organic ring compound.

9. (3) Anaerobic oxidation is far less efficient than aerobic oxidation. Pasteur showed that fermentation can take place in the absence of air. The common equations are written in the following manner: Aerobic respiration:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6H_2O + 6\,CO_2 + \text{Energy (673 calories)}$$

Anaerobic respiration (alcoholic Fermentation):

$$C_6H_{12}O_6 \longrightarrow 2C_2H_5OH + 2CO_2 + \text{Energy (25 calories).}$$

10. (2) The different isomers are 1, 2; 1,3; 1,4; and 2,3. There might appear to be other possibilities; but 2,4 is more properly 1,3 and 3,4 is more properly 1,2.

11. (4) A reaction in which electrons (e^-) are removed is termed an oxidation reaction; the adding of electrons to an atom or molecule is termed a reduction reaction

12. (4) As long as the volume units are the same, $N_1V_1 = N_2V_2$

$$V_2 = \frac{N_1V_1}{N_2} = \frac{(50)\,(0.25)}{0.50} = 25 \text{ ml}$$

The fact that the acid produces two hydrogen ions per molecule does not enter into the calculations.

13. (2) Hemoglobin is the oxygen carrier in red blood cells of all vertebrates. With carbon monoxide hemoglobin forms carboxyhemoglobin. The binding capacity (affinity) of hemoglobin for carbon monoxide is over 100 times that of the binding capacity for oxygen

14. (3) A compound can only be separated by chemical means and not be physical means. A mixture can, however, be separated by physical means.

15. (3) The first reaction

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

is a synthesis reaction.

The second reaction

$$2HgO \longrightarrow 2Hg + O_2\uparrow$$

is decomposition reaction.

The third reaction

$$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$$

is a single replacement reaction.

The fourth reaction

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

is a double replacement reaction (as well as a neutralization or acid-base reaction).

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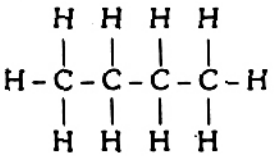
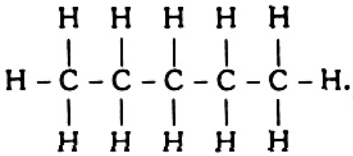
16. (1) James Chadwick discovered the neutron in 1932.

17. (3) The compound whose structural formula was listed in the question was

Butane



Pentane has the following structural formula



18. (1) This precipitate reacts with acid or base and therefore, is amphoteric. It could be aluminum hydroxide.

$$Al(OH)_3 + 3H^+ \longrightarrow Al^{+++} + 3H_2O$$

$$Al(OH)_3 + OH^- \longrightarrow Al(OH)_4.$$

19. (4) Follow the above explanation.

20. (2) 2,4-D is applied to field and lawns to eliminate weeds. Most of the weeds are dicotyledonous plants which are more sensitive to this potent stimulator of plant metabolism. The proper concentration must be carefully adhered to so that when the material is applied, the weeds will be stimulated to metabolize at such a great rate that they will consume their own protoplasm and die while the monocytyledonous grasses (or crops) will remain unharmed.

21. (2) Transuranium elements are those having more than the 92 protons of uranium. Several may be produced by neutron bombardment of lighter elements such as uranium.

22. (2) Light-catalyzed reduction of silver salts to produce elemental silver is the basis for black and white photographic film.

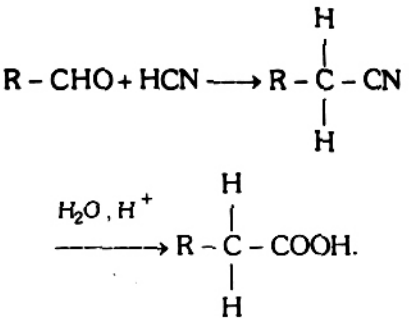
23. (4) The question lists the properties of a solid.

24. (3) Polyvinyl alcohol can be formed by polymerizing vinyl acetate and then removing the acetate groups (transesterification or saponification). Attempts to produce the monomer, vinyl alcohol, lead only to the production of acetaldehyde.

25. (4) This is the usual Wurtz reaction, and a mixture would be predicted.

26. (2) Sodium metal reacts with acetylene to form disodium acetylide. This acetylide reacts with alkyl halide, substituting the alkyl groups for the sodium substituent.

27. (3)



28. (4) A Grignard reagent will react with the active H of an alcohol to produce an alkane. In this case CH_4 will be produced.

29. (3) Glucose in solution primarily contains the pyranose ring (five carbons and one oxygen atom).

30. (1) A free radical reaction can often be propagated for some time unless a terminating collision occurs. The collision of two free radicals results in formation of a stable compound and thus in termination of the reaction (at least with respect to these two free radicals).

31. (1) The principle of LeChatelier, stated simply, says that a system, placed under stress, changes to relieve the stress. Four volumes of gas are on the left side of the equation, and only two volumes are on the right. A change of equilibrium toward the right would thus tend to relieve the stress brought about by higher pressure.

32. (1) This is an example of the aldol condensation. It requires an aldehyde or ketone possessing α-hydrogen.

33. (3) The concentration of (OH^-) will decrease due to the common ion effect. Since $(OH^-) \times (H^+) = 10^{-14}$, H^+ must increase, pH decreases and pOH increases.

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34. (3) The more ions formed, the greater the electric current carried by an electrolyte solution.

35. (2) $I_2 + 2S_2O_3^{-2} \longrightarrow 2I^- + S_4O_6^+$. Iodine is being reduced. Iodine (i.e., I_2) but not iodide (i.e., I^-) reacts with starch to form a blue complex.

36. (1) A yellow precipitate of iodoform is produced in this reaction with methyl ketones, alcohols that may be oxidized to methyl ketones, or acetaldehyde.

37. (4) Enzymes are influenced by ;*temperature*

1. inactivated usually above 60° C

2. rate of reaction is controlled as in any chemical reaction; the rate is approximately doubled by each 10° C increase

3. low temperatures slow the reactions PH. There is an optimum pH for every reaction

poisons

some enzymes themselves can be harmful to the organism but they are also susceptible to compounds like cyanide, etc., which inactivate them

concentration.

the rate of a reaction is directly proportional to the amount of enzyme present in relation to substrate. If a coenzyme or specific activator is required, that substance may control the overall rate of the reaction also.

38. (2) The alpha helix contributes to the secondary structure of proteins, but not all proteins (nor all regions of proteins) contain the alpha helix secondary structure.

39. (2) The four products of this Wurtz reaction are n-hexane, n-butane, and ethane. On the basis of probability only, the butane should represent 50 % of the product on a molar basis.

40. (4) See explanation for question 39.

41. (1) $\phi N_2^+ Br^- + H_2$ catalyst $\phi - NH - NH_2$

42. (1) $H_2O + Na \longrightarrow H_2 + NaOH$

43. (1) During the production of electricity the two half-cell reactions of the storage battery are

$Pb + SO_4^{-2} \longrightarrow PbSO_4 + 2e^-$

$PbO_2 + 4H + SO_4^{-2} + 2e^- \longrightarrow PbSO_4 + 2H_2O$

During recharging of the battery the two half-cell reactions are reversed.

44. (3) $CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$.

45. (3) Freezing point depression in water depends only on the number of solute particles per unit volume

1 M NaCl = $2 \times 1 \times 6.02 \times 10^{23}$ particles per liter

0.3 M $NaSO_4$ = $3 \times .03 \times 6.02 \times 10^{23}$ particles per liter.

1.5 M glucose = $1 \times 1.5 \times 6.02 \times 10^{23}$ particles per liter.

0.5 M $BaSO_4$ = $3 \times 0.5 \times 6.02 \times 10^{23}$ particles per liter.

Dividing by 6.02×10^{23} we can see that the comparative figures are NaCl, 2; Na_2SO_4, 0.9; glucose, 1.5; and $BaSO_4$, 1.5. Thus, the NaCl solution has the greatest number of particles per unit volume (considering the ionization of NaCl, Na_2SO_4 and $BaSO_4$),, and its will have the lowest freezing point.

46. (2) Markovanikov's rule predicts that in the absence of peroxides the addition of hydrogen halide across a double bond will occur with hydrogen being added to the carbon, which already contains the most hydrogen. In the presence of peroxides, however, a free radical mechanism results in hydrogen bromide being added in the opposite orientation.

47. (3) This is a definition of the zwitterion; an example is the amino acid, glycine.

48. (1) Helium has a higher density and cost than hydrogen, but it is much safer. Hydrogen readily escapes through tiny holes, and if ignited, it reacts quite readily with oxygen. Helium is essentially inert chemically.

49. (1) Low molecular weight mercaptans have a very unpleasant odor even in low concentration. They are added to give an odor to the odorless natural gas. This is quite helpful in detecting leaks and thus avoiding explosions.

50. (3) The question states a fact and the information should be learned.

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51.(4) Certain condition like extremely low temperature and very high pressure can liquefy the nobel gases. Reason is also true but not the correct explanation of assertion

52.(3) Due to excitation of valence electrons of alkali metals, their salts give colour to the bunsen flame

53.(4) It is true that among halogens, chlorine oxidises to highest oxidation state but reason is not correct explanation, though it is individually correct.

54.(1) Decolouration of Br_2 water shows unsaturation in hydrocarbon. As acetylene have tripple bond, it consist of one σ— and one π—bond. π—bond is replaced by bromine and addition reaction is taking place here.

55.(1) It is true that 4s electrons ionises before 3d–orbital electrons but the energy level of 3d– orbital electron is more than 4s–orbital electrons.

56.(1) N_2 molecules contains triple bond, hence, less reactive because of high bond energy. But reason is incorrect because there no delocalization of electron in it.

57.(4) Both assertion and reason are true but reason is not correct explanation of assertion because it never explain about the adsorption nature of fluorescein

58.(4) Assertion and reason are true but not explaining why all enzymes are proteins. In general all enzymes are proteinous macromolecules made of amino acids.

59.(3) Alkali metals are strong reducing agent because it has a tendency to get oxidised by removing one electron easily. The main reason for this, they have ns^1 electronic configuration and by removing ns^1 electron it can attain noble gas configuration which is a stable configuration.

60.(3) As we know that all exothermic reactions are not spontaneous whereas all such type of reactions where the entropy of system increases are spontaneous. So, we can say where the internal energy of system decreases and randomness increases the reaction become spontaneous. Hence, both assertion and reason are true and reason explains the assertion.

BIOLOGY

1.(3) 2.(4) 3.(4) 4.(4) 5.(3) 6.(2) 7.(4) 8.(1) 9.(4) 10.(3) 11.(3) 12.(4)
13.(1) 14.(2) 15.(3) 16.(4) 17.(3) 18.(1) 19.(3) 20.(4) 21.(2) 22.(3)
23.(3) 24.(1) 25.(3) 26.(4) 27.(3) 28.(2) 29.(1) 30.(1) 31.(3) 32.(4)
33.(2) 34.(4) 35.(2) 36.(4) 37.(2) 38.(4) 39.(4) 40.(2) 41.(3) 42.(3)
43.(2) 44.(3) 45.(3) 46.(2) 47.(3) 48.(4) 49.(4) 50.(3) 51.(1) 52.(3)
53.(3) 54.(3) 55.(1) 56.(1) 57.(3) 58.(1) 59.(1) 60.(1)

EXPLANATIONS

1. Suberin is a protein and gives rigidity to the cell wall

2. It is caused by puccinia graminis and has 5 stages

3. Heterotrichous stage is the arrangement of different types of flagella on the body

5. Garner and Allored found out that tobacco plants could flower only after exposure to a number of short days

7. Cleistothecium is a closed structure containing spores on the inner wall

8. It is so named because it was discovered for the 1^{st} time in polygonum by strasburger

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13. Robertson model says a phospholipid layer is sandwitched between two layers of proteins are discontinuosly embedded in two layers of lipids

16. Mn helps in the electron transport reactions

18. Auxins help in cell elongation,cell division phototropism geotropism, apical dominance, root initiation, abcission etc.

20. Nodes and internodes are exclusive characteristics of stem

21. Smallest flower is Wolffia

22. Classification of Cucurbitaceae is

Polypetalae, Calyciflorae, Passiflorales, Cucurbitaceae

23. PMA covers stomata as a film and allows CO_2 diffusion but restrict diffusion of water and thus reduce transpiration without affecting CO_2 uptake . Other anti transpirants is ABA

28. Holocene represents the age of man

29. Due to development in the field of medicine, mortality rate in chlidren have lowred.

30. Heckels theory takes into account the comparative embryological evidences

31. Colour blindness is a sex linked disease and therefore it appears due to inheritance through X chromosome

32. Archenteron opens through blastopore

33. The heart of rabbit is a mammalian heart and therefore mitral valve is situated at the left auriculoventircular opening

38. Trypanosoma affects blood and nervous tissue due to which man feels sleepy and may cause death. It is also called African sleeping sickness or gambian fever .

42. Its infection takes place by contaminated water .

44. Carbon dioxide reacts with water forming carbonic acid in the presence of carbonic anhydrase carbonic acid dissociates into hydrogen ion and bicarbonate which diffuse into plasma

$$CO_2 + H_2O \longrightarrow H_2CO_3 \longleftrightarrow HCO_3^- + H^+$$

47. Body temperature is a function of rate of metabolism thus active animals have high body temperature.

49. Sustentacular cells are found in germinal epithelia of seminiferous tubules of testis. These are also known as nurse cells or sertoli cells

51. This is expressed by chargaff's base pairing rule

52. Cholera patient is given these to over come dehydration to which human cells may plasmolyse

53. Excessive alcohol hampers metabolism

55. Plasmodium vivax the protozoan due to which malaria is caused and it is carried by female anopheles mosquito

56. Since no antibodies are present in AB blood group thus no antigen in required and therefore AB is universal acceptor

57. The patient had scurvy which is caused due to deficiency of vitamin 'C' thus to provide vitamin 'C' doctor advised him citrus fruits

59. Sexlinked gene is found on X chromosome of male thus can not be transferred from male .

GENERAL KNOWLEDGE

1.(3) 2.(1) 3.(3) 4.(1) 5.(2) 6.(4) 7.(1) 8.(2) 9.(1) 10.(1) 11.(4) 12.(3) 13.(3) 14.(4) 15.(1) 16.(4) 17.(4) 118.(1) 19.(2) 20.(2)