S.C.R.A-2010

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

T.B.C. : Q-RBQZ-K-OR

Test Booklet Series

A

Serial No. 123345

TEST BOOKLET
PHYSICAL SCIENCES
PAPER II

Time Allowed : Two Hours ***Maximum Marks : 200***

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES *NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C,** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. ***DO NOT*** write ***anything else*** on the Test Booklet.
4. This Test Booklet contains **120** items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ***ONLY ONE*** response for each item.
5. You have to mark all your responses ***ONLY*** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator ***only the Answer Sheet.*** You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**

    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.

    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. What is the lateral displacement of a ray of light passing through a parallel plate of glass of thickness t with angles of incidence and refraction respectively as α and β ?

(a) $t \sec(\alpha/\beta)$

(b) $t \sin(\alpha - \beta) \sec\beta$

(c) $t \sin(\alpha - \beta)$

(d) $t \cos(\alpha - \beta) \operatorname{cosec}\beta$

2. A spaceship is launched into a circular orbit close to the Earth's surface. What additional velocity has to be imparted to the spaceship to overcome the gravitational pull ? (Radius of the Earth is R)

(a) gR

(b) $\sqrt{2}gR$

(c) $\left(\sqrt{2}-1\right)\sqrt{gR}$

(d) $\left(\sqrt{2}-1\right)gR$

3. What is the trajectory of a particle if it moves according to the law $x = a \sin(\omega t)$ and $y = a \cos(2\omega t)$?

(a) Circle

(b) Parabola

(c) Hyperbola

(d) Ellipse

4. The velocity of a particle moving in the positive direction of x-axis varies as $v = \alpha\sqrt{x}$ where α is a positive constant. Assuming $t = 0$, the particle is at $x = 0$. What is the time dependence on displacement ?

(a) $t = \dfrac{2x}{\alpha}$

(b) $t = \dfrac{2\sqrt{x}}{\alpha}$

(c) $t = 2\sqrt{\dfrac{x}{\alpha}}$

(d) $t = \sqrt{\dfrac{2x}{\alpha}}$

5. A particle of mass m moves in a horizontal circle of radius r under the influence of a centripetal force given by $-kr^{-2}$, where k is a constant. What is the energy of the particle ?

(a) k/r

(b) $-k/(2r)$

(c) $k/(2r)$

(d) $-k/r$

6. Helium gas expands at a constant pressure when 15 kJ of heat is supplied. If $C_p : C_V$ is equal to 5 : 3, what is the increase in the internal energy ?

(a) 3 kJ

(b) 6 kJ

(c) 9 kJ

(d) 15 kJ

7. What is the maximum charge (approximate) that can be given to a sphere of diameter 5 m if the insulating property of air breaks down at an electric field of intensity of 6×10^6 V/m ?

$\left[\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}\right]$

(a) 2×10^{-3} C

(b) 4×10^{-3} C

(c) 9×10^{-6} C

(d) 2×10^{-7} C

8. The depolarization in a primary cell is used for the purpose of

(a) increasing the life of the cell

(b) increasing the emf of the cell

(c) removing the hydrogen collected at one of the plates

(d) removing the dipoles from the electrolytes

9. A car is driven by a constant power P. If the car moves over a distance x, then velocity attained by the car will be proportional to

(a) $x^{\frac{1}{3}}$

(b) $x^{\frac{1}{2}}$

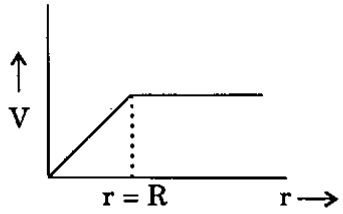
(c) $x^{-\frac{1}{2}}$

(d) $x^{-\frac{1}{3}}$

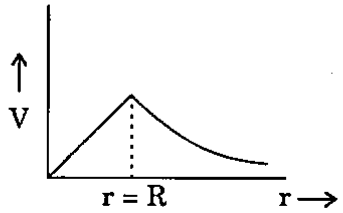
10. Which one of the following graphs represents the variation of potential (V) for a uniformly charged non-conducting sphere of radius R ?

[r is the distance from the centre of sphere]

(a)



(b)



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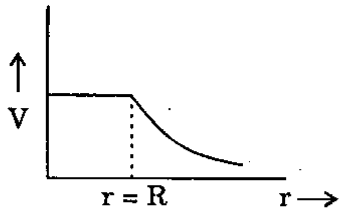
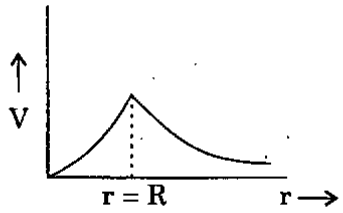


(d)



11. At very high magnifications, optical microscopes use oil immersion objectives where a drop of oil with refractive index close to that of objective lens is introduced between the object and the objective lens. The purpose of this is to

1. increase the resolving power.
2. decrease the aberrations.
3. increase the field of view.
4. increase the image brightness.

Which of the above is/are correct ?

(a) 1 and 3

(b) 3 only

(c) 2 and 3

(d) 4 only

12. A student is setting up a lens to create the image of an object when he drops the lens which breaks into several pieces. He picks up a piece which is about one-fourth of the original lens and tries to use it in his experiment.

Consider the following statements :

1. No image will be created.
2. An image will be created but it will be distorted.
3. An image with decreased brightness and resolution will be made.
4. Only about one-fourth of the object will be imaged.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 and 4

(c) 3 only

(d) 4 only

13. One hundred antennas are putting out identical waves given by

$$E = 0{\cdot}02 \cos (\varepsilon - \omega t) \text{ V/m}$$

The waves are brought together at a point. What will be the amplitude of the resultant incoherent waves (random phase) ?

(a) 0·02 V/m

(b) 0·2 V/m

(c) 2 V/m

(d) None of the above

14. An open organ pipe of length L vibrates in its fundamental mode. Where is the pressure variation maximum ?

(a) At the two ends

(b) The middle

(c) At L/4 from each end

(d) At L/8 from each end

15. For the correction of astigmatism in an otherwise normal eye, an ophthalmologist will prescribe

(a) a negative spherical lens

(b) a positive spherical lens

(c) an aspheric lens

(d) a cylindrical lens

16. The photon energy of the visible spectrum approximately ranges from

(a) 1·7 eV to 3 eV

(b) 3 eV to 4 eV

(c) 7 eV to 10 eV

(d) 4 eV to 7 eV

[Planck's constant = $6{\cdot}63 \times 10^{-34}$ Js]

17. Sound waves travel through a chamber filled with an inert gas. The pressure in the chamber is increased in such a manner that the temperature of the gas does not change. The velocity of sound through the gas will

(a) increase

(b) decrease

(c) remain constant

(d) depend on the amount of pressure change

18. Three particles A, B, C are situated at the vertices of an equilateral triangle ABC of side d at t = 0. Each of the particles moves with constant speed v. A always has its velocity along AB, B along BC and C along CA. The time the particles meet each other is

(a) d/(3v)

(b) 2d/(3v)

(c) 3d/(2v)

(d) d/v

19. An open bamboo pipe has a fundamental frequency f. The tube is dipped vertically into water so that exactly half of the length is immersed. What will be the new fundamental frequency ?

(a) f/4

(b) f/2

(c) f

(d) 2f

20. In a certain two-dimensional field of force, the potential energy of the particle has the form $U = ax^2 + by^2$ where a, b ($a \neq b$) are positive constants with different magnitudes. What is the shape of the equipotential surface for which the magnitude of force vector is constant ?

(a) Circle

(b) Ellipse

(c) Parabola

(d) Hyperbola

21. A sphere of solid material of specific gravity 8 has a concentric spherical cavity and just sinks in water. What should be the ratio of radius of the cavity to that of outer radius of sphere ?

(a) $\frac{\sqrt[3]{3}}{2}$

(b) $\frac{\sqrt[3]{5}}{2}$

(c) $\frac{\sqrt[3]{7}}{2}$

(d) $\frac{\sqrt[3]{9}}{2}$

22. A small body was launched up an inclined plane set at an angle θ against the horizontal. The time of ascent of the body is k times less than the time of descent. What is the coefficient of friction ?

(a) $\left(\frac{k^2-1}{k^2+1}\right)\tan\theta$

(b) $\left(\frac{k^2+1}{k^2-1}\right)\tan\theta$

(c) $\left(\frac{k-1}{k+1}\right)\tan\theta$

(d) $\left(\frac{k+1}{k-1}\right)\tan\theta$

23. A plank with a body of mass m placed on it starts moving straight up according to the law $y = 2a \sin^2(\omega t/2)$ where y is the displacement from the initial position. What is the minimum amplitude of oscillation of the plank at which the body starts falling behind the plank ?

(a) g/ω

(b) g/ω^2

(c) $2g/\omega^2$

(d) None of the above

24. When the speed of the particle increases by 2 units, the kinetic energy becomes doubled. What is the original speed of the particle ?

(a) 2 unit

(b) $\sqrt{2}$ unit

(c) $2(\sqrt{2}+1)$ unit

(d) $\sqrt{2}(\sqrt{2}+1)$ unit

25. At what height over the Earth's pole does the free fall acceleration decrease by 1% ? (Radius of the Earth = 6400 km)

(a) 32 km

(b) 64 km

(c) 320 km

(d) 640 km

26. A body is moved along a straight line by a machine delivering constant power. The distance moved by the body in time t is proportional to

(a) $t^{1/2}$

(b) $t^{3/4}$

(c) $t^{3/2}$

(d) t^2

27. Each division on the main scale is 1 mm. Which one of the following vernier scales will give vernier constant equal to 0·01 mm ?

(a) 9 mm divided by 10 divisions

(b) 95 mm divided by 100 divisions

(c) 99 mm divided by 100 divisions

(d) 9 mm divided by 100 divisions

Directions : *For the next 03 (three) items that follow :*

A solid body rotates about a stationary axis according to the law $\varphi = at - bt^3$, where $a > 0$, $b > 0$.

28. What is the mean value of angular velocity averaged over the time t = 0 and the complete stop ?

(a) a/3

(b) 2a/3

(c) a/2

(d) a/4

29. What is the mean value of angular acceleration averaged over the time t = 0 and the complete stop ?

(a) $(3ab)^{1/2}$

(b) $(3ab)^{1/3}$

(c) $(ab)^{1/2}$

(d) None of the above

30. What is the angular acceleration at the moment when the body stops ?

(a) $(3ab)^{1/2}$

(b) $2\,(3ab)^{1/2}$

(c) $3\,(3ab)^{1/2}$

(d) None of the above

31. A piece of wax weighs 'x' g in air. A piece of metal is found to weigh 'y' g in water. Then the metal piece is tied to the wax and both together weigh 'z' g in water. What is the specific gravity of the wax ?

(a) x/y

(b) y/x

(c) x/(x + y – z)

(d) x/(x – y + z)

32. The angle of incidence of a light ray on a plane mirror is reduced by 15°. The angle between the reflected ray and the incident ray becomes 90°. What was the original angle of incidence ?

(a) 30°

(b) 45°

(c) 60°

(d) 90°

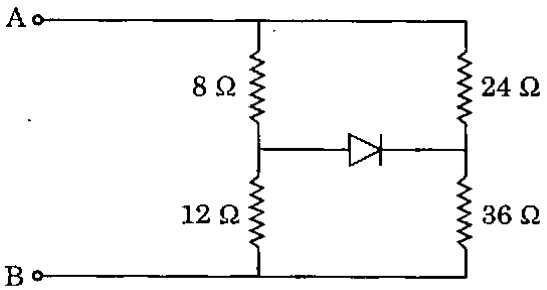
33. The platinum resistance thermometer is used to measure temperature. The great advantage of it lies in the fact :

(a) Accuracy in measurement

(b) High melting point of platinum

(c) Quick measurement of temperatures

(d) Wide range

34. 

What is the equivalent resistance between A and B in the above circuit ?

(a) 15 Ω

(b) 19·2 Ω

(c) Depends upon whether diode is forward biased or reverse biased

(d) Cannot be determined because of insufficient data

35. The internal energy of an ideal gas depends on which of the following factors ?

(a) Pressure only

(b) Volume only

(c) Temperature only

(d) Pressure, volume and temperature

36. The escape velocity of a body from the Earth is v. What will be the escape velocity of the same body from a planet whose radius is twice that of the Earth and mean density same as that of the Earth ?

(a) 8v

(b) 4v

(c) 2v

(d) v

37. A light ray is passing through a glass plate of thickness d and refractive index n. What is the time taken by the light to cross the glass plate ?

[c is the speed of light in vacuum]

(a) dnc

(b) d/(nc)

(c) dn/c

(d) nc/d

38. The magnification of a magnifying glass of focal length f, when held at a distance equal to least distance of distinct vision, is M. What is the magnifying power of another magnifying glass having focal length (3f)/2 ?

(a) 3M/2

(b) 2M/3

(c) (2M + 1)/3

(d) (9M + 2)/6

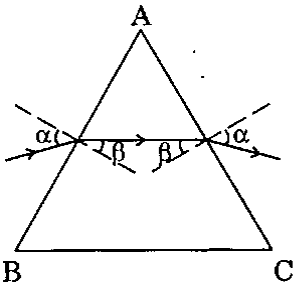
39. At absolute zero, which one of the following is zero for a gas ?

(a) Potential energy

(b) Kinetic energy

(c) Vibration energy

(d) None of the above

40. 

A monochromatic ray of light is incident on a prism at an angle of incidence 45° and emerges from the other surface after undergoing refraction as shown in the diagram above. If the angle of refraction is 35°, what is the angle of deviation ?

(a) 80°

(b) 20°

(c) 15°

(d) 10°

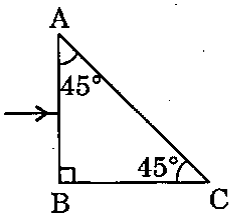
41. The refractive index of the material of a prism with apex angle A is cot (A/2). What is the angle of minimum deviation ?

(a) 2A

(b) 3A/2

(c) 180° – A

(d) 180° – 2A

42. 

A ray of monochromatic light enters normally on face AB of a transparent prism of refractive index n = 1·6 as shown in the figure. Which one of the following is correct ?

(a) The ray of light emerges from face BC after total internal reflection from face AC

(b) The ray of light emerges from face AC after refraction

(c) The ray of light partly gets reflected from face AC and partly emerges from face BC

(d) The ray of light disposes in different directions

43. Consider the following statements :

Statement I : A thermally insulated vessel contains some water. If the vessel is shaken vigorously, the temperature of the water will rise.

Statement II : In this process energy is given to the water.

Which one of the following is correct with reference to the above statements ?

(a) Both statement I and statement II are true and statement II is the correct explanation of statement I

(b) Both statement I and statement II are true and statement II is not the correct explanation of statement I

(c) Statement I is true and statement II is false

(d) Both statement I and statement II are false

44. Consider the following statements :

1. Magnetisation can be increased without limit by applying strong magnetizing fields.

2. Magnetisation is maximum at 0 K.

Which of the statements given above is/are correct in respect of a ferromagnetic material ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

45. How can a voltmeter be converted into an ammeter ?

(a) By removing high resistance from parallel and connecting low resistance in series

(b) By removing high resistance from series and connecting low resistance in parallel

(c) By removing low resistance from parallel and connecting high resistance in series

(d) By removing low resistance from series and connecting high resistance in parallel

46. A magnetic needle is placed in a non-uniform magnetic field. The needle will experience

(a) a force but not a torque

(b) a torque but not a force

(c) neither a force nor a torque

(d) both force and torque

47. Four metallic rods of same material but of different dimensions are placed between two constant temperature baths of different temperatures. Which of the rods having the following dimensions will conduct maximum heat between the temperature baths ?

(a) Length is 100 cm and radius is 1 cm

(b) Length is 200 cm and radius is 2 cm

(c) Length is 200 cm and radius is 1 cm

(d) Length is 100 cm and radius is 2 cm

Directions : *For the next 02 (two) items that follow :*

Two superposed plane waves are represented by

$$E_1 = \frac{5E_0}{(3x - 4t)^2 + 2} \text{ and } E_2 = \frac{-5E_0}{(3x + 4t - 6)^2 + 2}$$

48. Consider the following statements :

1. The two waves are travelling in opposite directions.

2. There is always a node at x = 1.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

49. At what instant will there be always a node ?

(a) t = 1/2 s

(b) t = 3/4 s

(c) t = 1 s

(d) None of the above

50. While making very large diameter astronomical telescopes, why are reflecting mirrors preferred to refractive object lenses ?

1. Mirrors are easier and less expensive to make as only one surface is to be polished.
2. Mirrors have a higher light collection ability.
3. Chromatic aberration is eliminated.

Select the correct answer using the code given below :

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

51. Two spectral lines are separated by a wavelength difference of 0·01 nm. If the mean wavelength is 600 nm, what is the frequency separation ?

(a) 3×10^{19} Hz
(b) 3×10^{9} Hz
(c) $8{\cdot}3 \times 10^{15}$ Hz
(d) $8{\cdot}3 \times 10^{9}$ Hz

52. A old man misplaces his spectacles but needs urgently to read some fine print. His grandson takes a thin paper card, pierces it to make a fine pin hole and asks his grandfather to look through it keeping the fine print at a close distance. The old man is able to do so. What is the reason for this ?

1. He is using a small axial part of his eye lens which is not affected due to ageing.
2. The pin hole plus the eyeball act like a pin hole camera and a magnified image of the object is formed on the retina.

Select the correct answer using the code :

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

53. A string is tied and stretched between two rigid walls. The string is now vibrated and stationary waves are observed. At a frequency of vibration f_1, n_1 antinodes are observed. At another frequency of vibration f_2, n_2 antinodes are observed. If λ_1 and λ_2 are the respective wavelengths, which one of the following relations is correct ?

(a) $\frac{n_1}{n_2} = \frac{\lambda_2}{\lambda_1}$

(b) $\frac{n_1}{n_2} = \frac{\lambda_1}{\lambda_2}$

(c) $n_1 \lambda_1^2 = n_2 \lambda_2^2$

(d) $n_1^2 \lambda_1 = n_2^2 \lambda_2$

54. An electron oscillates along the y-direction in the xy-plane under the influence of a sinusoidal electric field applied in the y-direction. Now a uniform magnetic field is switched on such that $\vec{B} = B_z \hat{k}$, $\hat{k}$ being the unit vector along z-direction. The general motion of the electron is now described as

(a) linear but not along y-direction
(b) along an ellipse in the xy-plane
(c) along a circle in the xy-plane
(d) None of the above

55. Consider the following statements :

1. The Bohr model could explain the coarse structure of the spectrum of the hydrogen atom.

2. The Bohr model connects the frequency of revolution of an electron in its orbit to the frequency of spectral lines.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

56. A full wave rectifier has a 50 Hz a.c. signal at the input. What will be the frequency of the rectified output ?

(a) 50 Hz

(b) 100 Hz

(c) 200 Hz

(d) 0

57. Electrons strike a high Z target and a characteristic X-ray, K_α line is observed. This line is due to the electron transition from

(a) K shell to L shell

(b) L shell to K shell

(c) K shell to M shell

(d) M shell to K shell

58. Nucleons inside a nucleus can be attributed a binding energy just as electrons inside an atom possess a binding energy. The ratio of the binding energy of a nucleon in a nucleus of middle mass number to an outer electron in an atom is of the order of

(a) 10^6

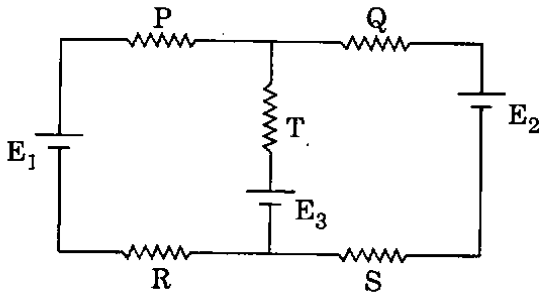
(b) 10^9

(c) 10^{12}

(d) 10^{15}

Directions : *For the next 02 (two) items that follow :*

Consider the following circuit :



The three batteries in the above circuit are ideal batteries.

$P = Q = R = S = 2\,\Omega$, $T = 4\,\Omega$, $E_1 = 3$ V, $E_2 = E_3 = 6$ V

59. Which one of the following is correct ?

(a) The magnitude of current through P is equal to that of Q

(b) The magnitude of current through P is twice that of Q

(c) The magnitude of current through P is half that of Q

(d) None of the above

60. Which one of the following is correct ?

(a) The magnitude of current through Q is equal to that of T

(b) The magnitude of current through Q is twice that of T

(c) The magnitude of current through Q is half that of T

(d) None of the above

61. The number of water molecules differing in molecular mass formed by hydrogen isotopes ^{1}H, ^{2}H, ^{3}H and oxygen isotopes ^{16}O, ^{17}O, ^{18}O is

(a) 6

(b) 9

(c) 12

(d) 18

62. Consider the following statements in respect of hydrogen atom :

It can attain the stability

1. by losing an electron.

2. by gaining an electron.

3. by forming an electron pair with other atom.

Which of the statements given above are correct ?

(a) 1 and 3 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1, 2 and 3

63. In water or its acidic solution, proton can exist as H_3O^+, $H_9O_4^+$, $[H(H_2O)_n]^+$. This is due to more polarizing power of

(a) H

(b) H_2^+

(c) H^+

(d) H_2O

64. When gypsum is heated between 100° C to 120° C, it loses

(a) three-fourth of its water of crystallization

(b) half of its water of crystallization

(c) two-third of its water of crystallization

(d) whole water of crystallization

65. In cement manufacturing, gypsum is added to clinker. Which one of the following is ***not*** the function of gypsum ?

(a) It decreases the rate of setting of cement

(b) It makes the clinker more brittle

(c) It helps in binding the silicate particles

(d) It helps in facilitating the formation of colloidal gel

66. Tincture of iodine contains

(a) KI

(b) KIO_3

(c) HI

(d) CHI_3

67. Electrolytic reduction of Al_2O_3 to Al generally faces the difficulties like bad conductivity of Al_2O_3 and high fusion temperature. These difficulties are overcome by the addition of

(a) Cryolite and CaF_2 to alumina

(b) Cryolite only to alumina

(c) CaF_2 only to alumina

(d) Cryolite and NaF to alumina

68. 5 mL solution of hydrogen peroxide contains 0·085 g of hydrogen peroxide. What will be its volume strength ?

(a) 4·5 V

(b) 5·6 V

(c) 10 V

(d) 15 V

69. Which of the following can be the oxidizing as well as reducing agent ?

(a) MnO_4^-

(b) CrO_4^-

(c) H_2O_2

(d) $Cr_2O_7^-$

70. In froth floatation process for the concentration of sulphide ore of copper, pine oil and sodium ethyl xanthates are added. The functions of these respectively are

(a) Collecting agent and collecting agent

(b) Collecting agent and frothing agent

(c) Frothing agent and frothing agent

(d) Frothing agent and collecting agent

71. In the extraction of a certain metal M from its salts, the following basic chemical reactions are commonly used :

M-salt + 4 NaCN $\rightarrow$ $Na_2M(CN)_2$ + Na-salt

2 $Na_2M(CN)_2$ + Zn $\rightarrow$ 2 M + $Na_2Zn(CN)_4$

What is the metal salt ?

(a) HgS

(b) CdS

(c) AgCl

(d) None of the above

72. Consider the following conditions in respect of substitution alloys :

1. Both metals should be of similar atomic size.
2. Both metals should have same crystal structure.
3. Chemical properties must be similar for both the metals.

Which of the above conditions are required for the formation of substitution alloys ?

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

73. Bauxite ore mainly consists of Al_2O_3 + Fe_2O_3 + SiO_2 + TiO_2. When this impure ore is digested with concentrated NaOH at 500 K and 40 bar pressure, which of the constituents are mainly dissolved ?

(a) Al_2O_3 and TiO_2

(b) Al_2O_3 and SiO_2

(c) Al_2O_3 and Fe_2O_3

(d) SiO_2 and TiO_2

74. The aqueous solution of which one of the following is ***not*** basic ?

(a) $Na_2B_4O_7 . 10\ H_2O$

(b) ClOH

(c) $NaHCO_3$

(d) CH_3COONa

75. Consider the following regarding potash alum :

1. It has 24 water molecules.
2. It swells on heating.
3. Its aqueous solution is basic.
4. It is white in colour.

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 1, 3 and 4

(c) 2, 3 and 4

(d) 1, 2 and 4

76. Heavy water is ***not*** used for drinking because

(a) it is costly

(b) its chemical properties are different from ordinary water

(c) its physiological action is different from ordinary water

(d) its physical properties are different

77. Which one of the following molecules has zero dipole moment ?

(a) NO_2^+

(b) H_2O

(c) NH_3

(d) CO

78. In order to determine the number of replaceable hydrogen atoms in H_2SO_4, a titration with 0·1 N NaOH solution was performed. If the H_2SO_4 acid solution contains 0·049 g of acid dissolved in 100 mL volume, what will be the volume of NaOH ?

(a) 0·1 mL

(b) 1·0 mL

(c) 10·0 mL

(d) None of the above

79. In the change of NO^+ to NO, the electron is added to a

(a) σ orbital

(b) π orbital

(c) σ^* orbital

(d) π^* orbital

80. Consider the following statements :

Statement I : Impurity of lead in silver can be removed by liquation.

Statement II : Melting point of lead is lower than that of silver and consequently on heating it melts first and flows down the sloping hearth leaving behind pure silver.

Which of the following in respect of the above two statements is correct ?

(a) Statement I and statement II are independently true and statement II is the correct explanation of statement I

(b) Statement I and statement II are independently true and statement II is not the correct explanation of statement I

(c) Statement I is true, but statement II is false

(d) Statement I is false, but statement II is true

81. The molecular orbital configuration of CO is

$\sigma_{1s}^2 \ \sigma_{1s}^{*2} \ \sigma_{2s}^2 \ \sigma_{2p_z}^2 \ \pi_{2p_x}^2 \ \pi_{2p_y}^2 \ \sigma_{2s}^{*2}$

The bond order and magnetic nature of CO molecule are respectively :

(a) 7 and paramagnetic

(b) 5 and paramagnetic

(c) 3 and diamagnetic

(d) 2 and diamagnetic

82. What is the normality of a solution containing 20 g acetic acid in 2 L of solution ?

(a) 0·20 N

(b) 1·06 N

(c) 4·00 N

(d) 0·166 N

83. The rate reaction that doubles for every 10° C rise in temperature is raised from 10° C to 80° C. The rate of reaction increases by

(a) 14 times

(b) 16 times

(c) 64 times

(d) 128 times

84. An ideal solution is formed when its components

1. can be converted into gases.
2. obey Raoult's law.
3. have no change of volume.
4. have zero heat of mixing.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2, 3 and 4

(c) 2 only

(d) 3 and 4 only

85. The order of photochemical reaction between H_2 and Cl_2 is

(a) Zero

(b) First

(c) Second

(d) Third

86. A proton is converted to a neutron by

1. β^- emission.
2. β^+ emission.
3. electron capture.

Which of the statements given above are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

87. Consider the following statements :

1. One kind of energy can be converted into an exactly equivalent amount of other kind of energy.
2. Continuous production of mechanical work is possible without the supply of equivalent quantity of heat.

Which of the statements given above is/are contrary to first law of thermodynamics ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

88. What is the approximate wavelength in Å of a photon having energy 2 eV ?
[Planck's constant = $6{\cdot}63 \times 10^{-34}$ J-s]

(a) 6200
(b) 5100
(c) 4600
(d) 3900

89. The velocity of an electron in the first Bohr orbit is v_1. What is its velocity in the third Bohr's orbit ?

(a) $v_1/9$
(b) $v_1/3$
(c) v_1
(d) $3\ v_1$

90. One mole of pure ethyl acetate is mixed with one mole of acetic acid at room temperature and it is found that at equilibrium two-third mole of ester and two-third mole of water are present in the reaction mixture. What is the equilibrium constant for the reaction ?

(a) 1
(b) 2
(c) 4
(d) 6

91. The number of α and β particles emitted in the nuclear reaction $^{228}_{90}Th \rightarrow ^{212}_{83}Bi$ are

(a) 4 α and 1 β
(b) 3 α and 7 β
(c) 4 α and 3 β
(d) 4 α and 7 β

92. An acidified solution of 0·1 M $CuSO_4$ is electrolysed using platinum electrodes. What is the reaction that occurs at the anode ?

(a) $Cu = Cu^{++} + 2\ e^-$
(b) $Cu = Cu^+ + e^-$
(c) $2\ H_2O = 4\ H^+ + O_2 \uparrow + 4\ e^-$
(d) None of the above

93. At a fixed temperature, solubilities of AgCl in water, in 0·01 mol L^{-1} aqueous NaCl solution, in 0·01 mol L^{-1} aqueous $NaNO_3$ solution and in 0·01 mol L^{-1} aqueous Na_2SO_4 solution are p, q, r, s respectively. What is the correct order of their solubilities ?

(a) $p < q < r < s$
(b) $q < p < r < s$
(c) $q < p < s < r$
(d) $s < r < p < q$

94. Electrolysis of NaCl results in evolution of Cl_2 (g) with the formation of NaOH (aq). In an experiment, the resultant solution after electrolysis of NaCl (aq) is found to be N/2 normal solution. What is the number of Faradays used in the experiment ?

(a) 0·25
(b) 0·50
(c) 1·0
(d) 10

95. When blood cells are placed in a solution of KCl whose osmotic pressure is greater than that of the cell fluid, there occurs

(a) Shrinking in size of the cell

(b) Increase in size of the cell

(c) No change in size

(d) First shrinking and then regaining of original size

96. In winter season specially in cold countries, ethylene glycol is added to water in the radiators of cars. It results in

(a) reducing the viscosity of water

(b) lowering the freezing point of water

(c) lowering the boiling point of water

(d) reducing the specific heat of water

Directions : *For the next 02 (two) items that follow :*

A sample of Mo-90 is observed to have an activity of 346 disintegrations per minute.

[1 curie = $3{\cdot}7 \times 10^{10}$ disintegrations per second]

97. What is the activity in microcurie ?

(a) $1{\cdot}6 \times 10^{-4}$

(b) $1{\cdot}6 \times 10^{-7}$

(c) $3{\cdot}2 \times 10^{-4}$

(d) $3{\cdot}2 \times 10^{-7}$

98. If half-life of Mo-99 is 66·6 hours, how many grams of Mo-99 is present in the sample ?

(a) $3{\cdot}3 \times 10^{-16}$

(b) $3{\cdot}3 \times 10^{-13}$

(c) $3{\cdot}3 \times 10^{-10}$

(d) $1{\cdot}6 \times 10^{-13}$

Directions : *For the next 02 (two) items that follow :*

A gas contained in a cylinder fitted with a frictionless piston expands against a constant pressure 1 atmosphere from a volume 5 L to 15 L. In doing so it absorbs 813 J thermal energy from surroundings [1 L atm = 101·3 J]

99. What is the work done (approximately) ?

(a) – 120 cal

(b) – 180 cal

(c) – 240 cal

(d) – 300 cal

100. What is the change in internal energy (approximately) ?

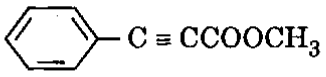
(a) – 1826 J

(b) – 813 J

(c) – 512 J

(d) – 200 J

101. Consider the following molecule :



What are the number of sigma and pi bonds present in the above molecule respectively ?

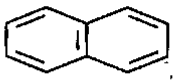
(a) 20, 6

(b) 18, 5

(c) 15, 5

(d) 14, 4

102. Which one of the following molecules is non-planar ?

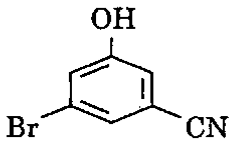
(a) 

(b) $CH_2 = C = CH_2$

(c) $CH_2 = CH - CH = CH_2$

(d) $CH_2 = CH - C \equiv CH$

103. Consider the following compound :



What is the acceptable IUPAC name of the above compound ?

(a) 3 – Bromo – 5 – cyanophenol

(b) 5 – Bromo – 3 – cyanophenol

(c) 3 – Bromo – 5 – hydroxybenzonitrile

(d) 5 – Bromo – 3 – hydroxybenzonitrile

104. Consider the following compounds :

1. $CHCl_3$
2. CH_3Cl
3. NH_3

What is the correct order of the dipole moment of the above compounds ?

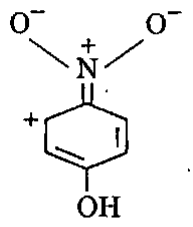
(a) 1 > 3 > 2

(b) 2 > 1 > 3

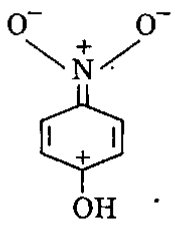
(c) 2 > 3 > 1

(d) 3 > 2 > 1

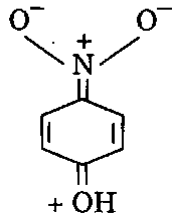
105. Consider the following resonance structures :



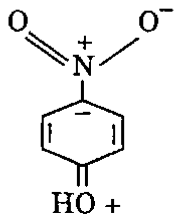
I



II



III



IV

Which of the above resonance structures is the most important contributor to the resonance hybrid ?

(a) I

(b) II

(c) III

(d) IV

106. Which one of the following hydrocarbons has octane number 100 ?

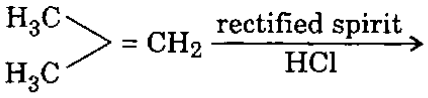
(a) 2, 2, 3-trimethylpentane

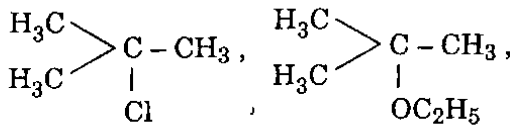
(b) 2, 3, 3-trimethylpentane

(c) 2, 2, 4-trimethylpentane

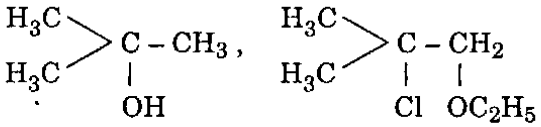
(d) 2, 3, 4-trimethylpentane

107. Consider the following :





I II



III IV

Which of the following products will ***not*** be formed when 2-methylpropene is passed through rectified spirit containing dissolved HCl gas ?

(a) I

(b) II

(c) III

(d) IV

108. What is the number of isomers (including stereoisomers) possibly formed on free radical monochlorination of 2-methylbutane ?

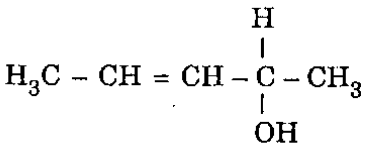
(a) 4

(b) 5

(c) 6

(d) 7

109. Consider the following compound :



What is the number of stereoisomers in the above compound ?

(a) 2

(b) 3

(c) 4

(d) 6

110. In electronic aromatic substitution reactions, nitro group is meta directing because the nitro group

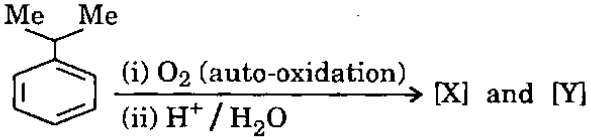
(a) increases the electron density at *meta* position

(b) increases the electron density at *ortho* and *para* positions

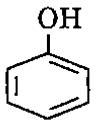
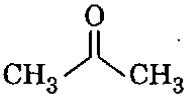
(c) decreases the electron density at *ortho* and *para* positions

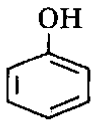
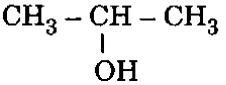
(d) decreases the electron density at *meta* position

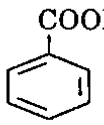
111. Consider the following reaction sequence :



What are the major products [X] and [Y] ?

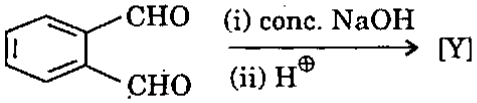
(a)  and 

(b)  and 

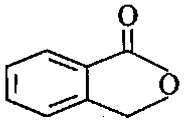
(c)  and CH_3COOH

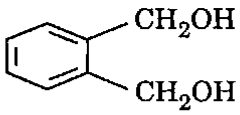
(d) None of the above

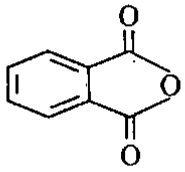
112. Consider the following reaction :

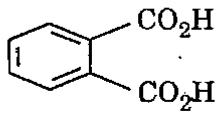


What is the major product [Y] in the reaction ?

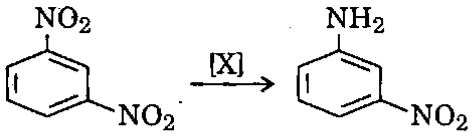
(a) 

(b) 

(c) 

(d) 

113. Consider the following reaction :



What is [X] in the above reaction ?

(a) Na_2S

(b) Sn/HCl

(c) Zn/NH_4Cl

(d) Fe/H_2O

114. Consider the following reaction sequence :

$$CH_3CH_2CO_2H \xrightarrow[(ii)\ H_2O]{(i)\ Cl_2\ /\ \text{Red phosphorus}} [X]$$

What is the major product [X] in the above reaction ?

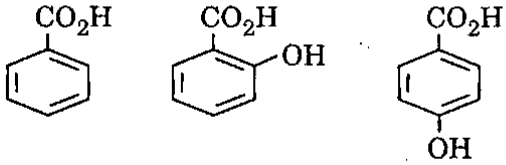
(a) $ClCH_2CH_2CO_2H$

(b) $CH_3CHClCO_2H$

(c) CH_3CH_2COCl

(d) CH_3CH_2Cl

115. Consider the following compounds :



I II III

What is the correct order of acidity of the above compounds ?

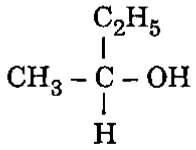
(a) I < II < III

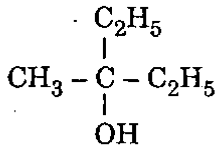
(b) III < I < II

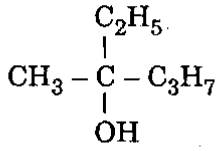
(c) II < I < III

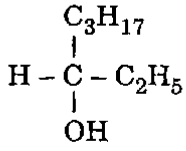
(d) III < II < I

116. Which one of the following is the most likely product of reaction of an ester with excess Grignard reagent ?

(a) 

(b) 

(c) 

(d) 

117. Which of the following statements is ***not*** true about natural amino acids which are derived from proteins ?

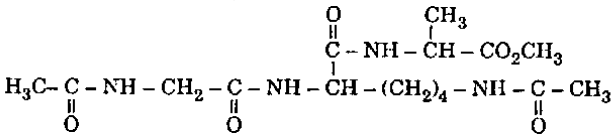
(a) All are α-amino acids

(b) All have primary amino group

(c) All the optically active amino acids have L configuration

(d) They may be neutral, acidic or basic

118. Consider the following peptide :



How many peptide bonds are present in the above peptide ?

(a) 1

(b) 2

(c) 3

(d) None of the above

119. Which one of the following statements about proteins is ***not*** correct ?

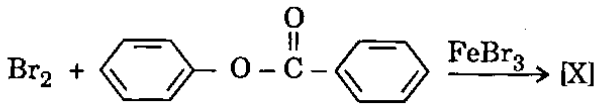
(a) It has α-helix

(b) It has double helix

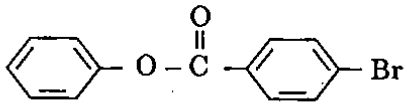
(c) It is a polymer of α-amino acids

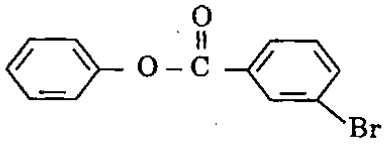
(d) It has β-pleated sheet

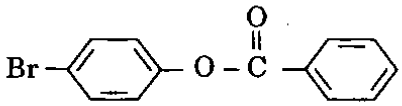
120. Consider the following reaction :



What is the major product [X] in the above reaction ?

(a) 

(b) 

(c) 

(d) None of the above

SPACE FOR ROUGH WORK

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