# PHYSICS

1. Match List I with List II and select the correct answer

List I
(Physical quantity)
A. Force
B. Angular velocity
C. Torque
D. Stress

List II
(Dimensions)
1. $T^{-1}$
2. $MLT^{-2}$
3. $ML^{-1}T^{-2}$
4. $ML^{-1}T^{-1}$
5. $ML^{2}T^{-2}$

| | A | B | C | D |
|---|---|---|---|---|
| a. | 5 | 4 | 3 | 1 |
| b. | 2 | 1 | 3 | 4 |
| c. | 1 | 2 | 3 | 5 |
| d. | 2 | 1 | 5 | 3 |

2. Which one of the following pairs does not represent quantities of identical dimensions?
   a. Angular momentum and Planck's constant
   b. Moment of inertia and moment of a force
   c. Work and torque
   d. Impulse and momentum

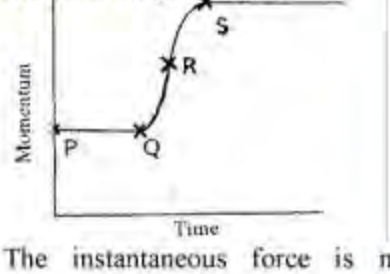
3. Work done when a force $\vec{F} = (x' + 2y' + z')$ N acting on a particle takes it from the point $\vec{r}_1 = (x' + y' + z')$ m to the point $\vec{r}_2 = (x' - y' - 2z')$ m is
   a.
   b. -1J
   c.
   d. 2J

4. The resultant of two forces acting at an angle of 1500 is 10 kg.wt and is perpendicular to one of the forces. The other force is
   a. $10\sqrt{3}$ kg.wt
   b. $20\sqrt{3}$ kg.wt
   c. 20 kg.wt
   d. $\frac{20}{\sqrt{3}}$ kg.wt

5. A body falling freely under gravity travels half its path in the last one second. The total time of fall is approximately
   a. 4.4 s
   b. 3.4 s
   c. 2.4 s
   d. 2.0 s

6. A point particle of unit mass is moving in a straight line. Its speed decreases linearly with time until it comes to rest. Which one of the following statements is wrong?
   a. Force is antiparallel to the particles motion
   b. Force is possibly a constant frictional force
   c. One cannot calculate the force from the given data
   d. The slope of the trace is negative

7. The variation of momentum with time of one of the bodies in a two-body collision is shown in the given figure




The instantaneous force is maximum corresponding to the point
   a. P
   b. Q
   c. R
   d. S

8. Suppose one sits on a rotating stool and holds a 2 kg mass in each outstretched hand. He drops these masses without moving his arms relative to his body. Then his
   a. angular velocity will increase
   b. angular velocity will remain unchanged
   c. angular velocity will decrease but his K.E. will increase.
   d. K.E. and angular velocity both will increase

9. A rocket is fired from the earth s surface to put the payload in the required orbit. The

motion of the rocket is (where symbols have their usual meaning) given by

a. $F = m\frac{dv}{dt}$

b. $F = \frac{dP}{dt}$

c. $F = v\frac{dm}{dt}$

d. F = constant

10. In circular motion a particle moves with
a. constant velocity but variable speed
b. constant acceleration and constant speed
c. constant speed and constant velocity
d. constant speed but variable acceleration

11. An object of mass 'm' moving with a velocity 'v' is approaching a second object of the same mass but at rest. The total kinetic energy of the two objects as viewed from the centre of mass is
a. $mv^2$
b. $\frac{1}{2}mv^2$
c. $\frac{1}{4}mv^2$
d. $\frac{1}{8}mv^2$

12. A box weighing 20 kg is pushed along the floor at a constant speed by applying a horizontal force. If the coefficient of friction is 0.25, then the force applied is
a. 5 N
b. 10 N
c. 50 N
d. 200 N

13. Consider two satellites A and B revolving around the earth in circular orbits with radii $R_A$ and $R_B$. Their periods, $T_A$ and $T_B$ are 1 hr and 1 hr respectively. The ratio $R_A/R_B$ is equal to
a. 8
b. 8
c. 4
d. $8^{1/2}$

14. A satellite in a circular orbit about the earth has a kinetic energy $E_k$. What is the minimum amount of energy to be added so that it escapes from the earth?
a. $\frac{E_k}{4}$
b. $\frac{E_k}{2}$
c. $E_k$
d. $2E_k$

15. Consider the head-on elastic collision of a neutron moving respectively through a sample of lead, carbon, paraffin and tin. Which one of the above samples is most efficient in slowing down the neutron?
a. Lead
b. Carbon
c. Tin
d. Paraffin

16. Which one of the following is a non-conservative force?
a. Electrostatic force
b. Gravitational force
c. Viscous force
d. Inter-atomic force

17. The energy, the rest mass $m_0$ and the momentum p of a relativistic particle are related
a. $E^2 - p^2c^2 = m_0^2c^2$
b. $E^2 - p^2c^2 = m_0^2c^4$
c. $E^2 - pc = m_0^2c^4$
d. $E^2 - pc = m_0^2c^2$

18. Match List I with List II and select the correct answer

List I
A. Bernoulli's equation
B. Stoke's law
C. Einstein's theory
D. Hooke's law

List II
1. Elasticity
2. Surface tension
3. Venturimeter
4. Photoelectric effect
5. Viscosity

| | A | B | C | D |
|---|---|---|---|---|
| a. | 3 | 5 | 1 | 4 |
| b. | 3 | 2 | 4 | 1 |
| c. | 3 | 5 | 4 | 1 |
| d. | 5 | 2 | 1 | 4 |

19. Spirit and water are mixed in a glass cylinder such that the density of the mixture becomes equal to the density of the olive oil. If a drop of olive oil is added to this mixture then oil will
a. spread on the surface of the mixture
b. take a spherical shape inside the mixture
c. take a spherical shape on the surface of the mixture

d. take the shape of a ring on the surface of the mixture

20. Water is flowing from a reservoir through two tubes of lengths 1 m and 16 m respectively, fixed at the bottom of the reservoir. The diameters of their bores and 4 mm and 8 mm respectively. The rates of flow of water in these tubes will be in the ratio of
a. 1:1
b. 1:4
c. 1:8
d. 1:16

21. A small wooden ball, an oil drop and an air bubble each of radius r are moving up in a liquid of viscosity η. The terminal velocities of these three i.e. $v_w$, $v_0$ & $v_a$ respectively will be such that
a. $v_w = v_0 = v_a$
b. $v_w < v_0 < v_a$
c. $v_w > v_0 > v_a$
d. $v_w > v_0 = v_a$

22. The equation of a wave is given by

$$y = 10 \sin\left(\frac{2\pi t}{30} + \alpha\right)$$

If the displacement is 5 cm at t = 0, then the total phase at t= 7.5 s will be
a. $\frac{2\pi}{3}$ rad
b. $\frac{2\pi}{5}$ rad
c. $\frac{\pi}{3}$ rad
d. $\frac{\pi}{2}$ rad

23. Two wave pulses (the shape of one being inverted with respect to the other) travel in opposite directions on a string to approach each other. What will happen to them?
a. They will collide and vanish after collision
b. The pulses will reflect, that is, the pulse going towards right will move to left after collision and vice-versa
c. The pulses will pass through each other without any change in their shape
d. The pulses will pass through each other but their shapes will be modified.

24. Consider the following statements relating to a stationary wave:
1. Different particles move with same amplitude.
2. All the particles between two successive nodes reach their extreme positions together in phase.
3. Displacement nodes and velocity nodes coexist.
4. Velocity nodes and pressure nodes coexist.

Of these statements
a. 1 and 4 are correct
b. 2 and 3 are correct
c. 2 and 4 are correct
d. 1, 2 and 3 are correct

25. A particles is subjected to two simple harmonic motions
$x_1 = A_1 \sin\omega t$ ; $x_2 = A_2 \sin(\omega t + \pi/4)$
The resultant simple harmonic motion will have an amplitude of:
a. $\frac{A_1 + A_2}{2}$
b. $\sqrt{A_1^2 + A_2^2}$
c. $\sqrt{A_1^2 + A_2^2 + \sqrt{2}A_1A_2}$
d. $\sqrt{A_1^2 + A_2^2 + A_1A_2}$

26. A train travelling with a speed of 20 $ms^{-1}$ blows its whistle at a frequency of 640 Hz. while approaching an observer standing on a platform. If the velocity of sound is 340$ms^{-1}$ , then the apparent frequency of the whistle as heard by the observer is about
a. 640 Hz
b. $640 \times \frac{340}{320}$ Hz
c. $640 \times \frac{360}{340}$ Hz
d. $640 \times \frac{320}{340}$ Hz

27. If $n_1$, $n_2$, $n_3$ are the fundamental frequencies of the three segments into which a string is divided by placing a number of bridges below it, then the original fundamental frequency 'n' of the string is given by
a. $\sqrt{n} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3}$
b. $n = n_1 + n_2 + n_3$
c. $\frac{1}{n} = \frac{1}{n_1} + \frac{1}{n_2} + \frac{1}{n_3}$
d. $\frac{1}{\sqrt{n}} = \frac{1}{\sqrt{n_1}} + \frac{1}{\sqrt{n_2}} + \frac{1}{\sqrt{n_3}}$

28. In the case of a forced vibration the resonance wave becomes very sharp when the
    a. damping force is small
    b. restoring force is small
    c. applied oscillatory force is small
    d. quality factor is small

29. Consider the following statements related to ultrasonics
    1. It is a mechanical vibration.
    2. Its frequency is greater than audio waves.
    3. It travels with velocity of light.
    4. No medium is necessary for its propagation.

    Of these statements
    a. 1, 2 and 3 are correct
    b. 1, 2 and 4 are correct
    c. 2 and 3 are correct
    d. 1 and 2 are correct

30. Two objects (A & B) are 10 cm apart in air. Tile system is immersed in a liquid of refractive index 1.6. The equivalent optical path between A and B will be
    a. 6.25 cm
    b. 8 cm
    c. 10 cm
    d. 16 cm

31. In any medium light travels between two points along a path such that
    a. the path of propagation is a straight line
    b. energy loss in transit is the least
    c. time of transit is the least
    d. dispersion is minimum

32. The ratio of phase velocity to group velocity for non-dispersive media is
    a. 1:1
    b. 1:2
    c. 2:1
    d. 4:1

33. A convex spherical surface made of glass of refractive index 1.62 having a radius of curvature 5cm is placed in air. The refraction matrix for this lens is
    a. $\begin{bmatrix} 1 & 12.4 \\ 0 & 1 \end{bmatrix}$
    b. $\begin{bmatrix} 12.4 & 0 \\ 1 & 1 \end{bmatrix}$
    c. $\begin{bmatrix} 1 & 1 \\ 12.4 & 1 \end{bmatrix}$
    d. $\begin{bmatrix} 1 & 0 \\ 1 & 12.4 \end{bmatrix}$

34. A lens or optical system is said to be aplanatic, if it is free from
    a. spherical aberration
    b. coma
    c. both spherical aberration and coma
    d. neither spherical aberration nor coma

35. A concave lens of focal length -20 cm is kept in contact with a convex lens of focal length 10cm. The combination will have a focal length of
    a. 10 cm
    b. -10 cm
    c. 20 cm
    d. -20 cm

36. In order to increase the resolving power of a telescope it is necessary to
    a. increase the diameter of the eyepiece
    b. decrease the diameter of the eyepiece
    c. increase the diameter of the objective
    d. decrease the diameter of the objective

37. The thickness of quarter-wave plate made for a boubly refracting crystal is $6.7 \times 10^{-5}$ cm for a light of wavelength 4800 A. What is the corresponding thickness of half-wave plate for a light of wavelength 6000 A?
    a. $16.75 \times 10^{-5}$ cm
    b. $13.4 \times 10^{-5}$ cm
    c. $10.72 \times 10^{-5}$ cm
    d. $8.34 \times 10^{-5}$ cm

38. The angle of specific rotation of sugar is 660 $(\text{decimeter})^{-1}$ $(\text{gm/cc})^{-1}$. What is the angle of optical rotation caused b sugar solution of concentration 15 gm/100cc filled in a tube of length 15 cm?
    a. 14.8°
    b. 18.8°
    c. 25.8°
    d. 27.8°

39. The phase difference between two interfering waves of wavelength $\lambda$ is 300. The path difference between them is
    a. $\lambda/3$
    b. $\lambda/6$
    c. $\lambda/9$
    d. $\lambda/12$

40. The diameter of a given bright ring in Newtons rings set up. when a lens of radius of curvature R and light of wavelength $\lambda$ are used, is D. The proportionality between D, $\lambda$ and R is

a. $D^2 \propto \lambda R$
b. $D^2 \propto \lambda^2 R$
c. $D^2 \propto \lambda^2 R^2$
d. $D \propto \lambda R$

41. 41. The angular dispersion of two spectral lines from a plane diffraction grating in first order spectrum is 30. The dispersion in the second order spectrum for the same spectral lines will be approximately
a. 1.50
b. 30
c. 60
d. 90

42. The resolving power of a telescope is highest for
a. blue light
b. green light
c. yellow light
d. red light

43. In a single-slit Fraunhofer diffraction set-up used with light of wavelength 4000 A. the distance D between the central maximum and first minimum is found to be 0.3. cm. In the same set-up if the wavelength of light used is changed to 6000 A. the corresponding value of D will be
a. 0.20 cm
b. 0.24 cm
c. 0.30 cm
d. 0.45 cm

44. A beam of light is incident on a glass plate at an angle of incidence 600. The reflected ray is polarized. What is the angle of refraction when the angle of incidence is 45°?
a. $\sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$
b. $\sin^{-1}\left(\frac{\sqrt{5}}{2}\right)$
c. $\sin\left(\frac{1}{\sqrt{6}}\right)$
d. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

45. Assuming the wavelength of light used to be 5890 A, by what distance should the movable mirror of Michaelson's interferometer be shifted to generate a shift of 200 fringes?
a. $1.18 \times 12^{-2}$ cm
b. $5.89 \times 10^{-3}$ cm
c. $2.95 \times 10^{-3}$ cm
d. $2.00 \times 10^{-3}$ cm

46. The fraction of light scattered due to Rayleigh scattering is more in the case of violet light (wavelength =4000 A) than yellow light (Wavelength 6000 A) by a factor of
a. 1.5
b. 2.25
c. 3.38
d. 5.06

47. The exciting line of a particular Raman spectrum has a wavelength of 5460 A and a Stokes line has a wavelength of 5520 A. The wave number of the displacement of Stokes line is
a. 60 $cm^{-1}$
b. 199 $cm^{-1}$
c. 120 $cm^{-1}$
d. 200 $cm^{-1}$

48. Consider the following statements relating to a laser beam
1. It is highly monochromatic.
2. It has high angular divergence.
3. It is produced by spontaneous emission.
4. It is used in communications.
5. It is an electromagnetic wave.
Of these statements
a. 1, 4 and 5 are correct
b. 4 and 5 are correct
c. 1, 2 and 3 are correct
d. 2, 3 and 4 are correct

49. Which of the following property/properties is/are used in the construction of thermometers?
1. Expansion in length of a thin thread of Mercury.
2. Change in electrical resistance of a conductor.
3. Change in volume of a gas kept at constant pressure.
Select the correct answer using the codes given below
a. 1 alone
b. 1 and 2
c. 2 and 3
d. 1, 2 and 3

50. The temperature in the Fahrenheit scale corresponding to 253 K is
a. $-4^0$ F
b. $4^0$ F
c. $12^0$ F
d. $36^0$ F

51. 200 gm of a solid ball at 20°C is dropped in an equal amount of water at 80° C. The resultant temperature is 60° C. This means that the specific heat of the solid is
a. one-fourth that of water
b. one half that of water
c. twice that of water
d. four times that of water

52. The unit of coefficient of thermal conductivity is
a. cal/gm/unit temperature gradient/sec
b. cal/sq.cm/unit temperature gradient/sec
c. cal/cm/unit temperature gradient/sec
d. cal/kg/unit temperature gradient/sec

53. A system absorbs $1.5 \times 10^3$ J of energy as heat and produces 500 J of work. The change in internal energy of the system is
a. 50 J
b. 100 J
c. 150 J
d. 1000 J

54. One mole of a diatomic gas $\left(C_v = \frac{5}{2}R\right)$ and one mole of a monatomic gas $\left(C_v = \frac{3}{2}R\right)$ are mixed. The value of γ for the mixture is (where γ is the ratio specific heats of the gas)
a. 1.33
b. 1.40
c. 1.50
d. 1.67

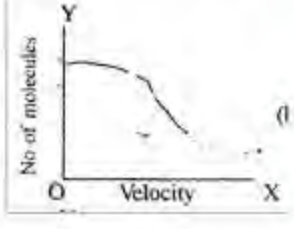
55. The change in entropy during melting of 1 kg of ice at $0^0$C is
a. 3.66 J/K
b. 15.31 J/K
c. $12.3 \times 10^3$ J/K
d. $1.14 \times 10^6$ J/K

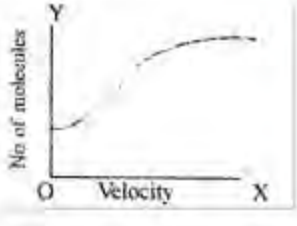
56. Work done in an isothermal expansion from volume $V_1$ to volume $v_2$ at temperature T is given by
a. $\frac{RT}{\log \frac{v_2}{v_1}}$
b. $\frac{\log \frac{v_2}{v_1}}{RT}$
c. $RT \log \frac{v_2}{v_1}$
d. $RT \log v_1 v_2$

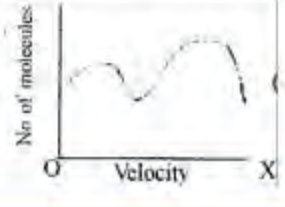
57. The Calpeyron's equation $\frac{L}{v_2 - v_1} = T\left(\frac{\partial p}{\partial p}\right)_v$ can be derived from
a. $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial v}{\partial T}\right)_P$
b. $\left(\frac{\partial C}{\partial P}\right)_T = -T\left(\frac{\partial^2 v}{\partial T^2}\right)_P$
c. $\left(\frac{\partial S}{\partial v}\right)_T = +\left(\frac{\partial P}{\partial T}\right)_v$
d. $\left(\frac{\partial P}{\partial v}\right)_T = -\left(\frac{\partial P}{\partial T}\right)_v \left(\frac{\partial T}{\partial \quad}\right)_v$

58. Real gases can be treated as near ideal gases when real gas system is
a. having very low number of gas molecules per unit volume
b. at a very high temperature but at standard pressure
c. at very high pressure but at standard temperature
d. at STP

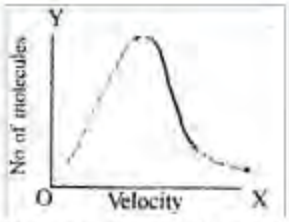
59. A perfect gas at $27^0$ C is heated at constant pressure so as to double its volume. The temperature of the gas will now be
a. 54° C
b. 300° C
c. 327° C
d. 600° C

60. Which one of the following curves represents Maxwells distribution law of velocities of molecules in a gas?
a.


b.


c.


d.




61. For a diatomic gas having 3 translational and 2 rotational degree of freedom, the energy is given by

a. $\frac{5}{2}kT$

b. $\frac{3}{2}kT$

c. $\frac{1}{2}kT$

d. kT

62. From Van der Waal's equation one can deduce that the critical temperature $T_c$ of a substance is proportional to

a. a/b
b. b/a
c. $a/b^2$
d. $b/a^2$

63. Stefan's law states that the radiation emitted by a back body is proportional to the

a. average kinetic energy of a molecule
b. frequency cut-off in the Debye model
c. fourth power of the temperature in degree Celsius $(T^0C)^4$
d. fourth power of the temperature in degree Kelvin (TK)

64. The maximum value of the emissive power of black body corresponds to a frequency $v_1$ and $T_1$ K and $v_2$ at $T_2$K. It follows from Wien's law of radiation that

a. $T_1 / T_2 = v_1 / v_2$
b. $T_2 / T_1 = v_1 / v_2$
c. $T_2^2 / T_1^2 = v_1 / v_2$
d. $T_2^3 / T_1^3 = v_1 / v_2$

65. Which one of the following pairs is correctly matched?

a. Diamagnetism ..... Susceptibility is positive
b. Paramagnetism ..... Susceptibility decreases with increasing temperature
c. Ferromagnetism ..... Susceptibility is zero
d. Anti-ferromagnetism ..... Susceptibility is infinite

66. Curie temperature of iron is the temperature below which it is

a. Ferromagnetic
b. Electrically conducting
c. Superconducting
d. Radioactive

67. An electric charge is surrounded by several other electric charges. The force exerted by one of the surrounding charges on this charge

a. decreases because of the other charges
b. increases because of the surrounding charges
c. is independent of the presence of other charges
d. depends on the position of other charges

68. The work done in moving an electron of charge e and mass m from A and B along the circular path (shown by arrow in the given figure) in the vertical plane in the field of charge Q is


a. 2mgr
b. $-\frac{2Qe}{r}$
c. $2mgr + \frac{2Qe}{r}$
d. zero

69. Two spheres of radii $R_1$ and $R_2$ joined by a fine wire, are raised to a potential V. Let the surface charge densities at these two spheres be, respectively $\sigma_1$ and $\sigma_2$ then

a. $\sigma_2 = \left(\frac{R_1}{R_2}\right)\sigma_1$
b. $\sigma_2 = \left(\frac{R_2}{R_1}\right)\sigma_1$
c. $\sigma_2 = \sigma_1$
d. $\sigma_2 = \left(\frac{R_1}{R_1}\right)^2 \sigma_1$

70. Two particles A and B having equal charges are placed at distance 'd' apart. A third charged particle, placed on the perpendicular bisector of AB at distance x, will experience the maximum coulomb force when

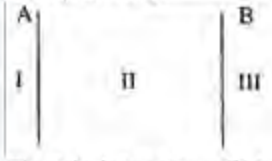
a. $x = \frac{d}{\sqrt{2}}$

b. $x = \frac{d}{2}$

c. $x = \frac{d}{2\sqrt{2}}$

d. $x = \frac{d}{3\sqrt{2}}$

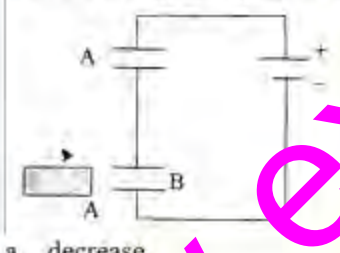
71. The given figure shown two parallel planes A and B of charge density $+\sigma$ and $-\sigma$ respectively.




Electric intensity will be zero in the

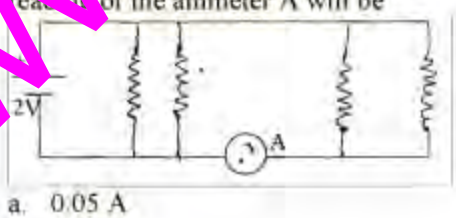
a. region I
b. region II
c. region III
d. region I and III

72. Two identical capacitors A and B shown in the given circuit are joined in series with a battery. If a dielectric slab of dielectric constant K is slipped between the plates of capacitor B and battery remains connected then the energy of capacitor A will



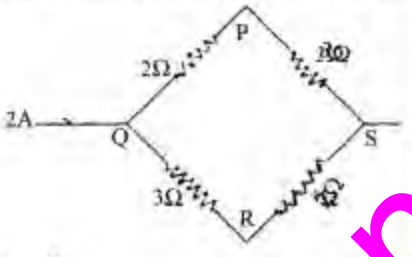

a. decrease
b. increase
c. remain the same
d. be zero since circuit will not work

73. Four resistances each of 10 Ω are connected as shown in given figure. The reading of the ammeter A will be




a. 0.05 A
b. 0.2 A
c. 0.4 A
d. 0.8 A

74. A current of 2 A flows in a system of conductors as shown in the given figure. The potential difference $V_P - V_R$ will be




a. -2V
b. -1V
c. +1V
d. +2V

75. Two large parallel plates, separated by a distance of 3.0 mm have a capacitance of 10 pf and are charged to a potential of 12 V by a battery. The plates are disconnected from the battery and pulled apart to 5.0 mm. The potential difference between the plates is

a. 12 V
b. 7.2 V
c. zero
d. 7.2 V

76. A circular wire loop of radius r is placed in a region of magnetic field B such that the plane of the loop makes an angle θ with the direction of B. Consider the following conditions in this regard.

1. Change in B with time
2. Change in r with time
3. B being non-uniform in space
4. Change in θ with time

The conditions for an induced emf in the loop would include

a. 1 and 4
b. 1, 2 and 4
c. 1 and 3
d. 2, 3 and 4

77. A straight conductor of length 0.5 m is moved with a speed of 8 m/s perpendicular to a magnetic field of intensity 1.2 $Wb/m^2$. The induced emf across the conductor is

a. 2.4 V
b. 4.8 V
c. 9.6 V
d. 24 V

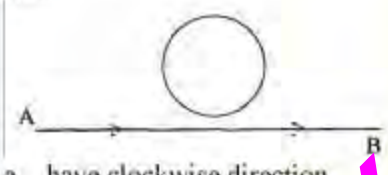
78. The coefficient of mutual inductance of two coils is 0.5 H. If the current is increased from 2 A to 3 A in 0.01 sec in the primary coil, then the induced emf in the secondary coil will be

a. 100 V
b. 75 V
c. 50 V
d. 25 V

79. A direct current of 5 A is superimposed on an alternating current i = 10 sin Wt flowing through a wire. The effective value of the resulting current will be
a. 15/2A
b. $5\sqrt{3}$ A
c. $5\sqrt{5}$ A
d. 15A

80. A coil of inductance 5.0 mH and negligible resistance is connected to an oscillator giving an output voltage of
$\varepsilon = 10 \sin (100\ t)$
The peak current in the circuit will be
a. 2 A
b. 5 A
c. 10 A
d. 20 A

81. In the arrangement shown in the given figure current from A to B is increasing in magnitude. Induced current in the loop will




a. have clockwise direction
b. have anticlockwise direction
c. be zero
d. oscillate between clockwise and anti-clockwise direction

82. An electromagnetic wave is propagating in a medium. The quantity $\sqrt{\mu/\varepsilon}$ is the
a. intrinsic impedance of the medium
b. square of the refractive index of the medium
c. reflective index of the medium
d. average energy density

83. Sign of the Hall Coefficient determines the
a. nature of the charge carriers
b. magnitude of charge on the carries
c. number of density of carrier
d. average energy of charge carrier

84. If a cyclotron is used to accelerate electrons, they can attain kinetic energies of the order of a few
a. TeV
b. BeV
c. MeV
d. keV

85. For a copper iron thermocouple the values of the various temperatures are given below:
$T_0 = 0^0C$, $T_N = 275^0C$ and $T_1 = 550^0C$
If $T_0$ is changed at $10^0C$, the new values of $T_N$ and $T_1$ will be respectively
a. $275^0C$ and $560^0C$
b. $275^0C$ and $540^0C$
c. $285^0C$ and $540^0C$
d. $285^0C$ and $560^0C$

86. The conditions for the emission of cathode rays in a gas discharge tube will include
a. high pressure and low potential difference
b. low pressure and low potential difference
c. low pressure and high potential difference
d. high pressure and high potential difference

87. In Rutherford's experiment on the scattering of $\alpha$-particles by a metal foil, the scattering cross-section depends on the angle of scattering $\theta$ as
a. $\sin^4\frac{\theta}{2}$
b. $\text{cosec}^4\frac{\theta}{2}$
c. $\sin^4\theta$
d. $\text{cosec}^4\theta$

88. A spectral line results from the transition N = 2 to n =1 in the atoms/species given below. Which one of these will produce the shortest wavelength emission?
a. Hydrogen atom
b. Singly ionised helium
c. Doubly ionised lithium
d. Deuterium atom

89. Match List I with List II and select the correct answer
List I
A. Balmer series
B. Brackett series
C. Lyman series
D. Paschen series
List II
1. $V = R_H\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$
2. $V = R_H\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$

3. $\bar{\nu} = R_H\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$

4. $\bar{\nu} = R_H\left(\frac{1}{4^2} - \frac{1}{n^2}\right)$

| | A | B | C | D |
|---|---|---|---|---|
| a. | 3 | 2 | 1 | 4 |
| b. | 3 | 4 | 2 | 1 |
| c. | 4 | 3 | 2 | 1 |
| d. | 2 | 3 | 1 | 4 |

90. If the wavelength of $K_\alpha$ line for silicon (Z = 47) is 0.57 $A^0$, then the value of wavelength for uranium (Z = 92) is
a. 0.146 $A^0$
b. 0.28 $A^0$
c. 1.128 $A^0$
d. 2.53 $A^0$

91. In a photoelectric effect measurement the stopping potential for a given metal is found to be $V_0$ volts when radiation of wavelength $\lambda_0$ is used. If radiation of wavelength $2\lambda_0$ is used with the same metal then the stopping potential will be observed to be (where symbols have their usual meaning)
a. $V_0/2$
b. $2V_0$
c. $V_0 + \frac{hc}{2e\lambda}$
d. $V_0 - \frac{hc}{2e\lambda}$

92. The wavelength of 10 keV electron beam is 0.1227 A. When these waves are diffracted from a metal foil having d = 0.55 A, the first maxima would occur at an angle θ where sin θ is
a. 0.1116
b. 0.223
c. 0.44[illegible]4
d. [illegible]

93. In Compton scattering a photon loses maximum energy to the electron when it is scattering at
a. zero degree
b. $45^0$
c. $90^0$
d. $180^0$

94. The half-life of $^{214}$Bi is 20 minutes. What fraction of a sample of $^{214}$Bi will remain after 2 hours?
a. $\frac{1}{6}$
b. $\frac{1}{20}$
c. $\frac{1}{36}$
d. $\frac{1}{64}$

95. Which one of the following decays is permissible?
a. $n \rightarrow p + \beta + \bar{\nu}$
b. $n \rightarrow p + \beta^+ + \nu$
c. $P \rightarrow n + \beta^- + \nu$
d. $P \rightarrow n + \beta^+ + \bar{\nu}$

96. Which one of the following represents a pair of mirror nuclei
a. $^{15}_{7}N$ and $^{15}_{8}O$
b. $^{16}_{8}O$ and [illegible]
c. [illegible]
d. $^{214}_{83}RaB$ and $^{214}_{83}RaC$

97. In the [illegible] process
$^1_1H + {}^3_1H \rightarrow {}^3_2H + e^- + \nu + 4.6\,MeV$, the [illegible] of interactions involved include
a. weak and strong
b. weak and electromagnetic
c. electromagnetic and strong
d. weak, electromagnetic and strong

98. According to the liquid drop model, when a nucleus is bombarded by neutrons, the compound nucleus attains the given shapes in the sequence
a. ellipsoidal, spherical, dumb-bell
b. spherical, ellipsoidal, dumb-bell
c. spherical, dump-bell, ellipsoidal
d. dumb-bell, ellipsoidal, spherical

99. An electron cannot exist in the nucleus of an atom because
a. It has a larger size than the other particles in the nucleus
b. it has a negative charge
c. it moves with a very large velocity
d. its de Broglie wavelength is large than the size of the nucleus

100. Consider the following elementary particles
1. $P_0$
2. $\Lambda^0$
3. $K^0$
4. $\Sigma^+$
Of these the ones which belong to the baryon family include
a. 1 and 2

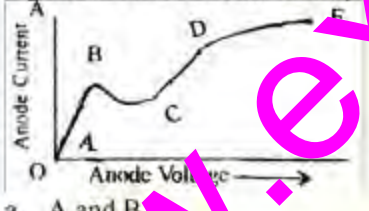
b. 3 and 4
c. 2 and 3
d. 1, 2 and 4

101. Under space-charge limited conditions 10mA is the plate current of a diode for a given plate potential. When its potential is made 4 times, the plate current will be
a. 20 mA
b. 40 mA
c. 80 mA
d. 160 mA

102. A thermionic cathode must have
a. low work function and low melting point
b. low work function and high melting point
c. high work function and high melting point
d. high work function and low melting point

103. The voltage gain of a triode of amplification factor 7 and load resistance of 10 kΩ is 10. The plate resistance is
a. 5 kΩ
b. 7 kΩ
c. 10 kΩ
d. 15 kΩ

104. The characteristic curve of an electron device is shown in the given figure. To use this device as an oscillator, the operating region should be between the points

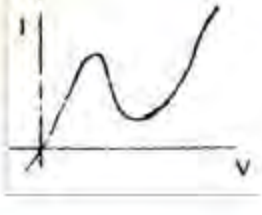



a. A and B
b. B and C
c. C and D
d. D and E

105. Match List I (I-V characteristic) with List II (Diode) and select the correct answer

List I

A.




B.


C.


D.


List II
1. Semiconductor diode
2. Vacuum diode
3. Tunnel diode
4. Zener diode

| | A | B | C | D |
|---|---|---|---|---|
| a. | 4 | 2 | 3 | 1 |
| b. | 4 | 1 | 3 | 2 |
| c. | 3 | 2 | 4 | 1 |
| d. | 3 | 1 | 4 | 2 |

106. A crystal oscillator provides a very stable frequency because of
a. high stability of the crystal
b. the rigid crystal structure
c. low $\frac{X_L}{R}$ ratio of the crystal
d. High Q of the crystal

107. The best amplifier to match a high impedance source and a low impedance load is the
a. RC coupled amplifier
b. Transformer coupled amplifier
c. Push pull amplifier
d. Cathode follower

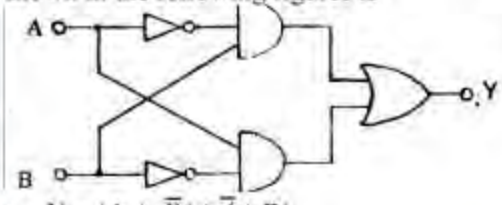
108. Logic table given below shown the output for inputs A and B. The logic operation performed is

| A | B | Y |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

a. OR
b. XOR
c. NAND
d. Negative of XOR

109. The two binary inputs 'a' and 'b' are to be compared. The Boolean expression for the output when 'a' and 'b' are equal is given by
   a. $a\bar{b} + \bar{a}b$
   b. $ab + \bar{a}\bar{b}$
   c. ab
   d. $a\bar{b}$

110. The Boolean expression of the output Y in terms of the input A and B for the circuit shown in the following figures is




   a. $Y = (A + \bar{B})(\bar{A} + B)$
   b. $Y = (\bar{A} + \bar{B})\ (A + B)$
   c. $Y = A\bar{B} + \bar{A}B$
   d. $Y = \bar{A}\bar{B} + AB$

111. **Assertion (A):** The shape of an automobile is so designed that it resembles the stream-line pattern of the fluid through which it moves.
**Reason (R):** Only then the resistance offered by the fluid is maximum.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

112. **Assertion (A):** When two vibrating tuning forks having frequencies 256 Hz and 512 Hz are held near each other, beats cannot be heard.
**Reason (R):** The principle of superposition is valid only if the frequencies of the oscillators are nearly equal.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

113. **Assertion (A):** Resonance is a special case of forced vibration in which the natural frequency of vibration of the body is the same as the impressed frequency and the amplitude of forced vibration is maximum.
**Reason (R):** The amplitude of forced vibrations of a body increases with the increase in the frequency of the externally impressed periodic force.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

114. **Assertion (A):** A single lens produces a coloured image of an object illuminated by white light.
**Reason (R):** The refractive index of the material lens is different for different wavelengths of light.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

115. **Assertion (A):** At room temperature water does not sublimate from ice to steam.
**Reason (R):** The critical point of water is much above the room temperature.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

116. **Assertion (A):** It is not possible for a system, unaided by an external agency to transfer heat from a body at a lower temperature to another at a higher temperature.
**Reason (R):** It cannot violate the Second Law of Thermodynamics.
   a. Both A and Rare true and R is the correct explanation of A
   b. Both A and Rare true but R is not a correct explanation of A
   c. A is true but R is false
   d. A is false but R is true.

117. **Assertion (A):** In the absence of an externally applied electric field, the dipole moment per unit volume of a polar dielectric material is always zero.
**Reason (R):** In polar dielectrics each molecule has a 'permanent dipole moment but these are randomly oriented in the absence of an externally applied electric field.

a. Both A and Rare true and R is the correct explanation of A
b. Both A and Rare true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true

118. **Assertion (A):** If a heavy nucleus is split into two medium sized ones, each of the new nuclei will have more binding energy pe nucleon than the original nucleus.
**Reason (R):** Joining two light nuclei together to give' a single nucleus of medium size means more binding energy per nucleon in the new nucleus.
a. Both A and Rare true and R is the correct explanation of A
b. Both A and Rare true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true.

119. **Assertion (A):** In the process of nuclear fission the fragments emit two or three neutrons as soon as they are formed and subsequently emit $\beta^-$ particles.
**Reason (R):** As the fragments contain an excess of neutrons over protons, emission of neutrons and $\beta^-$ particles bring their neutron/proton ratio to stable values.
a. Both A and Rare true and R is the correct explanation of A
b. Both A and Rare true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true.

120. **Assertion (A):** The energy gap between the valence band and conduction band is greater in silicon than in germanium.
**Reason (R):** Thermal energy produces fewer minority carriers in silicon than in germanium.
a. Both A and Rare true and R is the correct explanation of A
b. Both A and Rare true but R is not a correct explanation of A
c. A is true but R is false
d. A is false but R is true.