WARNING:	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – I PHYSICS & CHEMISTRY-2020

Version Code	A1	Question Booklet Serial Number :	8133655

Time: 150 Minutes	Number of Questions: 120	Maximum Marks: 480

Name of the Candidate	
Roll Number	
Signature of the Candidate	

INSTRUCTIONS TO CANDIDATES

1. Please ensure that the VERSION CODE shown at the top of this Question Booklet is same as that shown in the Admit Card issued to you. If you have received a Question Booklet with a different Version Code please get it replaced with a Question Booklet with the same Version Code as in the Admit Card. **THIS IS VERY IMPORTANT.**

2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial Number given at the top of this page against item 3 in the OMR Answer Sheet.

3. This Question Booklet contains 120 questions. For each question five answers are suggested and given against (A), (B), (C), (D) and (E) of which only one will be the 'Most Appropriate Answer.' Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black Ball Point Pen only.**

4. **Negative Marking:** In order to discourage wild guessing the score will be subjected to penalization formula based on the number of right answers actually marked and the number of wrong answer marked. Each correct answer will be awarded FOUR marks. ONE mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

5. Please read the instructions in the OMR Answer Sheet for marking the answers. Candidates are advised to strictly follow the instruction contained in the OMR Answer Sheet.

IMMEDIATELY AFTER OPENING THE QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO.

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1. If ε_0 and μ_0 are respectively the electrical permittivity and magnetic permeability of vacuum, the dimensional formula for $\dfrac{1}{\sqrt{\mu_0 \varepsilon_0}}$ is

(A) MLT   (B) MLT^{-2} (C) $ML^{-1}T^{-1}$ (D) M^0LT^{-1} (E) $M^0L^{-2}T$

2. The power in an electrical circuit for a current of 5 ± 0.4A and voltage 10 ± 0.2 V is measured at 10% error. To measure the power at 5% error the current should be measured at an error of

(A) 5%   (B) 2%   (C) 10%   (D) 3%   (E) 4%

3. The angular diameter of a planet measured from earth is 90". If the diameter of the planet is $\pi \times 10^6$m , then its distance from the earth is

(A) 3.6×10^9 m   (B) 7.2×10^9 m   (C) 3.6×10^6 m

(D) 7.2×10^6 m   (E) 1.8×10^8 m

4. The angle between $\vec{A}$ and the resultant of $2\vec{A} + 3\vec{B}$ and $4\vec{A} - 3\vec{B}$ is

(A) 90°   (B) $\tan^{-1}\left(\dfrac{A}{B}\right)$ (C) $\tan^{-1}\left(\dfrac{B}{A}\right)$

(D) $\tan^{-1}\left(\dfrac{A-B}{A+B}\right)$ (E) 0°

Space for rough work

5. A particle is moved in a semi-circular path of radius R. Then

(A) its average velocity is zero

(B) its average acceleration is zero

(C) its magnitude of displacement is 2R

(D) its average velocity and average speed are equal

(E) its distance travelled is equal to displacement

6. Two projectiles P and Q thrown with velocities v and $\frac{v}{2}$ respectively have the same range. If Q is thrown at an angle of 15° to the horizontal, P must be thrown at an angle of

(A) 30°   (B) $\frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$ (C) $\frac{1}{4}\sin^{-1}\left(\frac{1}{2}\right)$

(D) 60°   (E) 45°

7. An object is thrown vertically with a velocity u. The velocity with which it strikes the ground on its return is

(A) $\frac{u}{2}$ (B) $\frac{-u}{2}$ (C) $-u$ (D) u (E) $2u$

8. Pick out the **correct** statement

(A) Second law of motion is a vector equation

(B) Second law of motion is applicable to a particle and not to the system of particles

(C) Force is always in the direction of motion

(D) If external force on a body is zero, it does not mean the acceleration is zero

(E) Acceleration at an instant depends on the history of the motion of the particle

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Space for rough work

9. A boy is standing on a weighing machine inside a lift. When the lift goes upwards with acceleration $\frac{g}{4}$, the machine shows the reading 50 kg. wt. When the lift goes downward with acceleration $\frac{g}{4}$, the reading of the machine in kg. wt. would be

(A) 50   (B) 30   (C) 45.5   (D) 62.5   (E) 14

10. A ship of mass 2×10^7 kg initially at rest is pulled by a force of 5×10^5 N through a distance of 2 m. Assuming that the resistance due to water is negligible, the speed of the ship is

(A) 2 ms^{-1} (B) 0.01 ms^{-1} (C) 0.1 ms^{-1} (D) 1 ms^{-1} (E) 5 ms^{-1}

11. A force of $\left(2\hat{i}+3\hat{j}\right)$ N acts on a body of mass 1 kg which is at rest initially. The acceleration of the body is

(A) $\left(4\hat{i}+6\hat{j}\right)$ ms^{-2} (B) $\left(2\hat{i}+3\hat{j}\right)$ ms^{-2} (C) $\left(3\hat{i}+5\hat{j}\right)$ ms^{-2}

(D) $\left(6\hat{i}+2\hat{j}\right)$ ms^{-2} (E) $\left(\hat{i}+\hat{j}\right)$ ms^{-2}

12. The Work - Energy theorem

(A) does not hold in all inertial frames

(B) is independent of Newton's second law

(C) may be viewed as a scalar form of Newton's second law

(D) cannot be extended to non-inertial frames

(E) is independent of Newton's third law

Space for rough work

13. A running boy has the same kinetic energy as that of a man of twice his mass. If the speed of the boy is 14.14 ms^{-1}, the speed of the man is

(A) 1.414 ms^{-1} (B) 0.25 ms^{-1} (C) 10 ms^{-1}

(D) $3\sqrt{2}$ ms^{-1} (E) 0.5 ms^{-1}

14. A body of mass 2 kg is moving with a momentum of 10 kg ms^{-1}. The force needed to increase its kinetic energy by four times in 10 seconds is

(A) 2 N   (B) 4 N   (C) 1 N   (D) 0.5 N   (E) 8 N

15. If a force $\vec{F} = \hat{i} - 2\hat{j} - 4\hat{k}$ acting on a particle displaces it from (1, 1, 1) to (2, −1, 0), then the work done by the force (in units of work) is

(A) 2   (B) 1   (C) 5   (D) 4   (E) 9

16. A disc spinning at the rate 27.5 rad s^{-1} is slowed at the rate 10 rad s^{-2}. The time after which it will come to rest is

(A) 2.75 s   (B) 5.5 s   (C) 1.25 s   (D) 3.5 s   (E) 6.2 s

17. Four particles of masses $m_1 = 1$ kg, $m_2 = 2$ kg, $m_3 = 1$ kg and m_4 are placed at the four corners of a square. The mass m_4 required, so that the centre of mass of all the four particles is exactly at the centre of the square is

(A) 3 kg   (B) 4 kg   (C) 1.5 kg   (D) 0.5 kg   (E) 2 kg

Space for rough work

18. A solid sphere of radius r is revolving about one of its diameters with an angular velocity ω. If it suddenly expands uniformly so that its radius increases to n times its original value, then its angular velocity becomes

(A) $n^2\omega$ (B) $\dfrac{\omega}{n^2}$ (C) $n\omega$ (D) $\dfrac{\omega}{n}$ (E) $2n\omega$

19. If a ring rolls down from top to bottom of an inclined plane, it takes time t_1. If it slides, it takes time t_2. Then the ratio $\dfrac{t_2^2}{t_1^2}$ is

(A) $\dfrac{1}{3}$ (B) $\dfrac{2}{3}$ (C) $\dfrac{1}{4}$ (D) $\dfrac{1}{2}$ (E) $\dfrac{2}{5}$

20. If the distance between sun and earth is d, then the angular momentum of earth around the sun is proportional to

(A) $\sqrt{d}$ (B) d^2 (C) $d^{1/3}$ (D) d (E) $d^{3/2}$

21. Two identical objects each of mass 50 kg are kept at a distance of separation of 50 cm apart on a horizontal table. The net gravitational force at the mid-point of the line joining their centres is

(A) zero   (B) 6.6733×10^{-9} N   (C) 13.346×10^{-9} N
(D) 3.336×10^{-9} N   (E) 6.673×10^6 N

22. The ratio of the weight of a body at a height of $\dfrac{R}{10}$ from the surface of the earth to that at a depth of $\dfrac{R}{10}$ is (R is radius of earth)

(A) $4:5$ (B) $1:1$ (C) $9:8$ (D) $2:3$ (E) $8:9$

Space for rough work

23. Three thin wires of equal length are suspended from the top of a roof. The respective ratio of their area of cross section is $1 : 2 : 4$ and Young's modulii is $4 : 2 : 1$, then the ratio of their weights to be attached at the other ends to obtain same elongation in them is

    (A) $1 : 1 : 1$ (B) $1 : 2 : 4$ (C) $4 : 2 : 1$ (D) $2 : \sqrt{2} : 1$ (E) $1 : \sqrt{2} : 2$

24. Water flows through a horizontal pipe of diameter 2 cm at a speed of 3 cm s^{-1}. The pipe has a nozzle of diameter 0.5 cm at its end. The speed of water emerging from the nozzle is

    (A) 6 cm s^{-1} (B) 48 cm s^{-1} (C) 16 cm s^{-1}

    (D) 12 cm s^{-1} (E) 36 cm s^{-1}

25. The density of kerosene is 800 kg m^{-3}. Its relative density is

    (A) 1.6   (B) 3.2   (C) 1   (D) 0.8   (E) 0.4

26. A solid sphere of volume V experiences a viscous force F when descending with a speed v in a liquid. If another solid sphere of volume $27\,V$ descends with the same speed v in the same liquid, it experiences a viscous force

    (A) $12\,F$ (B) $6\,F$ (C) $9\,F$ (D) F (E) $3\,F$

27. Two taps supply water to a container, one at the temperature of 20°C at the rate of 2 kg/minute and another at 80°C at the rate of 1 kg/minute. If the container gets water from the two taps simultaneously for 10 minutes, then the temperature of water in the container is

    (A) 35°C   (B) 30°C   (C) 50°C   (D) 40°C   (E) 45°C

Space for rough work

28. If a monoatomic gas is compressed adiabatically to (1/27)th of its initial volume, then its pressure becomes

(A) 27 times   (B) 125 times   (C) 243 times   (D) 81 times   (E) 64 times

29. The values of C_p and C_v for a diatomic gas are respectively (R=gas constant)

(A) $\frac{5}{2}R$, $\frac{7}{2}R$ (B) $\frac{3}{2}R$, $\frac{5}{2}R$ (C) $3R$, $4R$

(D) $\frac{5}{2}R$, $\frac{3}{2}R$ (E) $\frac{7}{2}R$, $\frac{5}{2}R$

30. Three moles of an ideal gas are in a rigid cubical box with sides of length 0.170 m. The ratio of the forces that the gas exerts on each of the six sides of the box when the gas temperature are 27°C and 127°C is

(A) 6 : 1   (B) 1 : 2   (C) 3 : 1   (D) 3 : 4   (E) 1 : 3

31. The average kinetic energy of a monoatomic gas molecule kept at temperature 27°C is (Boltzmann constant $k = 1.3 \times 10^{-23}$ JK^{-1})

(A) 5.85×10^{-21} J   (B) 4.12×10^{-21} J   (C) 3.75×10^{-21} J

(D) 2.85×10^{-21} J   (E) 7.55×10^{-21} J

Space for rough work

32. A travelling wave in a medium is given by the equation $y = a \sin(\omega t - kx)$. The maximum acceleration of the particle in the medium is

(A) $a\omega$ (B) $a\omega^2$ (C) $\dfrac{\omega}{k}$ (D) $\dfrac{x}{t}$ (E) $k\omega$

33. Two simple harmonic motions with the same amplitude and same frequency acting in the same direction are impressed on a particle. If the resultant amplitude of the particle is equal to the amplitude of individual S.H.M.s, the phase difference between the two simple harmonic motions is

(A) $\dfrac{2\pi}{\sqrt{3}}$ (B) $\dfrac{\pi}{2}$ (C) $\dfrac{\pi}{4}$ (D) $\dfrac{2\pi}{3}$ (E) $\dfrac{\pi}{3}$

34. Two nearest harmonics of an organ pipe open at both the ends are 200 Hz and 240 Hz. The fundamental frequency is

(A) 40 Hz   (B) 20 Hz   (C) 30 Hz   (D) 80 Hz   (E) 50 Hz

35. Two strings of the same material and same length are given equal tension. If they are vibrating with fundamental frequencies 1600 Hz and 900 Hz, then the ratio of their respective diameters is

(A) 16 : 9   (B) 4 : 3   (C) 81 : 256   (D) 3 : 4   (E) 9 : 16

36. An object, moving in a straight line with velocity 100 ms^{-1}, goes past a stationary observer. If the object emits note of 400 Hz while moving, the change in the frequency noted by the observer as the object goes past him is (speed of sound in air = 300 ms^{-1})

(A) 350 Hz   (B) 300 Hz   (C) 200 Hz   (D) 100 Hz   (E) 150 Hz

Space for rough work

37. The electric flux (in SI units) through any face of a cube due to a positive charge Q situated at the centre of a cube is

(A) $\dfrac{Q}{4\pi\epsilon_0}$ (B) $4\pi\epsilon_0 Q$ (C) $\dfrac{Q}{6\epsilon_0}$ (D) $\dfrac{Q}{6\pi\epsilon_0}$ (E) $6\pi\epsilon_0 Q$

38. A capacitance of a parallel plate air capacitor is $10\mu F$. Dielectric constant of the medium to be introduced in between its plates to double its capacitance is

(A) 2 (B) 3 (C) 4 (D) 2.5 (E) 1.5

39. The electric potential V at any point (x, y, z) in space is given by $V = 4z^2$ volt, where x, y, z are all in metre. The electric field at that point (1m, 0, 2m) in Vm^{-1} is

(A) 16 along the positive z axis (B) 16 along the negative z axis

(C) 4 along the positive z axis (D) 4 along the negative z axis

(E) 8 along the negative z axis

40. The work done in moving a point charge of $10\mu C$ through a distance of 3 cm along the equatorial axis of an electric dipole is

(A) 10×10^{-6} J (B) 30×10^{-6} J (C) 20×10^{-6} J

(D) 5×10^{-6} J (E) zero

Space for rough work

41. A steady current flows in a metallic conductor of non-uniform cross section. The quantity/quantities that remains/remain constant along the length of the conductor is/are

(A) current, electric field and drift speed   (B) drift speed only

(C) current and drift speed only   (D) current and electric field only

(E) current only

42. In a platinum resistance thermometer, the resistances of the wire at ice point and steam point are of 4 Ω and 4.25 Ω respectively. When the thermometer is kept in a hot water bath, whose temperature is not known, the resistance of the wire is found to be 4.5 Ω. The temperature of the hot water bath is

(A) 150°C   (B) 100°C   (C) 300°C   (D) 350°C   (E) 200°C

43. Internal resistance of a cell is independent of

(A) the circuit elements connected to it   (B) surface area of the electrode

(C) distance between the electrode   (D) concentration of the electrolytes

(E) temperature of the electrolytes

44. Six cells, each of emf 5 V and internal resistance 0.1 Ω are connected as shown in Figure. The reading of the ideal voltmeter V is
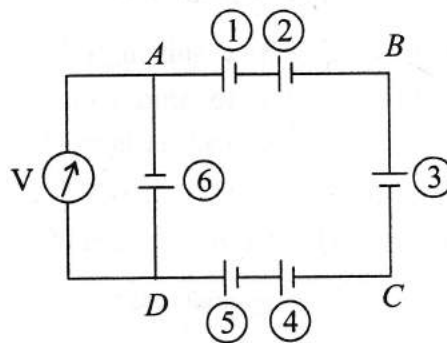
(A) 30 V   (B) 5 V   (C) 15 V   (D) zero   (E) 0.5 V

Space for rough work

45. Which one of the following characteristics is not associated with a paramagnetic material?

(A) It is weakly magnetised in the direction of the magnetising field, in which it is placed

(B) Its magnetic permeability is greater than one

(C) Its magnetic susceptibility is positive

(D) Its magnetic susceptibility increases with rise in temperature

(E) Its individual atom/molecule/ion has a net non-zero magnetic moment of its own

46. A coil of 50 turns carrying a current of 2A in a magnetic field of 0.5T. The torque acting on the coil is

coil

N   10 cm   S

8 cm
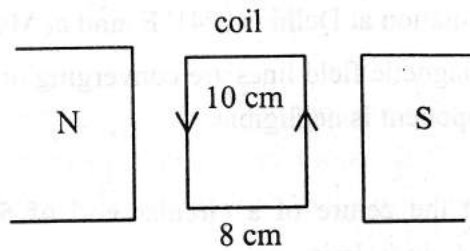
(A) 0.4 Nm clockwise

(B) 0.2 Nm anticlockwise

(C) 0.4 Nm anticlockwise

(D) 0.2 Nm clockwise

(E) 0.8 Nm anticlockwise

Space for rough work

47. A long solenoid with 500 turns per unit length carries a current of 1.5 A. The magnetic induction at one of the ends of the solenoid on its axis is nearly

(A) 32×10^{-4} T

(B) 4×10^{-5} T

(C) 47×10^{-5} T

(D) 16×10^{-4} T

(E) 8×10^{-5} T

48. Choose the **wrong** statement.

(A) The magnetic declination is greater at higher latitudes and smaller near the equator.

(B) In most of the northern hemisphere, the south pole of the dip needle tilts downwards.

(C) Circulating electron in an atom has a magnetic moment.

(D) The magnetic declination at Delhi is 0°41' E and at Mumbai is 0°58' W.

(E) At the poles, the magnetic field lines are converging or diverging vertically so that the horizontal component is negligible

49. The magnetic field at the centre of a circular coil of 50 turns and radius 10 cm carrying a current of 1A, in tesla is

(A) $\pi \times 10^{-4}$

(B) $\pi \times 10^{-2}$

(C) $2\pi \times 10^{-3}$

(D) $\frac{\pi}{4} \times 10^{-5}$

(E) $\frac{\pi}{2} \times 10^{-4}$

Space for rough work

50. Choose the **wrong** statement for the pure inductive circuit.

(A) The inductive reactance limits the current in a purely inductive circuit.

(B) The average power supplied to an inductor over one complete cycle is zero.

(C) The inductive reactance is directly proportional to the frequency of the current.

(D) The emf of the source and current oscillates symmetrically about zero value.

(E) The current leads the voltage by $\frac{\pi}{2}$.

51. A train is running at a speed of 72 km hr^{-1} on the rails separated by a distance of 150 cm. If the vertical component of earth's magnetic field at the place is 4.0×10^{-5} T. The induced emf on the rails is

(A) 1.2 mV   (B) 3 mV   (C) 2.5 mV   (D) 0.5 mV   (E) 4.2 mV

52. A transformer operates at $V_p = 6$ kV on the primary side and supplies electric energy at $V_S = 220$ V to a number of houses in a town. If the total power consumption of the town is 7.2 kW, the current (in amperes) in the primary is

(A) 2   (B) 1.2   (C) 2.5   (D) 3   (E) 1

53. The relation between the charge flow ΔQ through the circuit of resistance r and the change in the magnetic flux $\Delta\phi_B$ is

(A) $\Delta Q = \frac{\Delta\phi_B}{r}$ (B) $\Delta\phi_B = \frac{\Delta Q}{r}$ (C) $\Delta\phi_B = \Delta Q$

(D) $\Delta\phi_B = \frac{\Delta Q}{r^2}$ (E) $\Delta Q = \frac{r}{\phi_B}$

Space for rough work

54. If an electromagnetic wave of frequency 5 MHz travels from vacuum into a dielectric medium of electrical permittivity $\varepsilon_r = 4$, then its (take $\mu_r = 1$)

(A) wavelength is halved and the frequency remains unchanged

(B) wavelength and frequency are both doubled

(C) wavelength and frequency both remain unchanged

(D) wavelength is doubled but the frequency remains unchanged

(E) wavelength remains unchanged but the frequency is doubled

55. Among the following, which is **not** true for ultraviolet light?

(A) induces the production of more melanin, causing tanning of the skin

(B) can be focused into very narrow beams

(C) kills germs in water purifiers

(D) used in eye surgery

(E) treatment for certain forms of cancer

56. Choose the **wrong** statement.

(A) A ray entering a material of larger index of refraction bends toward the normal.

(B) A ray entering a material of smaller index of refraction bends away from the normal.

(C) A ray oriented along the normal does not bend, regardless of the materials.

(D) Light rays from any submerged object bend away from the normal when they emerge into the air.

(E) When a wave passes from one material into a second material with larger index of refraction, the wave speed increases.

Space for rough work

57. Angular width of the first minimum on either side of the central maximum due to a single slit of width a, illuminated by a light of wave length λ is

(A) $\dfrac{\lambda}{a}$ (B) $\dfrac{\lambda}{2a}$ (C) $\dfrac{2\lambda}{a}$ (D) $\dfrac{\lambda}{4a}$ (E) $\dfrac{4\lambda}{a}$

58. The reflected ray is completely polarized for certain angle of incidence in a transparent medium. If the angle of refraction is $30°$, then the refractive index of the medium is

(A) 1.5   (B) 1.732   (C) 1.33   (D) 1.414   (E) 1.6

59. A certain prism produces a minimum deviation of $42°$. It produces a deviation of $45°$ when the angle of incidence is either $43°$ or $62°$. The angle of incidence when the prism undergoes minimum deviation is

(A) $60°$ (B) $30°$ (C) $49°$ (D) $51°$ (E) $40°$

60. If two waves of intensities I and 4I superpose, the ratio between maximum and minimum intensities is

(A) 9:1   (B) 5:2   (C) 4:3   (D) 3:1   (E) 6:1

61. Among the following photosensitive substances, the one which emits electrons when it is illuminated by visible light is

(A) magnesium   (B) zinc   (C) sodium

(D) cadmium   (E) platinum

Space for rough work

62. The de Broglie wavelength of the matter wave associated with an object dropped from a height x, when it reaches the ground is proportional to

(A) x^2 　　(B) $\dfrac{1}{\sqrt{x}}$ 　　(C) $\sqrt{x}$ 　　(D) $x^{3/2}$ 　　(E) x

63. The number of α-particles emitted during the radioactive decay chain from $^{226}_{88}\text{Ra}$ and ending at $^{206}_{82}\text{Pb}$ is

(A) 5 　　(B) 4 　　(C) 6 　　(D) 3 　　(E) 2

64. The shortest wavelength of Paschen series in hydrogen spectrum is 8182 Å. The first member of the Paschen series is nearly

(A) 15400 Å 　　　　　(B) 12200 Å 　　　　　(C) 13400 Å

(D) 18700 Å 　　　　　(E) 16700 Å

65. A nucleus, initially at rest, breaks up into two nuclear fragments with their radii in the ratio 2 : 1. Then their velocities will be in the ratio

(A) 3 : 2 　　(B) 1 : 5 　　(C) 1 : 8 　　(D) 2 : 1 　　(E) 1 : 4

66. The ratio of the energy released by 4 kg of hydrogen at sun by fusion process to 23.5 kg of ^{235}U in the nuclear reactor by fission process is (Assume energy released per fusion is 26 MeV and that per fission is 200 MeV)

(A) 5 : 13 　　(B) 1 : 26 　　(C) 13 : 10 　　(D) 10 : 13 　　(E) 26 : 1

Space for rough work

67. If the Ge diode in the circuit is reverse biased, the current through 2 kΩ resistor
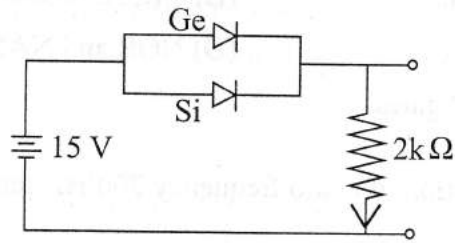
(A) increases by 0.2 mA

(B) decreases by 0.4 mA

(C) increases by 0.4 mA

(D) decreases by 0.25 mA

(E) does not change

68. The contribution to the total current in a semiconductor, due to electrons and holes are 0.75 and 0.25 respectively. The drift velocity of electrons is $\frac{3}{2}$ times that of holes at this temperature. Then the ratio between electron concentration and hole concentration is

(A) 1 : 3 (B) 3 : 2 (C) 6 : 5 (D) 4 : 1 (E) 2 : 1

69. In a common emitter amplifier, the input resistance and output resistance are 200 Ω and 500 Ω respectively. If the voltage gain of the amplifier is 50, then the power gain is

(A) 1250 (B) 1000 (C) 750 (D) 100 (E) 500

Space for rough work

70. The gates that give output Y = 0 for the two inputs A = 1 and B = 1 are

(A) AND and OR gates
(B) OR, AND and NAND gates
(C) NOR and OR gates
(D) NOR and NAND gates
(E) NAND and AND gates

71. In amplitude modulation of audio frequency 700 Hz, the appropriate carrier frequency to be used is

(A) 5 MHz (B) 50 MHz (C) 1000 kHz (D) 350 kHz (E) 1000 MHz

72. The maximum line-of-sight distance d_M between the transmitting antenna of height h_T and receiving antenna of height h_R in LOS communication is (R = radius of the earth)

(A) $h_T + h_R$
(B) $\sqrt{h_T + h_R}$
(C) $\dfrac{h_T + h_R}{2}$
(D) $\sqrt{h_T} + \sqrt{h_R}$
(E) $\sqrt{2Rh_T} + \sqrt{2Rh_R}$

Space for rough work

73. Which one of the following will have the largest number of atoms?

    (A) 1g Au(s)   (B) 1g Na(s)   (C) 1g Li(s)

    (D) 1g of $Cl_2(g)$ (E) 1g of $O_2(g)$

74. An organic compound contains 24% carbon, 4% hydrogen and remaining chlorine. Its empirical formula is

    (A) $CHCl$ (B) CH_2Cl (C) $CHCl_2$

    (D) CH_3Cl (E) CH_2Cl_2

75. The IUPAC name of an element is Unbinilium. Its atomic number is

    (A) 102   (B) 110   (C) 120

    (D) 106   (E) 100

76. The number of electrons, protons and neutrons in a species are equal to 10, 11 and 12 respectively. The proper symbol of the species is

    (A) $^{22}_{11}Na^+$ (B) $^{23}_{11}Na$ (C) $^{23}_{10}Ne$ (D) $^{23}_{11}Na^+$ (E) $^{23}_{11}Na^{2+}$

Space for rough work

77. Which one of the following element is represented as Eka-Silicon in Mendeleev's periodic table?

    (A) Gallium   (B) Germanium   (C) Aluminium

    (D) Tin   (E) Arsenic

78. The **correct** match among the following is

    (a) Lithium, Sodium, Potassium   (i) Alkaline earth metals

    (b) Beryllium, Magnesium, Calcium   (ii) Semi-metals

    (c) Oxygen, Sulphur, Selenium   (iii) Alkali metals

    (d) Silicon, Germanium, Arsenic   (iv) Chalcogens

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

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

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

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

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

79. Which one of the following molecules is formed by sp^3d hybridisation?

    (A) BrF_5 (B) PF_5 (C) SF_6 (D) $[Co(NH_3)_6]^{3+}$ (E) $[Pt(Cl)_4]^{2-}$

80. The correct order of bond energy (in kJ/mol) of the following molecules is

    (A) $O_2 < B_2 < C_2 < N_2$ (B) $B_2 < C_2 < O_2 < N_2$ (C) $C_2 < O_2 < B_2 < N_2$

    (D) $B_2 < O_2 < C_2 < N_2$ (E) $B_2 < O_2 < N_2 < C_2$

81. The type of attractive forces that operate between gaseous HCl molecules is

    (A) dipole-dipole forces   (B) dispersion forces

    (C) ion-dipole forces   (D) dipole-induced dipole forces

    (E) electrostatic forces

Space for rough work

82. Schottky defect is shown by

(A) ionic substances in which the size of the cation is smaller than that of the anion

(B) ionic substances in which the cation and anion are of almost similar sizes

(C) ionic substances in which the size of the cation is larger than that of the anion

(D) non-stoichiometric inorganic solids

(E) non-ionic substances

83. In which one of the following reactions, entropy decreases?

(A) Sodium chloride is dissolved in water

(B) Water is heated from 303K to 353K

(C) Sodium bicarbonate is decomposed to $Na_2CO_3(s)$, $CO_2(g)$ and $H_2O(g)$

(D) Water crystallizes into ice

(E) Dihydrogen molecule is decomposed into hydrogen atoms

84. The standard enthalpies of formation of $H_2O(l)$ and $CO_2(g)$ are respectively -286 kJ mol^{-1} and -394 kJ mol^{-1}. If the standard heat of combustion of $CH_4(g)$ is -891 kJ mol^{-1}, then the standard enthalpy of formation of $CH_4(g)$ is

(A) -75 kJ mol^{-1}

(B) $+75 \text{ kJ mol}^{-1}$

(C) -211 kJ mol^{-1}

(D) $+211 \text{ kJ mol}^{-1}$

(E) $-1571 \text{ kJ mol}^{-1}$

Space for rough work

85. The equilibrium constant for the equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ at a particular temperature is 2×10^{-2} mol dm^{-3}. The number of moles of PCl_5 that must be taken in a one-litre flask at the same temperature to obtain a concentration of 0.20 mol of chlorine at equilibrium is

(A) 2.0   (B) 2.2   (C) 1.8   (D) 0.2   (E) 0.1

86. The pH of the resultant solution obtained by mixing 20mL of 0.01M HCl and 20mL of 0.005M $Ca(OH)_2$ is

(A) 2   (B) 0   (C) 1   (D) 7   (E) 5

87. $CH_4(g) + 4Cl_2(g) \rightarrow CCl_4(l) + 4HCl(g)$

In the above reaction, the change of oxidation state of carbon is

(A) from +4 to –4   (B) from +1 to +4   (C) from –4 to +4

(D) from –1 to +1   (E) from –4 to –1

88. How many moles of platinum will be deposited on the cathode when 0.40 F of electricity is passed through a 1.0 M solution of Pt^{4+}?

(A) 0.60 mol   (B) 1.0 mol   (C) 0.40 mol

(D) 0.45 mol   (E) 0.10 mol

Space for rough work

89. When the same amount of the solute 'P' and 'Q' are separately dissolved in 500g water, the ΔT_f values are 0.15K and 0.30K respectively. If the molecular weight of 'P' is 80 g mol^{-1}, then the molecular weight of 'Q' is

(A) 30 g mol^{-1} (B) 60 g mol^{-1} (C) 40 g mol^{-1}

(D) 45 g mol^{-1} (E) 160 g mol^{-1}

90. A solution is prepared by dissolving 20g NaOH in 1250 mL of a solvent of density 0.8 g/mL. Then the molality of the solution is

(A) 0.2 mol kg^{-1} (B) 0.08 mol kg^{-1} (C) 0.25 mol kg^{-1}

(D) 0.0064 mol kg^{-1} (E) 0.5 mol kg^{-1}

91. The rate constant of a first order reaction is 231×10^{-5} s^{-1}. How long will 4 g of this reactant reduce to 2 g?

(A) 310 s   (B) 300 s   (C) 210 s   (D) 30.1 s   (E) 230.3 s

92. An endothermic reaction A → B has an activation energy of 13 kJ mol^{-1} and the enthalpy change for the reaction is 2 kJ mol^{-1}. The activation energy of the reaction B→ A is

(A) 15 kJ mol^{-1} (B) 11 kJ mol^{-1} (C) 2 kJ mol^{-1}

(D) –15 kJ mol^{-1} (E) 26 kJ mol^{-1}

Space for rough work

93. Adsorption is accompanied by

(A) decrease in enthalpy and decrease in entropy

(B) increase in enthalpy and decrease in entropy

(C) decrease in enthalpy and increase in entropy

(D) increase in enthalpy and increase in entropy

(E) no change in enthalpy and entropy

94. In the coagulation of a positive sol, the flocculating power of the ions PO_4^{3-}, SO_4^{2-} and Cl^- decreases in the order

(A) $PO_4^{3-} > Cl^- > SO_4^{2-}$

(B) $PO_4^{3-} > SO_4^{2-} > Cl^-$

(C) $Cl^- > SO_4^{2-} > PO_4^{3-}$

(D) $Cl^- > PO_4^{3-} > SO_4^{2-}$

(E) $SO_4^{2-} > PO_4^{3-} > Cl^-$

95. Which one of the following nitrates does not give the corresponding metallic oxide, nitrogen dioxide and oxygen on heating?

(A) Lithium nitrate

(B) Beryllium nitrate

(C) Magnesium nitrate

(D) Calcium nitrate

(E) Potassium nitrate

Space for rough work

96. Which of the following statement is **incorrect** about beryllium?

(A) Beryllium hydroxide is amphoteric.

(B) Beryllium compounds are largely covalent.

(C) Beryllium is not easily attacked by acids.

(D) Beryllium exhibit coordination number of six.

(E) Beryllium hydroxide dissolves in excess of alkali to give a beryllate ion.

97. The oxyacid of phosphorus that contains one P–OH, two P–H and one P=O bonds is

(A) Phosphinic acid   (B) Phosphoric acid

(C) Pyrophosphoric acid   (D) Hypophosphoric acid

(E) Pyrophosphorous acid

98. Choose the **correct** statements about diborane

I. It is prepared by the oxidation of sodium borohydride with iodine.

II. It undergoes cleavage reactions with Lewis bases to give borane adducts.

III. It is produced on an industrial scale by the reaction of BF_3 with $LiAlH_4$.

IV. It is readily hydrolysed by water to give borazine.

V. It burns in oxygen and gives boron trioxide.

(A) I, II, III   (B) I, II, V   (C) I, II, IV   (D) II, III, IV   (E) I, III, V

99. Which one of the following actinoid has no electron in 6d orbital?

(A) Pa   (B) Np   (C) Lr   (D) Cm   (E) Pu

Space for rough work

100. The catalyst used in the Wacker process of oxidation of ethyne to ethanal is

(A) Silver   (B) Nickel   (C) $PdCl_2$

(D) V_2O_5 (E) Ziegler catalyst

101. The correct formula of dichlorobis (triphenylphosphine) nickel(II) is

(A) $[NiCl_2(PPh_3)_2]Cl$ (B) $[NiCl_2(PPh_3)]$ (C) $[NiCl_2(PPh_2)_3]$

(D) $[NiCl(PPh_3)_2]Cl$ (E) $[NiCl_2(PPh_3)_2]$

102. Which one of the following is an ambidentate ligand?

(A) Cl^- (B) H_2O (C) $H_2NCH_2CH_2NH_2$

(D) SCN^- (E) $C_2O_4^{2-}$

103. Which one is not correctly matched?

Ore		Composition
(A) Siderite	-	$FeCO_3$
(B) Calamine	-	$ZnCO_3$
(C) Sphalerite	-	ZnS
(D) Kaolinite	-	$[Al_2(OH)_4Si_2O_5]$
(E) Cuprite	-	$CuCO_3.Cu(OH)_2$

104. Which one of the following is a benzenoid aromatic compound?

(A) Cyclooctatetraene   (B) Hexyne   (C) Cyclohexane

(D) Toluene   (E) Cyclopentadiene

105. The products obtained by the ozonolysis of 2-methylbut-1-ene are

(A) propanone and ethanal   (B) propanone and methanal

(C) butanone and methanal   (D) ethanal and propanal

(E) butanone and methanol

Space for rough work

106. Which one of the following is not an isomer of 3-methylbut-1-yne?

(A) 2,3-Dimethylbuta-1,3-diene   (B) Pent-1-yne   (C) Pent-2-yne

(D) Penta-1,3-diene   (E) 2-Methylbuta-1,3-diene

107. The compound that does not undergo hydrolysis by S_N1 mechanism is

(A) $C_6H_5CH_2Cl$ (B) $C_6H_5CH(CH_3)Cl$ (C) C_6H_5Cl

(D) CH_3CH_2Cl (E) $C_6H_5CH(C_6H_5)Cl$

108. Which one of the following is a secondary alcohol?

(A) 2-methylbutan-2-ol   (B) 3-methylbutan-1-ol   (C) 2-methylbutan-1-ol

(D) 3-methylbutan-2-ol   (E) 2,2-dimethylbutan-1-ol

109. An organic compound 'A' with molecular formula C_7H_6O forms 2,4-DNP derivative and reduces Tollens' reagent. When 'A' is heated with conc. KOH, it gives sodium benzoate and compound 'B'. The compound 'B' is

(A) Benzene   (B) Toluene   (C) Acetophenone

(D) Benzaldehyde   (E) Benzyl alcohol

Space for rough work

110. Which one of the following compounds would undergo Cannizaro reaction?

    (A) 2-Methylpentanal   (B) Cyclohexanone   (C) 2,2-Dimethylbutanal

    (D) 1-Phenylpropanone   (E) Phenylacetaldehyde

111. Which one of the following can be prepared by Gabriel phthalimide synthesis?

    (A) 2-Aminotoluene   (B) Aniline   (C) 4-Bromoaniline

    (D) Allylamine   (E) N-Methylethanamine

112. The reagent that is used to distinguish between a secondary amine and a tertiary amine is

    (A) p-toluenesulphonyl chloride   (B) dil. HCl   (C) dil. NaOH

    (D) $CHCl_3$ and alc. KOH   (E) bromine water

113. Choose the **correct** statement of the following

    (A) Cellulose is also known as animal starch.

    (B) A linkage between two monosaccharide units through oxygen atom is called oxide linkage.

    (C) Glucose on oxidation with bromine water gives n-hexane.

    (D) Carbohydrates are used as storage molecules as starch in animals.

    (E) Water insoluble component of starch is amylopectin.

114. Among the following which one is a non-reducing sugar?

    (A) Lactose   (B) Glucose   (C) Sucrose   (D) Maltose   (E) Fructose

Space for rough work

115. Which one of the following polymer is a copolymer formed by condensation polymerisation?

(A) Buna-S   (B) Neoprene   (C) Polythene

(D) Melamine-formaldehyde (E) Buna-N

116. Which one of the following sets forms the biodegradable polymer?

(A) 3-Hydroxybutanoic acid and 3-hydroxypentanoic acid.

(B) Acrylonitrile and 1,3-butadiene.

(C) Urea and formaldehyde.

(D) Ethylene glycol and terephthalic acid.

(E) Adipic acid and hexamethylene diamine.

117. The antimicrobial drug that contains arsenic is

(A) Prontosil   (B) Salvarsan   (C) Sulphapyridine

(D) Ofloxacin   (E) Sulphanilamide

118. Which one of the following statements is **not** correct?

(A) All monosaccharides are reducing sugars.

(B) Lactose is commonly known as milk sugar.

(C) Glucose pentaacetate does not react with hydroxylamine.

(D) Glucose does not give 2,4- DNP test.

(E) Glucose on oxidation with bromine water, gives saccharic acid.

119. Which one of the following is an antifertility drug?

(A) Bithionol   (B) Ofloxacin   (C) Norethindrone

(D) Aspartame   (E) Terpineol

120. Which one of the following is a greenhouse gas?

(A) Methane   (B) Ethane   (C) Hydrogen sulphide

(D) Acetylene   (E) Ethylene

Space for rough work

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