

PHYSICS & CHEMISTRY

Full Marks : 100

Time : 2 hours

Read the following instructions carefully.

1. This question paper contains all objective questions.
2. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked A, B, C, D) against the question number on the respective left hand columns. Each question has only one correct answer.
3. All ORS will be processed by electronic means. Hence, invalidation of Answer Sheet due to folding or putting stray marks on it or any damage to the Answer Sheet as well as incomplete / incorrect filling of the Answer Sheet will be the sole responsibility of the candidate.
4. Incorrect answers will carry **NEGATIVE** marks. 1/4 mark will be deducted for each wrong answer.
5. Answers without any response will be awarded zero mark. Wrong response or more than one response will be treated as incorrect answer and negative marks will be awarded for the same.
6. Write your Roll number, Application Form No. and Question Booklet number at the specified locations of the ORS.
7. Use only Black/Blue Ball Point Pen to mark the answers by complete filling up of the respective bubbles.
8. Mobile phones, Calculators, Slide Rules, Log Tables and Electronic Watches with facilities of Calculator, Charts, Graph sheets or any other form of Tables are **NOT** allowed in the examination hall. Possession of such devices during the examinations may lead to cancellation of the paper besides seizing of the same.
9. Mark the answers only in the space provided. Please do not make any stray mark on the ORS.
10. Rough work can be done on the question paper itself. Additional blank pages are given at the end of the question paper for rough work.
11. This question paper contains 36 printed pages including pages for rough work. Please check all pages and report, if there is any discrepancy.
12. Please hand over the ORS to the Invigilator before leaving the Examination Hall.

PHYSICS

(English Version)

Each question carries 1 mark

Full Marks : 50

1. What will be the dimension of $\frac{a}{b}$ in the equation $p = \frac{a-t^2}{bx}$ where p is pressure, x is distance and t is time ?

(A) T^{-1}

(B) MT^{-2}

(C) MT

(D) T^{-2}

2. When an object is dropped from the peak of a tower, the object falls freely under gravity and traverses S distance in n seconds. Then

(A) $S \propto n^2$

(B) $S \propto n$

(C) $S \propto \frac{1}{n^2}$

(D) $S \propto \frac{1}{n}$

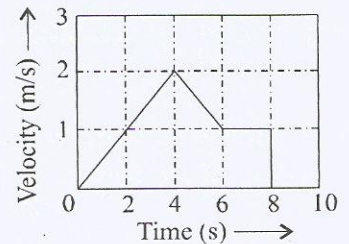
3. Adjacent figure shows the velocity- time graph of an object. What will be the displacement of the particle in 8 seconds?

(A) 9 m

(B) 8 m

(C) 10 m

(D) 16 m



4. In the figure, \vec{R} is the resultant vector of \vec{P} and \vec{Q} . If

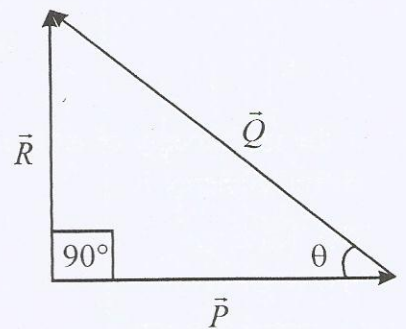
$R = \frac{Q}{\sqrt{2}}$ then what will be the value of θ ?

(A) 30°

(B) 60°

(C) 75°

(D) 45°



5. A particle rotates in a circular path at uniform speed v . What will be the magnitude of the average velocity after half rotation ?

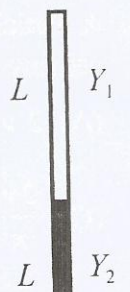
(A) $2v$

(B) 0

(C) $\frac{2v}{\pi}$

(D) $\frac{v}{2\pi}$

6. Three particles with equal mass are kept in the XY plane. If the position of the particles are (1, 1), (2, 2) and (3, 3) respectively then the position of the centre of mass of the system will be
- (A) (1, 2) (B) (2, 3)
(C) (2, 2) (D) (1, 3)
7. Rain drops are falling vertically at 6km/h. To a man walking on a road, the rain drops appear to fall at an angle of 45° . The velocity of the man is
- (A) 6 km / h (B) $6\sqrt{2}$ km/h
(C) 12 km / h (D) 3 km / h
8. A uniform chain of length l is kept on the rough surface of a table. When $\frac{1}{n}$ portion of the chain hangs outside the table top then the chain starts to fall on the ground. What will be the value of frictional constant between table and chain?
- (A) $\frac{1}{n}$ (B) $\frac{1}{n-1}$
(C) $\frac{1}{n+1}$ (D) $\frac{n-1}{n+1}$
9. A particle of mass m is thrown upward at an angle of 60° with the horizontal. If K is the kinetic energy of the particle at maximum height then the initial kinetic energy will be
- (A) $4K$ (B) $\frac{K}{4}$
(C) K (D) 0
10. If the total energy of an artificial satellite rotating in a circular path around the earth is E , then its potential energy is
- (A) $1.5 E$ (B) $2 E$
(C) $- E$ (D) E
11. Two rods with same length and cross sectional area having different Young's modulus Y_1 and Y_2 are connected lengthwise (See figure). What will be the equivalent Young's modulus of the combined rod?
- (A) $\frac{2Y_1Y_2}{Y_1+Y_2}$ (B) Y_1+Y_2
(C) Y_1/Y_2 (D) Y_2/Y_1



12. Two substances with densities d_1 and d_2 are mixed with equal mass. Then what will be the density of mixture?

(A) $\frac{1}{2}(d_1 + d_2)$

(B) $\sqrt{d_1 d_2}$

(C) $\frac{d_1 d_2}{d_1 + d_2}$

(D) $\frac{2d_1 d_2}{d_1 + d_2}$

13. A boat with length 3m and breadth 2m is floating on a river. The boat dips 1cm more in the river when a man enters the boat. What is the mass of the man?

(A) 60 kg

(B) 72 kg

(C) 12 kg

(D) 128 kg

14. In the case of a non-viscous, incompressible liquid, Bernoulli's theorem expresses conservation of

(A) density

(B) linear momentum

(C) energy

(D) angular momentum

15. A container having linear expansion coefficient $\frac{\alpha}{3}$ is fully filled with a liquid having volume expansion coefficient α and is heated. Then the liquid level will

(A) rise

(B) decrease

(C) remain same

(D) remain nearly equal

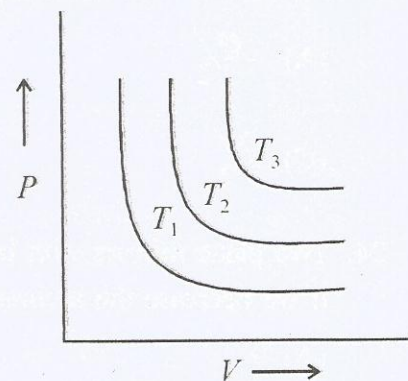
16. Figure shows the P - V diagram of an isothermal process for three fixed temperatures T_1 , T_2 and T_3 . Relation between T_1 , T_2 and T_3 is

(A) $T_1 > T_2 > T_3$

(B) $T_3 > T_2 > T_1$

(C) $T_1 = T_2 = T_3$

(D) $T_3 = T_2 \neq T_1$



17. Specific heat capacity of water at 100°C during boiling is

(A) 0

(B) 0.5

(C) infinite

(D) 1

18. Which law can we use to determine the temperature of stars ?

(A) Stephan's law

(B) Wien's law

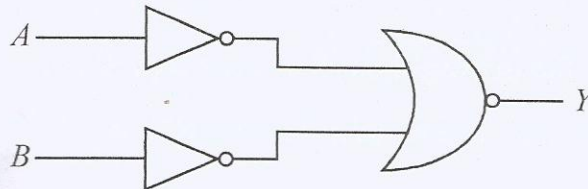
(C) Kirchhoff's law

(D) Planck's law

19. Q amount of heat is required to increase the temperature of one mole of a monoatomic ideal gas from 20°C to 30°C . If the gas is diatomic, the heat required is
- (A) Q (B) $1.5Q$
 (C) $2Q$ (D) $5Q/3$
20. What will be the initial phase of the simple harmonic motion represented by the equation $x = A \sin \omega t + B \cos \omega t$
- (A) $\frac{A}{B}$ (B) $\frac{B}{A}$
 (C) $\tan^{-1} \frac{A}{B}$ (D) $\tan^{-1} \frac{B}{A}$
21. A closed organ tube emits fundamental tone. Suddenly the stop from the mouth of the organ tube is removed. What will happen in case of tone?
- (A) Pitch will reduce (B) Pitch will increase
 (C) Intensity will reduce (D) Intensity will increase
22. Equivalent capacitance of four capacitors is C_1 when they are connected in series and is C_2 when they are connected in parallel. The ratio $C_1 : C_2$ will be
- (A) 1 : 4 (B) 1 : 16
 (C) 1 : 8 (D) 1 : 12
23. A point charge q is placed at the midpoint of a line having two equal charges Q at two ends. If the charge system is in equilibrium then what will be the value of q ?
- (A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$
 (C) $\frac{Q}{2}$ (D) $\frac{Q}{4}$
24. Two plane mirrors with inclination θ produce five images of a point object placed between them. If we decrease the inclination θ by 30° then what will be the number of images?
- (A) 9 (B) 10
 (C) 11 (D) 12
25. Minimum deviation of an incident ray is 30° on one surface of a prism having refracting angle 60° . What will be the refractive index of the material of the prism?
- (A) 1.54 (B) 1.41
 (C) 1.33 (D) 1.44

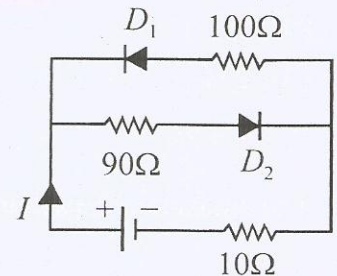
26. If the frequencies of carrier waves in case of frequency modulated (FM) and amplitude modulated (AM) waves are f_M and f_A respectively, then
- (A) $f_A \approx f_M$ (B) $f_A < f_M$
 (C) $f_A > f_M$ (D) $f_A \gg f_M$

27. Identify the gate formed by a combination of some gates as shown in figure.



- (A) OR (B) NOT
 (C) AND (D) NAND

28. What will be the value of current I in the given circuit?
 (D_1 and D_2 are ideal diodes)



- (A) 0.1 A (B) 0.01 A
 (C) $\frac{1}{11}$ A (D) 0.05 A

29. Work function of a material is 4.0 eV. What will be the maximum value of wavelength of the light which can emit photo-electrons from the material?

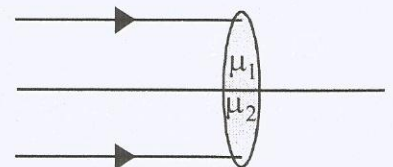
- (A) 540 nm (B) 400 nm
 (C) 310 nm (D) 220 nm

30. If the polarization angle for a medium is 60° then the critical angle for it will be

- (A) $\sin^{-1} \sqrt{3}$ (B) $\tan^{-1} \sqrt{3}$
 (C) $\cos^{-1} \sqrt{3}$ (D) $\sin^{-1} \frac{1}{\sqrt{3}}$

31. If parallel rays of light fall on a lens made by two materials then what will be the number of images?

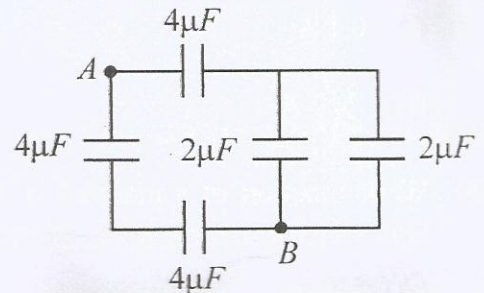
- (A) two (B) infinity
 (C) one (D) 0



32. If a concave mirror of focal length f is immersed in water ($\mu = \frac{4}{3}$), then its value of focal length will change to
- (A) $\frac{4}{3}f$ (B) f
 (C) $\frac{3}{4}f$ (D) $\frac{7}{3}f$
33. If the value of the electric flux passing through a vector area $\vec{S} = a\vec{i} - \vec{j} + \vec{k}$ in a uniform electric field of intensity $\vec{E} = \vec{i} + 2\vec{j} + 3\vec{k}$ is zero, then the value of a is
- (A) 2 (B) 1
 (C) -1 (D) 0
34. The length of a conducting wire is increased by 1%. Then the change in resistance of the wire will be
- (A) 2% (B) 1.2%
 (C) 1.4% (D) 2.5%

35. The equivalent capacitance between points A and B is

- (A) $8\mu F$ (B) $4\mu F$
 (C) $2\mu F$ (D) $3\mu F$

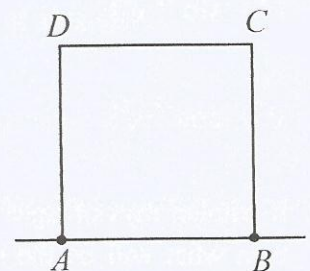


36. Which physical quantity is having unit ampere-hour ?

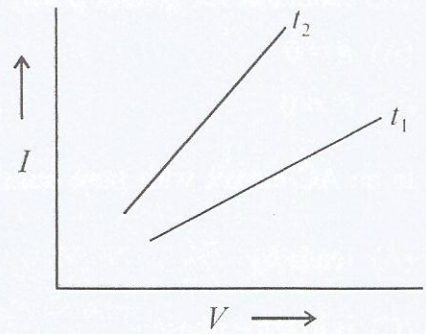
- (A) time (B) current
 (C) electrical energy (D) electric charge

37. A square with side 10cm as shown is made from a wire having resistance 20Ω per meter. What will be the resistance between A and B ?

- (A) 1.5Ω (B) 20Ω
 (C) 10Ω (D) 5Ω



38. Figure shows the Voltage-Current (V-I) curve for temperatures t_1 and t_2 . The relation between t_1 and t_2 is



- (A) $t_1 = t_2$ (B) $t_1 > t_2$
 (C) $t_2 > t_1$ (D) none of the above
39. A $60V - 120W$ electric bulb is to be connected with a $220V$ DC source. What should be the resistance to be connected in series so that the bulb glows with the rated intensity
- (A) 40Ω (B) 60Ω
 (C) 80Ω (D) 100Ω
40. A galvanometer shows full scale deflection when 1 mA current passes through it. How can this galvanometer be converted into an ammeter to measure a current upto a maximum of $10A$?
- (A) 0.05Ω is to be connected in parallel with the galvanometer
 (B) 0.01Ω is to be connected in parallel with the galvanometer
 (C) 0.05Ω is to be connected in series with the galvanometer
 (D) 0.01Ω is to be connected in series with the galvanometer
41. B_1 is the magnetic field at the centre of a circular loop of radius r carrying current I and B_2 is the magnetic field at a distance r from an infinite straight wire carrying same current I . What will be value of $B_1 : B_2$?
- (A) $1 : \pi$ (B) $r : \pi$
 (C) $\pi : 1$ (D) $\frac{\pi}{2} : 1$
42. What will be the value of angle of dip at a place on earth's surface where the vertical and horizontal components of earth's magnetic field are equal?
- (A) 0° (B) 90°
 (C) 60° (D) 45°
43. $8V$ e.m.f is induced in a coil when the current in the coil changes from $2A$ to $-2A$ in 0.05 s . What is value of the self-inductance of the coil?
- (A) $1 H$ (B) $10 H$
 (C) $0.1 H$ (D) $0.01 H$

44. The condition for getting purely reactive power in an AC circuit is
- (A) $R = 0$ (B) $L = 0$
 (C) $C = 0$ (D) $L = C$
45. In an AC circuit with pure inductance, the alternating voltage with respect to the current
- (A) leads by $\frac{\pi}{2}$ (B) lags by $\frac{\pi}{2}$
 (C) is in same phase (D) lags by π
46. Which one is not an electromagnetic wave?
- (A) cosmic ray (B) γ ray
 (C) β ray (D) X ray
47. One hydrogen atom goes from ground state to $n=4$ excited state. What will be the number of spectral lines in its emission spectrum?
- (A) 3 (B) 5
 (C) 6 (D) 2
48. What will be the ratio of nuclear density of two nuclei having mass numbers in the ratio of 1 : 3 ?
- (A) $\sqrt[3]{3} : 1$ (B) 1 : 1
 (C) 1 : 3 (D) 3 : 1
49. Decimal equivalent of the binary number $(110.011)_2$ is
- (A) 6.375 (B) 6.075
 (C) 6.325 (D) 0.375
50. What will be the momentum of a photon with frequency ν ?
- (A) 0 (B) $h\nu$
 (C) $\frac{h\nu}{c}$ (D) $\frac{hc}{\nu}$