

**ENTRANCE EXAMINATION, FEBRUARY 2014**  
**QUESTION PAPER BOOKLET**

**M. Sc. (PHYSICS)**

Marks: 75

Time: 2.00 hrs.

Hall Ticket No.:

- I. Please enter you **Hall Ticket Number on Page 1 of this question paper and on the OMR sheet** without fail.
- II. Read carefully the following instructions:
1. This Question paper has two Sections: **Section A** and **Section B**
  2. **Section A** consists of 25 objective type questions of one mark each.  
**There is negative marking of 0.33 mark for every wrong answer.**  
The marks obtained by the candidate in this Section will be used for resolving the tie cases.
  3. **Section B** consists of 50 objective type questions of one mark each.  
**There is no negative marking in this Section.**
  4. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
  5. Only Non programmable Scientific Calculators are permitted. Mobile phone based calculators are not permitted. Logarithmic tables are not allowed.
  6. Hand over the OMR answer sheet at the end of the examination to the Invigilator.

This book contains 24 pages

**III. Values of physical constants:**

$$c = 3 \times 10^8 \text{ m/s}; h = 6.63 \times 10^{-34} \text{ J.s}; k_B = 1.38 \times 10^{-23} \text{ J/K}$$

$$e = 1.6 \times 10^{-19} \text{ C}; \mu_0 = 4\pi \times 10^{-7} \text{ Henry/m}; \epsilon_0 = 8.85 \times 10^{-12} \text{ Farad/m}$$

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## SECTION - A

1. Which one of the following straight lines passes through the point (1,1)?
  - A.  $y = 2x + 3$
  - B.  $2y = x - 6$
  - C.  $x = 1$
  - D.  $x = y + 1$
  
2. The real and imaginary parts of the function  $f(z) = z e^z$  where  $z \equiv x + iy$  respectively are
  - A.  $x e^x$ ;  $y e^y$
  - B.  $x e^y$ ;  $y e^x$
  - C.  $x \cos y$ ;  $y \sin y$
  - D.  $[x \cos y - y \sin y]e^x$ ;  $[y \cos y + x \sin y]e^x$
  
3. The value of the integral

$$\int_0^1 dx \int_0^x dy xy$$

is

- A. 1
  - B.  $\frac{1}{4}$
  - C.  $\frac{1}{8}$
  - D.  $\frac{1}{2}$
4. If  $x = at^2$  and  $y = 3bt$ ,  $\frac{dy}{dx}$  is
    - A.  $\frac{a}{3b}$
    - B.  $\frac{3b}{2at}$
    - C.  $\frac{3b}{a}$
    - D.  $\frac{2at}{3b}$

5. Which of the following are eigenvalues of the matrix  $\begin{pmatrix} 2 & i \\ -i & 2 \end{pmatrix}$
- A. 1,0
  - B.  $i, -i$
  - C.  $1 + i, 1 - i$
  - D. 1,3
6. If a bag contains blue, green and red marbles, all but 15 are blue, all but 13 are red and all but 12 are green. How many are red?
- A. 13
  - B. 7
  - C. 8
  - D. 20
7. If the distance between two bodies of masses  $m_1$  and  $m_2$  is doubled, the gravitational force between them becomes
- A. double
  - B. half
  - C. one-fourth
  - D. unchanged
8. A simple pendulum executes oscillations of period 10 s on the surface of Earth. This pendulum is taken to another planet having same mass but one fourth of Earth's size. The period of oscillations of the pendulum would now be
- A. 40 s
  - B. 10 s
  - C. 5 s
  - D. 2.5 s
9. If an electric potential difference of 10 volts is applied between two plates kept 2 cm apart, the electric field between the plates is
- A. 20 V/m
  - B. 500 V/m
  - C. 5 V/m
  - D. 250 V/m

10. Which one of the following functions is a traveling wave?
- A.  $f(x - vt)^2$
  - B.  $f(x - vt)$
  - C.  $f(x^2 - v^2t^2)$
  - D.  $f(x^2 + v^2t^2)$
11. Which of the following is a correct statement of the second law of thermodynamics?
- A.  $dU = TdS - PdV$
  - B.  $W \geq \Delta F$
  - C.  $dS = \frac{dQ}{T}$
  - D.  $dS \leq 0$
12. Enthalpy is a function of
- A.  $S, V, N$
  - B.  $S, P, N$
  - C.  $T, V, N$
  - D.  $T, P, N$
13. The magnitude of the magnetic field at a distance  $r$  from a long straight wire carrying a steady current  $I$  is given by
- A.  $|B| = \mu_0 I / 2\pi r$
  - B.  $|B| = \mu_0 I / 4\pi r$
  - C.  $|B| = \mu_0 I / 2\pi r^2$
  - D.  $|B| = \mu_0 I^2 / 4\pi r$
14. The ratio of the magnetic fields generated by a solenoid with an iron core  $\vec{B}_1$ , to that of a solenoid without core  $\vec{B}_2$ , is
- A.  $\frac{|\vec{B}_1|}{|\vec{B}_2|} > 1$
  - B.  $\frac{|\vec{B}_1|}{|\vec{B}_2|} < 1$
  - C.  $\frac{|\vec{B}_1|}{|\vec{B}_2|} = 1$
  - D.  $\frac{|\vec{B}_1|}{|\vec{B}_2|} = 0$

15. The capacitance of two concentric spherical metal shells with radii  $a$  and  $b$  is
- A.  $\frac{1}{4\pi\epsilon_0} \left( \frac{1}{a} - \frac{1}{b} \right)$
  - B.  $\frac{1}{4\pi\epsilon_0} \frac{ab}{b-a}$
  - C.  $4\pi\epsilon_0 \frac{ab}{b-a}$
  - D.  $4\pi\epsilon_0 \left( \frac{1}{a} - \frac{1}{b} \right)$
16. If an ac signal  $V = 170 \sin 100\pi t$  is applied to a  $100 \Omega$  resistor, the r.m.s. current recorded by an ammeter connected in series with the resistor will be
- A. 1.2 A
  - B. 2 A
  - C. 3.1 A
  - D. 4.6 A
17. Two wires of equal length and equal diameter, having resistivities of  $\rho_1$  and  $\rho_2$ , are connected in series. The equivalent resistivity of the combination is
- A.  $\rho_1 + \rho_2$
  - B.  $\frac{(\rho_1 + \rho_2)}{2}$
  - C.  $\frac{\rho_1 + \rho_2}{\rho_1\rho_2}$
  - D.  $\sqrt{\rho_1\rho_2}$
18. The potential on a charged soap bubble is 16 V. If the the radius of the bubble is doubled then potential will now be
- A. 2 V
  - B. 4 V
  - C. 8 V
  - D. 16 V
19. The band gap energy of a semiconductor depends on the
- A. amount of doping
  - B. type of the material
  - C. temperature
  - D. all of the above

20. In photo electric effect, an increase in the intensity of the light
- A. increases the maximum kinetic energy of the electrons
  - B. increases the number of emitted electrons
  - C. increases both the kinetic energy and the number of electrons
  - D. decreases both the kinetic energy and the number of electrons
21. The wavelength of a particle with energy  $E$  is proportional to
- A.  $1/E$
  - B.  $1/E^2$
  - C.  $E^{1/2}$
  - D.  $E^2$
22. In a harmonic oscillator, if the transition energy from 3<sup>rd</sup> state to 2<sup>nd</sup> state is 4.8 eV, what is the ground state energy?
- A. 1.2 eV
  - B. 2.4 eV
  - C. 4.8 eV
  - D. 0.6 eV
23. De Broglie hypothesized that the linear momentum and wavelength of a free massive particle are related to one of the following constants.
- A. Rydberg's constant
  - B. Speed of light
  - C. Planck's constant
  - D. Boltzmann's constant
24. Light of wavelength  $\lambda = 600$  nm and frequency of  $\nu = c/\lambda$  enters a glass slab of refractive index  $n = 1.5$ .  $\lambda$  and  $\nu$  get modified as
- A.  $600/1.5$  nm and  $1.5 \times 10^8$  m/600 nm
  - B.  $600/1.5$  nm and  $3 \times 10^8$  m/600 nm
  - C. 600 nm and  $3.8 \times 10^8$  m/( $1.5 \times 600$  nm)
  - D.  $1.5 \times 600$  nm and  $3.8 \times 10^8$  m ( $1.5 \times 600$  nm)

25. The truth table given below represents one of the following digital gates

A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

- A. AND
- B. NOR
- C. NAND
- D. OR



## SECTION - B

26. The function

$$f(x) = \frac{-1}{x^2 + \alpha^2}$$

has

- A. a maximum at  $x = 0$
  - B. a minimum at  $x = 0$
  - C. has a maximum at  $x = \alpha$  and a minimum at  $x = -\alpha$
  - D. has a minimum at  $x = \alpha$  and a maximum at  $x = -\alpha$
- 27.
- $\vec{F} = \frac{1}{x}\hat{i} + 2y\hat{j}$
- , then
- $\vec{F}$
- is a gradient of the following function
- A.  $f = -\frac{1}{x^2} + z^2 + c$
  - B.  $f = y^2 + c$
  - C.  $f = \log x + y^2 + c$
  - D.  $f = 2xy + c$
28. The lines
- $l_1$
- and
- $l_2$
- are given by

$$l_1 : (3 + 2t)\hat{x} + (5 - t)\hat{y} + (7 + 3t)\hat{z}$$

$$l_2 : (3 + t)\hat{x} + (5 + 2t)\hat{y} + (7 + 2t)\hat{z}$$

The point of intersection of these two lines is

- A. (0,0,0)
- B. (5,4,10)
- C. (4,7,9)
- D. (3,5,7)

29. The series

$$x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots$$

corresponds to the expansion of

- A.  $e^x$
- B.  $\sin(x)$
- C.  $\log(1 + x)$
- D.  $(1 + x)^n$

30. The integral  $\int x e^{ax} dx$  is

- A.  $\frac{x^2}{2} e^{ax} + axe^{ax} + c$
- B.  $x \frac{e^{ax}}{a} - \frac{e^{ax}}{a^2} + c$
- C.  $\frac{x^2 e^{ax}}{2a} - \frac{x e^{ax}}{a} + c$
- D.  $e^{ax} + axe^{ax} + c$

31. The integral  $\int \frac{1}{a^2 - x^2} dx$  is

- A.  $\frac{1}{a} \tan(x/a) + c$
- B.  $-\frac{1}{a} \log(\cos(x/a)) + c$
- C.  $\frac{1}{a} \log(\tan x/a) + c$
- D.  $\frac{1}{a} \tanh^{-1}(x/a) + c$

32. If  $A$  and  $B$  are hermitian matrices then  $[A, B]$  is

- A. hermitian
- B. anti-hermitian
- C. unitary
- D. symmetric

33. In three dimensions the equation  $x + y + z = 1$  represents

- A. a straight line through the origin
- B. a sphere of radius 1 with centre at the origin
- C. a plane passing through the origin
- D. a plane passing through (1,0,0)

34. The first three terms in the Taylor series expansion of  $\sin x$  around  $x = \pi/2$  are

- A.  $\left(x - \frac{\pi}{2}\right) - \frac{\left(x - \frac{\pi}{2}\right)^3}{3!} + \frac{\left(x - \frac{\pi}{2}\right)^5}{5!}$
- B.  $\left(x - \frac{\pi}{2}\right) + \frac{\left(x - \frac{\pi}{2}\right)^3}{3!} + \frac{\left(x - \frac{\pi}{2}\right)^5}{5!}$
- C.  $1 - \frac{\left(x - \frac{\pi}{2}\right)^2}{2!} + \frac{\left(x - \frac{\pi}{2}\right)^4}{4!}$
- D.  $1 + \left(x - \frac{\pi}{2}\right) + \frac{1}{2!} \left(x - \frac{\pi}{2}\right)^2$

35. The least period  $T$  for the function

$$f(x) = \tan \frac{x}{2} - 2 \tan \frac{x}{3}$$

is

- A.  $T = 2\pi$
- B.  $T = 3\pi$
- C.  $T = 5\pi$
- D.  $T = 6\pi$

36. Given the function

$$f(x) = |x^2|, \quad g(x) = \sqrt{x},$$

the composition  $f \circ g$  and  $g \circ f$  are given by

- A.  $f \circ g(x) = x^2, \quad g \circ f(x) = x^{3/2}$
  - B.  $f \circ g(x) = x^{3/2}, \quad g \circ f(x) = x^{3/2}$
  - C.  $f \circ g(x) = x, \quad g \circ f(x) = |x|$
  - D.  $f \circ g(x) = x, \quad g \circ f(x) = x$
37. A sphere of radius 4 cm is carved from a homogeneous sphere of radius 8 cm and mass 160 gm. The mass of the smaller sphere is
- A. 80 gm
  - B. 60 gm
  - C. 40 gm
  - D. 20 gm
38. Two observers having identical instruments carry out identical experiments to study the motion of a massive particle. First observer concludes that the particle is moving in a straight line with constant velocity while the second observer concludes that the particle is moving with acceleration. Which of the following four statements made about these two observers are correct:
- (i) both observers are at rest
  - (ii) second observer is moving with constant velocity with respect to the first observer
  - (iii) both observers are moving with constant velocity with respect to a distant star
  - (iv) second observer is accelerating with respect to the first observer
- A. (i)
  - B. (ii)
  - C. (i) and (iii)
  - D. (iv)

39. A particle is accelerated such that its energy is three times its rest mass energy. Then velocity of the particle would be

- A.  $\sqrt{2}c/3$
- B.  $3c/2\sqrt{2}$
- C.  $2\sqrt{2}c/3$
- D.  $c/\sqrt{3}$

40. Two springs of spring constants  $k_1$  and  $k_2$  are attached to a block of mass  $m$  on its either side so as to be collinear. The free ends of both the springs are fixed to rigid supports. If the block is made to oscillate parallel to the springs then the frequency of oscillations is

- A.  $\frac{1}{2\pi} \left( \frac{k_1 + k_2}{m} \right)^{1/2}$
- B.  $\left( \frac{k_1 + k_2}{m} \right)^{1/2}$
- C.  $\frac{1}{2\pi} \left( \frac{k_1 - k_2}{m} \right)^{1/2}$
- D.  $\frac{1}{2\pi} \left( \frac{k_1 + k_2}{2m} \right)^{1/2}$

41. The maximum energy of a simple pendulum of length 1 m is  $E$ . If the length of the pendulum is increased to 1.5 m then its maximum energy, assuming amplitude has not changed, is

- A.  $\frac{2}{3}E$
- B.  $\frac{3}{2}E$
- C.  $\sqrt{\frac{3}{2}}E$
- D.  $\sqrt{\frac{2}{3}}E$

42. The displacement of a body executing simple harmonic motion is given by

$$y = 5 \sin \left( 2\pi t + \frac{\pi}{4} \right).$$

Its initial displacement, assuming all quantities are in SI unit, is

- A.  $\frac{5}{\sqrt{2}}$  m
- B. 5 m
- C. 0 m
- D.  $\frac{-5}{\sqrt{2}}$  m

43. The standing waves on a string of length  $L$  that is fixed at both ends have a speed  $v$ . The three lowest frequencies of vibration are
- A.  $\frac{v}{L}$ ,  $\frac{2v}{L}$  and  $\frac{3v}{L}$
  - B.  $\frac{v}{2L}$ ,  $\frac{v}{L}$  and  $\frac{3v}{2L}$
  - C.  $\frac{\lambda}{2}$ ,  $\lambda$  and  $\frac{3\lambda}{2}$
  - D.  $\frac{L}{v}$ ,  $\frac{2L}{v}$  and  $\frac{3L}{v}$
44. A vessel has two compartments of volume  $V_1$  and  $V_2$ , containing an ideal gas at pressures  $P_1$  and  $P_2$ , and temperatures  $T_1$  and  $T_2$  respectively. If the wall separating the compartments is removed the resulting equilibrium temperature will be
- A.  $\frac{P_1T_1 + P_2T_2}{P_1 + P_2}$
  - B.  $\frac{V_1T_1 + V_2T_2}{V_1 + V_2}$
  - C.  $\frac{P_1V_1 + P_2V_2}{P_1V_1/T_1 + P_2V_2/T_2}$
  - D.  $(T_1T_2)^{1/2}$
45. An athlete dissipates all the energy in a diet of 2000 kcal. per day. If he were to release this energy at a steady rate, its magnitude can be compared to the out put energy of an electric bulb of the following wattage
- A. 300 Watts
  - B. 200 Watts
  - C. 100 Watts
  - D. 40 Watts
46. 1 kg of ice at  $0^\circ\text{C}$  melts reversibly to water at the same temperature at atmospheric pressure. If the latent heat of melting is 79.8 cal/gm, the entropy change caused by melting is nearly
- A. 100 Joules/K
  - B. 1500 Joules/K
  - C. 1220 Joules/K
  - D. 1520 Joules/K

47. Work done in an isothermal process when an ideal gas goes from  $P_1V_1$  to  $P_2V_2$  reversibly equals
- A.  $P_1V_1 - P_2V_2$
  - B.  $P_1V_1 \ln(V_1/V_2)$
  - C.  $P_1V_2 - P_2V_1$
  - D.  $\frac{(P_1 + P_2)}{2}(V_2 - V_1)$
48. A magnetic needle of length 12cm is suspended at its midpoint by a thread and stays stable at  $45^\circ$  with horizontal. Given the horizontal component of the Earth's magnetic field is  $24 \mu\text{T}$ . If a vertical force of  $96 \mu\text{N}$  is required to be applied to one end of the needle to keep it in horizontal position, then the pole strength of the magnetic needle is
- A. 1.5 Am
  - B. 2.0 Am
  - C. 2.6 Am
  - D. 3.2 Am
49. A projectile is fired with an initial velocity of 98 m/s at an angle  $30^\circ$  to the horizontal. If it strikes the top of a hill after 5 s, what is the elevation of the hill above the point of firing ?
- A. 22.05m
  - B. 220.5 m
  - C. 11.025 m
  - D. 441.0 m
50. In an ac circuit, the current is given by

$$I = 5 \sin \left[ 100t - \frac{\pi}{2} \right]$$

and the ac potential is  $V = 200 \sin 100t$ . Then the power consumption is

- A. 1000 W
- B. 500 W
- C. 100 W
- D. 0 W

51. A hollow spherical shell with inner radius  $a$  and outer radius  $b$  carries a charge density  $\rho(r) = 1/r^2$  in the region  $a \leq r \leq b$ . The electric field in the region  $a < r < b$  is
- A.  $\frac{1}{4\pi\epsilon_0 r^2} \hat{r}$
  - B.  $\frac{1}{\epsilon_0} \frac{r-a}{r^2} \hat{r}$
  - C.  $\frac{1}{\epsilon_0} \frac{b-a}{r^2} \hat{r}$
  - D.  $\frac{1}{\epsilon_0} \frac{r-b}{r^2} \hat{r}$
52. Electric charges of  $+10\mu\text{C}$ ,  $+5\mu\text{C}$ ,  $-3\mu\text{C}$  and  $+8\mu\text{C}$  are placed at the corners of a square of side  $\sqrt{2}$  m. The potential at the centre of the square is
- A. 1.8 V
  - B.  $1.8 \times 10^5 \text{V}$
  - C.  $1.8 \times 10^6 \text{V}$
  - D.  $1.8 \times 10^4 \text{V}$
53. The half life of  $^{215}\text{At}$  is  $100\mu\text{s}$ . If the sample contains 6 mg of the element, the initial activity of the sample is: (Assume Avogadro number is  $6.03 \times 10^{23}$  atom/mol)
- A.  $0.58 \times 10^{23}$  Becquerels
  - B.  $1.16 \times 10^{23}$  Becquerels
  - C.  $3.32 \times 10^{23}$  Becquerels
  - D.  $6.64 \times 10^{23}$  Becquerels
54. A particle leaving a cyclotron has relativistic energy 10 GeV and a relativistic momentum 8 GeV/c. What is the rest mass of particle?
- A.  $0.25 \text{ GeV}/c^2$
  - B.  $1.20 \text{ GeV}/c^2$
  - C.  $2.00 \text{ GeV}/c^2$
  - D.  $6.00 \text{ GeV}/c^2$
55. The ground state energy of the Hydrogen atom is -13.6 eV. The energy of the first excited state is
- A. -1.5 eV
  - B. -3.4 eV
  - C. -27.2 eV
  - D. -4.5 eV

56. Which of the following functions can be an eigen-function of the operator  $i\hbar\frac{d}{dx}$ ?
- A.  $e^{ikx}$
  - B.  $\cos(kx)$
  - C.  $\sin(kx)$
  - D.  $\cos(2kx)$
57. Compton-scattered photons of wavelength  $\lambda'$  are observed at scattering angle  $90^\circ$ . In terms of  $\lambda'$  what is the scattered wavelength observed at  $180^\circ$ ?
- A.  $\lambda' + \frac{h}{m_0c}$
  - B.  $\lambda' + \frac{2h}{m_0c}$
  - C.  $\lambda' - \frac{h}{m_0c}$
  - D.  $\lambda' - \frac{2h}{m_0c}$
58. A rigid-walled box that extends from  $-L$  to  $+L$  is divided into three sections by interior walls at  $-x$  to  $+x$  where  $x < L$ . Each section contains one particle of same mass in its ground state. The total energy of the system in the ground state is
- A.  $E_T = \frac{\pi^2\hbar^2}{2m} \left[ \frac{2}{(L-x)^2} + \frac{1}{4x^2} \right]$
  - B.  $E_T = \frac{\pi^2\hbar^2}{6mL^2}$
  - C.  $E_T = \frac{\pi^2\hbar^2}{2m} \left[ \frac{2}{(L+x)^2} + \frac{1}{4x^2} \right]$
  - D.  $E_T = \frac{\pi^2\hbar^2}{2m} \left[ \frac{2}{(L+x)^2} + \frac{1}{(L-x)^2} \right]$
59. A single electron atom has an orbital angular momentum  $L = \sqrt{2}\hbar$ . Which of the following gives the possible values of a measurement of  $L_z$ , the  $z$ -component of  $L$  of the electron?
- A. 0
  - B.  $0, \hbar$
  - C.  $-2\hbar, -\hbar, 0, \hbar, 2\hbar$
  - D.  $-\hbar, 0, \hbar$

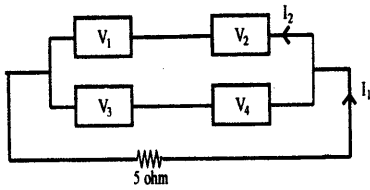


60. Work done in stretching a wire of cross-section 2 sq.mm and length 1 m through 0.1 mm is (given the Young's modulus of the material of the wire is  $2 \times 10^{12}$  dynes/sq.cm)
- A. 1.2 m Joules
  - B. 2.0 m Joules
  - C. 3.5 m Joules
  - D. 5.4 m Joules
61. A 1 mm thick layer of glycerin with a viscous coefficient of 20 g/cm.s separates a flat plate of area 6 sq.cm from a larger plate. Then the force required to keep the flat plate moving with a velocity of 1.5 cm/s is
- A. 4 mN
  - B. 6.4 mN
  - C. 14 mN
  - D. 18 mN
62. A gas bubble of diameter 1.6 cm rises steadily through a solution of density 1.8 g/cc at a rate of 0.32 cm/s. Then the viscosity of the solution is nearly (neglect the density of the gas)
- A. 785 poise
  - B. 850 poise
  - C. 982 poise
  - D. 1025 poise
63. A pin hole of 0.2 mm diameter at the bottom of a vessel is being filled with mercury (Hg.) The length of the Hg column that can be supported without leakage through the hole is nearly (Surface tension of Hg is 550 dyn/cm, density of Hg is 13.6 g/cc)
- A. 3.65 cm
  - B. 5.44 cm
  - C. 8.25 cm
  - D. 9.2 cm
64. Two trains each traveling with a velocity of 72 km/h are moving in opposite directions. If one of them blows a whistle of frequency 512 Hz, then the frequency of the note heard by the passenger in the other train, after the engines have crossed, is nearly (Velocity of sound wave is 343 m/s at 20°C)
- A. 412 Hz
  - B. 456 Hz
  - C. 512 Hz
  - D. 575 Hz

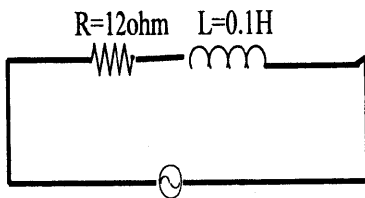
65. A metal rim of inner diameter 59.4 cm at 20°C is required to be fixed on a wooden wheel of diameter 59.6 cm. The temperature to which the rim must be heated to fit on to the wheel (given the coefficient of linear expansion of the metal is  $1.2 \times 10^{-5}/^\circ\text{C}$ ) is
- A. 160°C
  - B. 200°C
  - C. 260°C
  - D. 300°C
66. Two waves are represented by  $E_1 = E_{10} \cos \omega t$  and  $E_2 = E_{20} \sin(\omega t + \pi/2)$ , where  $\omega$  is the angular frequency and  $E_{10}$  and  $E_{20}$  are the amplitudes of the waves. Superposition of these two waves leads to a resultant wave with an amplitude
- A.  $\sqrt{(E_{10}^2 + E_{20}^2)}$
  - B.  $E_{10} + E_{20}$
  - C.  $\sqrt{(E_{10}^2 - E_{20}^2)}$
  - D.  $E_{10} - E_{20}$
67. In a Michelson interferometer the displacement of one of the mirrors by 0.2 mm leads to shifting of 600 fringes. What is the wavelength of light?
- A. 667 nm
  - B. 335 nm
  - C. 300 nm
  - D. 133 nm
68. Two lenses of focal lengths 5 cm each are kept separated by 10 cm. A parallel beam of light of 3 mm diameter is made to incident on one of the lenses. The light coming out of the second lens
- A. gets focussed at a distance of 2.5 cms from the second lens
  - B. is a parallel beam of 1.5 mm diameter
  - C. is a parallel beam of 6 mm diameter
  - D. is a diverging beam
69. A convex lens produces an upright image magnified three times of a given object which is kept 1.5 m away. Its focal length is
- A. 2.25 m
  - B. 1.125 m
  - C. 4.5 m
  - D. -2.25 m

70. A vertically polarized light of intensity  $I_0$  is incident on a polarizer whose axis makes an angle  $\theta$  to the vertical. The light then passes through another polarizer whose axis made  $60^\circ$  to that of the first one. The net intensity of the output light in relation to incident intensity is
- A.  $I_0 \cos^2 \theta$
  - B.  $2I_0 \cos^2 \theta$
  - C.  $\frac{3I_0 \cos^2 \theta}{2}$
  - D. 0
71. Two capacitors of capacitance  $6 \mu\text{F}$  and  $4 \mu\text{F}$  are connected in parallel and this combination is connected in series with a capacitor of capacitance  $5 \mu\text{F}$  across a voltage source of 1000 V. The total charge stored in the system is
- A.  $3 \times 10^{-3} \text{ C}$
  - B.  $7.4 \times 10^{-3} \text{ C}$
  - C.  $3.3 \times 10^{-3} \text{ C}$
  - D.  $1.3 \times 10^{-3} \text{ C}$
72. In an npn transistor circuit, the collector current is 15 mA. If 95% of the electrons emitted reach the collector, what is the base current?
- A. 0.345 mA
  - B. 1.58 mA
  - C. 0.79 mA
  - D. 15.79 mA
73. A  $50 \mu\text{F}$  capacitor is connected through a  $100 \Omega$  resistor and a 12 V DC supply through a switch, the time taken for the capacitor to be charged to 90% of the maximum possible value after the switch is on, is
- A. 34.5 mA
  - B. 23.0 mA
  - C. 11.5 mA
  - D. 5.75 mA

74. If 4 cells of emf 1.5 V and  $0.075 \Omega$  internal resistance are connected as shown in the figure. Then the current  $I_2$  will be



- A. 0.12 A  
 B. 0.3 A  
 C. 0.44 A  
 D. 0.6 A
75. If a 110 V, 60 Hz line is connected to a coil of inductance 0.1 H and resistance  $12 \Omega$ , the phase angle between the source voltage and the current through the circuit, is



- A.  $36.6^\circ$   
 B.  $45^\circ$   
 C.  $56.8^\circ$   
 D.  $72.4^\circ$