

NOTE : DO NOT BREAK THE SEAL UNTIL YOU GO THROUGH THE FOLLOWING INSTRUCTIONS

COMMON ENTRANCE TEST - 2012

Question Booklet PHYSICS

Roll No.

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(Enter your Roll Number in the above space)

Series

C

Booklet No.

116647

Time Allowed : 1.30 Hours

Max. Marks : 75

INSTRUCTIONS :

1. Use only BLACK or BLUE Ball Pen.
2. All questions are COMPULSORY.
3. Check the BOOKLET thoroughly.

IN CASE OF ANY DEFECT - MISPRINTS, MISSING QUESTION/S OR DUPLICATION OF QUESTION/S, GET THE BOOKLET CHANGED WITH THE BOOKLET OF THE SAME SERIES. NO COMPLAINT SHALL BE ENTERTAINED AFTER THE ENTRANCE TEST.

4. Before you mark the answer, fill in the particulars in the ANSWER SHEET carefully and correctly. Incomplete and incorrect particulars may result in the non-evaluation of your answer sheet by the technology.
5. Write the SERIES and BOOKLET NO. given at the TOP RIGHT HAND SIDE of the question booklet in the space provided in the answer sheet by darkening the corresponding circles.
6. Do not use any eraser, fluid pens, blades etc., otherwise your answer sheet is likely to be rejected whenever detected.
7. After completing the test, candidates are advised to hand over the OMR ANSWER SHEET to the Invigilator and take the candidate's copy with yourself.

SEAL

1. Taking the radius of the earth to be 6400 km, by what percentage will the acceleration due to gravity at a height of 100 km from the surface of the earth differ from that on the surface of the earth?
 (1) about 1.5% (2) about 5% (3) about 8% (4) about 3%

2. Which of the following is not related to the Bernoulli's principle?
 (1) rise of a liquid column inside a capillary
 (2) operation of a venturimeter
 (3) lift provided to an aero plane by the air
 (4) propelling force provided to an aero plane by its propellers

3. The air pressure inside a soap bubble of radius R exceeds the outside air pressure by 10 pa. By how much will the pressure inside a bubble of radius $2R$ exceed the outside air pressure?
 (1) 20 pa (2) 40 pa (3) 2.5 pa (4) 5 pa

4. A steel wire can support a maximum load of W before reaching its elastic limit. How much load can another wire, made out of identical steel, but with a radius one half the radius of the first wire, support before reaching its elastic limit?
 (1) W (2) $W/2$ (3) $W/4$ (4) $4W$

5. Which of the following laws of thermodynamics forms the basis for the definition of temperature?
 (1) first law (2) zeroth law (3) second law (4) third law

6. Which of the following is a true statement?
 (1) The total entropy of thermally interacting systems is conserved
 (2) Carnot engine has 100% efficiency
 (3) Total entropy does not change in a reversible process
 (4) Total entropy in an irreversible process can either increase or decrease

7. The molecules in an ideal gas at 27°C have a certain mean velocity. At what approximate temperature, will the mean velocity be doubled?
 (1) 54°C (2) 327°C (3) 1200°C (4) 927°C

8. Which of the two, (i) compressing a gas isothermally until its volume is reduced by half (ii) compressing the same gas adiabatically until its volume is reduced by half, will require more work to be done?
 (1) (i)
 (2) (ii)
 (3) both will require the same amount of work
 (4) it will depend upon the nature of the gas

9. Which of the following statements is true for the three types of magnetism – para, dia and ferro?
- (1) para magnetism is associated with negative susceptibility and dia and ferromagnetism with positive susceptibility
 - (2) diamagnetism is generally weakest of the three, and is associated with negative susceptibility
 - (3) ferromagnetism is the strongest of the three and is associated with negative susceptibility
 - (4) all three are associated with positive susceptibility, dia magnetism is the weakest form of magnetism, and ferro magnetism is the strongest form
10. Three coplanar, parallel, long straight wires are equally spaced, that is, the distance between each pair of successive wires is the same. The first and the third wire carry currents of 1 A each, in the same direction. What must be the current in the second wire (wire in the middle), so that the other two wires do not feel any net force?
- (1) 0.25 A in opposite direction to those in the first and the third
 - (2) 0.5 A in the same direction as those in the first and the third
 - (3) 0.5 A in the opposite direction to those in the first and the third
 - (4) 0.25 A in the same direction as those in the first and the third
11. A conducting rod of length L is moving in a uniform magnetic field (B) with a velocity v without rotation. The velocity of the rod is perpendicular to the rod, and the motion of the rod is confined to a plane perpendicular to the magnetic field. What is the induced emf developed across the rod?
- (1) BLv
 - (2) Bv^2L
 - (3) BL/v
 - (4) BL^2v
12. What is the resonance frequency of a driven LCR oscillator?
- (1) $1/LC$
 - (2) $1/2\pi LC$
 - (3) $(LC)^{-1/2}$
 - (4) $(2\pi LC)^{-1/2}$
13. A bar magnet is placed upright on a floor (so that the axis of the magnet is vertical). A copper ring is held above the magnet, with its plane horizontal, and released. The copper ring falls in such a manner that its axis always coincides with that of the magnet. What will be the acceleration with which the ring will fall? Acceleration due to gravity is 10 m/s^2 :
- (1) 10 m/s^2
 - (2) less than 10 m/s^2
 - (3) more than 10 m/s^2
 - (4) the answer will depend upon which pole of the magnet is up
14. A short solenoid of radius a , number of turns per unit length n_1 , and length L is kept coaxially inside a very long solenoid of radius b , number of turns per unit length n_2 . What is the mutual inductance of the system?
- (1) $\mu_0\pi b^2 n_1 n_2 L$
 - (2) $\mu_0\pi a^2 n_1 n_2 L^2$
 - (3) $\mu_0\pi a^2 n_1 n_2 L$
 - (4) $\mu_0\pi b^2 n_1 n_2 L^2$

15. Which of the following is a semiconductor?
 (1) Fe_2O_3 (2) SiO_2 (3) GaAs (4) CuO
16. What is the order of the reverse saturation current before breakdown in a Zener diode?
 (1) ampere (2) milli-ampere
 (3) it depends on the applied voltage (4) micro-ampere
17. Which logic gate does the following truth table represent?
- | Input A | Input B | Output Q |
|---------|---------|----------|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |
- (1) NAND (2) AND (3) OR (4) NOR
18. What is the equivalent expression of the decimal number 212 in binary number system?
 (1) 11000100 (2) 10010100 (3) 11010100 (4) 11010110
19. Why do we need carrier wave of high frequency to transmit audio signal over long distances?
 (1) High frequency carrier wave can propagate with a faster speed
 (2) High frequency carrier waves offer availability of higher transmission bandwidth
 (3) High frequency carrier waves offer availability of lower transmission bandwidth
 (4) High frequency carrier waves is easy to produce
20. What does the Poynting vector represent?
 (1) power flowing across unit area in an electromagnetic field
 (2) charge flowing across unit area per unit time in an electromagnetic field
 (3) momentum flowing across unit area per unit time in an electromagnetic field
 (4) angular momentum flowing across unit area per unit time in an electromagnetic field
21. In television transmission what type of modulation is used?
 (1) Only amplitude modulation
 (2) Only frequency modulation
 (3) Both amplitude and frequency modulation
 (4) TV signal does not need any kind of modulation

22. Which of the following is true for any collision?
- (1) both linear momentum and kinetic energy are conserved
 - (2) neither linear momentum nor kinetic energy may be conserved
 - (3) linear momentum is always conserved, however, kinetic energy may or may not be conserved
 - (4) kinetic energy is always conserved, but linear momentum may or may not be conserved
23. A uniform rod of length L and mass M is held vertical, with its bottom end pivoted to the floor. The rod falls under gravity, freely turning about the pivot. If acceleration due to gravity is g , what is the instantaneous angular speed of the rod when it makes an angle 60° with the vertical?
- (1) $\left(\frac{g}{L}\right)^{1/2}$
 - (2) $\left(\frac{3g}{4L}\right)^{1/2}$
 - (3) $\left(\frac{3\sqrt{3}g}{2L}\right)^{1/2}$
 - (4) $\left(\frac{3g}{2L}\right)^{1/2}$
24. A cheetah, weighing 150 kg, chases a deer, weighing 30 kg, in a straight path. The speed of the cheetah is 20 m/s and that of the deer is 25 m/s. The approximate speed of the centre of mass of the pair is :
- (1) 21 m/s
 - (2) 24 m/s
 - (3) 26 m/s
 - (4) zero
25. A tennis racket can be idealized as a uniform ring of mass M and radius R , attached to a uniform rod also of mass M and length L . The rod and the ring are coplanar, and the line of the rod passes through the centre of the ring. The moment of inertia of the object (racket) about an axis through the centre of the ring and perpendicular to its plane is :
- (1) $\frac{1}{12}M(6R^2 + L^2)$
 - (2) $\frac{1}{12}M(18R^2 + L^2)$
 - (3) $\frac{1}{3}M(6R^2 + L^2 + 3LR)$
 - (4) None of these
26. How long will a satellite, placed in a circular orbit of radius that is $1/4^{\text{th}}$ the radius of a geostationary satellite, take to complete one revolution around the earth?
- (1) 12 hours
 - (2) 6 hours
 - (3) 3 hours
 - (4) 4 days
27. A rocket is fired from inside a deep mine, so as to escape the earth's gravitational field. The minimum velocity to be imparted to the rocket is :
- (1) exactly the same as the escape velocity of fire from the earth's surface
 - (2) a little more than the escape velocity of fire from the earth's surface
 - (3) a little less than the escape velocity of fire from the earth's surface
 - (4) infinity

28. Which of the following is the correct Kirchhoff's Loop rule?
 (1) The algebraic sum of the currents meeting at a junction is zero
 (2) The algebraic sum of potential drops across all resistors in a circuit is zero
 (3) The algebraic sum of the currents across all the resistors in a circuit is zero
 (4) The algebraic sum of potential drops across all resistors plus those across sources in a circuit is zero
29. What are the dimensions of electrical conductivity? (I is current).
 (1) $ML^{-3}T^3I^2$ (2) $M^{-1}L^3T^3I^2$ (3) $M^{-1}L^{-3}T^3I^2$ (4) $M^{-1}L^{-3}T^3I$
30. A coil has resistance 25.00 Ohm and 25.17 Ohm at 20° C and 35° C respectively. What is the temperature coefficient of resistance?
 (1) $4.545 \times 10^{-4} / ^\circ\text{C}$ (2) $4.545 \times 10^{-3} / ^\circ\text{C}$
 (3) $4.545 \times 10^{-2} / ^\circ\text{C}$ (4) $4.545 \times 10^{-5} / ^\circ\text{C}$
31. An electron and a proton, both having the same kinetic energy, enter a region of uniform magnetic field, in a plane perpendicular to the field. If their masses are denoted by m_e and m_p respectively, then the ratio of the radii (electron to proton) of their circular orbits is :
 (1) $\sqrt{m_p/m_e}$ (2) $\sqrt{m_e/m_p}$ (3) m_e/m_p (4) 1
32. In using Ampere's law to find the magnetic field of a straight, long solenoid, the loop (Amperian loop) that is taken is :
 (1) a circular loop, coaxial with the solenoid
 (2) a rectangular loop in a plane perpendicular to the axis of the solenoid
 (3) a rectangular loop in a plane containing the axis of the solenoid, the loop being totally within the solenoid
 (4) a rectangular loop in a plane containing the axis of the solenoid, the loop being partly inside the solenoid, and partly outside it
33. A rectangular coil, of sides 2 cm and 3 cm respectively, has 10 turns in it. It carries a current of 1 A, and is placed in a uniform magnetic field of 0.2 T in such a manner that its plane makes an angle 60° with the field direction. The torque on the loop is :
 (1) 6.0×10^{-4} N-m (2) 6.0×10^{-5} N-m
 (3) 1.2×10^{-3} N-m (4) 6.0 N-m

34. Which of the following facts about the photoelectric effect can be understood without invoking the quantum concept of light propagation?
- (1) the rate of photoelectrons emission, when they are emitted, increases with the intensity of light used
 - (2) there is a threshold frequency, below which no photoelectrons are emitted, no matter how long the light is thrown on the metallic surface
 - (3) once the frequency of light is more than the threshold frequency, photoelectrons are emitted almost instantaneously, no matter how weak the light intensity is
 - (4) for each frequency of light, exceeding the threshold frequency, there is a maximum kinetic energy of the emitted electrons
35. Consider the four gases-hydrogen, oxygen, nitrogen and helium – at the same temperature. Arrange them in the increasing order of the de Broglie wavelengths of their molecules :
- (1) hydrogen, helium, nitrogen, oxygen
 - (2) oxygen, nitrogen, hydrogen, helium
 - (3) oxygen, nitrogen, helium, hydrogen
 - (4) nitrogen, oxygen, helium, hydrogen
36. The half-life of ^{60}Co is approximately 5.25 years. In a sample containing 1 gm of freshly prepared ^{60}Co , how much of the isotope will be left after 21 years?
- (1) 125 mg
 - (2) 62.5 mg
 - (3) nothing will be left
 - (4) 31.25 mg
37. Which of the following is true of the Balmer series of the hydrogen spectrum?
- (1) the entire series falls in the ultraviolet region
 - (2) the entire series falls in the infrared region
 - (3) the series is partly in the visible region and partly in the ultraviolet region
 - (4) the series is partly in the visible region and partly in the infrared region
38. In a nuclear fusion reaction, two nuclei, A & B , fuse to produce a nucleus C , releasing an amount of energy ΔE in the process. If the mass defects of the three nuclei are ΔM_A , ΔM_B & ΔM_C respectively, then which of the following relations holds? Here, c is the speed of light :
- (1) $\Delta M_A + \Delta M_B = \Delta M_C - \Delta E/c^2$
 - (2) $\Delta M_A + \Delta M_B = \Delta M_C + \Delta E/c^2$
 - (3) $\Delta M_A - \Delta M_B = \Delta M_C - \Delta E/c^2$
 - (4) $\Delta M_A - \Delta M_B = \Delta M_C + \Delta E/c^2$
39. Which of the following postulates of the Bohr model led to the quantization of energy of the hydrogen atom?
- (1) the electron goes around the nucleus in circular orbits
 - (2) the angular momentum of the electron can only be an integral multiple of $h/2\pi$
 - (3) the magnitude of the linear momentum of the electron is quantized
 - (4) quantization of energy is itself a postulate of the Bohr model

40. A certain vector in the xy plane has an x -component of 12 m and a y -component of 8 m. It is then rotated in the xy plane so that its x -component is halved. Then its new y -component is approximately :
- (1) 14 m (2) 13.11 m (3) 10 m (4) 2.0 m
41. A block is placed on a plane inclined at 12° to the horizontal. What is the maximum value of coefficient of static friction for which the block slides down the plane?
- (1) $\tan 12^\circ$ (2) $\cos 12^\circ$ (3) $\sin 12^\circ$ (4) None of these
42. A brick of mass m , tied to a rope, is being whirled in a vertical circle, with a uniform speed. The tension in the rope is :
- (1) the same throughout
 (2) largest when the brick is at the highest point of the circular path and smallest when it is at the lowest point
 (3) largest when the rope is horizontal and smallest when it is vertical
 (4) largest when the brick is at the lowest point and smallest when it is at the highest point
43. Two blocks, of mass 1 kg and 2 kg respectively, are connected by a spring and kept on a frictionless table. The blocks are pulled apart, so that the spring is stretched, and released from rest. At a certain instant of time, the block of mass 1 kg, is found to be moving at a speed 2 m/s. What must be the speed of the other block at this instant?
- (1) 1 m/s (2) 0.5 m/s (3) 4 m/s (4) 0.25 m/s
44. A coin of mass 10 g rolls along a horizontal table with a velocity of 6 cm/s. Its total kinetic energy is :
- (1) $9 \mu J$ (2) $18 \mu J$ (3) $27 \mu J$ (4) $36 \mu J$
45. A simple harmonic oscillator oscillates with an amplitude A . At what point of its motion, is the power delivered to it by the restoring force maximum?
- (1) when it is at a displacement $\pm A/\sqrt{2}$ from the equilibrium point and moving towards the equilibrium point
 (2) when it is at the maximum displacement
 (3) when it passes through the equilibrium point, either way
 (4) when it is at a displacement $\pm A/\sqrt{2}$ from the equilibrium point and moving away from the equilibrium point

46. There is a point charge q located at the centre of a cube. What is the electric flux of this point charge, through a face of the cube?
- (1) $\frac{q}{\epsilon_0}$ (2) $\frac{q}{6\epsilon_0}$
 (3) $\frac{q}{3\epsilon_0}$ (4) it will depend upon the size of the cube
47. A point dipole is located at the origin in some orientation. The electric field at the point (10 cm, 10 cm) on the x - y plane is measured to have a magnitude $1.0 \times 10^{-3} \text{ V/m}$. What will be the magnitude of the electric field at the point (20 cm, 20 cm)?
- (1) $5.0 \times 10^{-4} \text{ V/m}$
 (2) $2.5 \times 10^{-4} \text{ V/m}$
 (3) it will depend on the orientation of the dipole
 (4) $1.25 \times 10^{-4} \text{ V/m}$
48. Which of the following statements is false for a perfect conductor?
- (1) the surface of the conductor is an equipotential surface
 (2) the electric field just outside the surface of a conductor is perpendicular to the surface
 (3) the charge carried by a conductor is always uniformly distributed over the surface of the conductor
 (4) none of these
49. A parallel plate capacitor without any dielectric within its plates, has a capacitance C , and is connected to a battery of emf V . The battery is disconnected and the plates of the capacitor are pulled apart until the separation between the plates is doubled. What is the work done by the agent pulling the plates apart, in this process?
- (1) $\frac{1}{2}CV^2$ (2) $\frac{3}{2}CV^2$ (3) $-\frac{3}{2}CV^2$ (4) CV^2
50. Consider a copper wire of length L , cross-sectional area A . It has 'n' number of free electrons per unit volume. Which of the following is the correct expression of drift velocity of the electrons when the wire carries a steady current I ?
- (1) I/neL (2) I/n^2eL (3) I/neA (4) I/ne^2LA
51. A resistor has the following colour code, sequentially from the left :
 Black Brown Orange Red and Black.
 What is the resistance of the resistor?
- (1) 13 Ohm (2) 1300 Ohm (3) 130 Ohm (4) 13000 Ohm

52. Which of the following is false for interference of light?
- (1) coherence of the sources is an essential condition for interference
 - (2) the minima of the interference pattern need not be of zero intensity
 - (3) interference simply redistributes light energy, without destroying any of it
 - (4) the minima of the interference pattern must always be of zero intensity
53. Totally unpolarized light of intensity I_0 is incident normally on a polarizer, and the emerging light is made to pass through a second, parallel polarizer with its axis making an angle of 60° with that of the first. What is the intensity of light emerging out of the second polarizer?
- (1) Zero
 - (2) $I_0/8$
 - (3) $I_0/4$
 - (4) $I_0/16$
54. A concave mirror has a focal length of 5 cm. When an object is placed at a distance of 15 cm from the mirror, where is the image formed?
- (1) 10 cm in front of the mirror
 - (2) 7.5 cm behind the mirror
 - (3) 2.5 cm in front of the mirror
 - (4) 7.5 cm in front of the mirror
55. The power of a convex lens is 2 diopters. Its power is to be reduced to 1.5 diopters, by putting another lens in combination with it. Which of the following lenses will serve the purpose?
- (1) a concave lens of focal length 2 m
 - (2) a concave lens of focal lens 4 m
 - (3) a convex lens of focal lens 2 m
 - (4) a concave lens of focal length 1 m
56. Spherical wave fronts, emanating from a point source, strike a plane reflecting surface. What will happen to these wave fronts, immediately after reflection?
- (1) they will remain spherical with the same curvature, both in magnitude and sign
 - (2) they will become plane wave fronts
 - (3) they will remain spherical, with the same curvature, but sign of curvature reversed
 - (4) they will remain spherical, but with different curvature, both in magnitude and sign
57. Which of the following is true for the minimum angular separation of two stars, $\Delta\theta_{\min}$, that can be resolved by a telescope? In the following, aperture is the diameter of the objective :
- (1) it decreases with the increase in aperture of the telescope
 - (2) it is independent of the aperture of the telescope
 - (3) it increases linearly with the aperture of the telescope
 - (4) it increases quadratically with the aperture of the telescope

58. The flux density of mass is defined as the amount of mass crossing unit area per unit time. The dimension of this quantity is :

- (1) $ML^{-2}T^{-1}$ (2) ML^2T^{-1} (3) MLT^{-1} (4) $M^{-1}L^{-2}T$

59. A physical quantity z , depends upon two other physical quantities x and y , as follows.
 $z = \alpha x^2 y^{1/2}$ where, α is a constant.

In an experiment, the quantity x is determined by measuring z and y , and using the above expression. If the percentage of error in the measurement of z and y are 10% and 12% respectively, then the percentage of error in the determined value of x is :

- (1) 2%
(2) 8%
(3) 15%
(4) without the value of the constant α , the percentage of error cannot be calculated

60. If a particle moves with an acceleration, then which of the following can remain constant? :

- (1) both speed and velocity (2) neither speed nor velocity
(3) only the velocity (4) only the speed

61. A rubber ball is bounced on the floor of a room which has its ceiling at a height of 3.2 m from the floor. The ball hits the floor with a speed of 10 m/s, and rebounds vertically up. If all collisions simply reverse the velocity of the ball, without changing its speed, then how long does it take the ball for a round trip, from the moment it bounces from the floor to the moment it returns back to it? Acceleration due to gravity is 10 m/s² :

- (1) 4 s (2) 2 s (3) 0.8 s (4) 1.2 s

62. Two vectors \vec{a} & \vec{b} , add up to a vector \vec{c} . When vector \vec{a} is made 3 times as long and vector \vec{b} is doubled in length, without changing their directions, then it is found that vector \vec{c} is also doubled in length, without change in direction. Then which of the following is true?

- (1) all three vectors must be parallel
(2) \vec{b} & \vec{c} must be parallel to each other, but \vec{a} need not be parallel to \vec{b} & \vec{c}
(3) \vec{a} & \vec{b} must be perpendicular to each other
(4) it is impossible for three non-zero vectors \vec{a} , \vec{b} & \vec{c} to have the property stated above

63. Which of the following is not an assumption of the kinetic theory of gases?
- (1) the molecules travel in straight paths until they undergo collision with other molecules
 - (2) molecules of the gas are small hard spheres, occupying negligible volume compared with the total volume of the gas
 - (3) the molecules do not undergo any collisions at all
 - (4) the molecules undergo elastic collisions only
64. The equation describing the motion of a simple harmonic oscillator along the x axis is given as : $x = A \cos (\omega t + \phi)$. If at time $t = 0$, the oscillator is at $x = 0$ and moving in the negative x direction, then the phase angle ϕ is :
- (1) $\pi/2$
 - (2) $-\pi/2$
 - (3) π
 - (4) 0
65. At a displacement from the equilibrium position, that is one-half the amplitude of oscillation, what fraction of the total energy of the oscillator is kinetic energy?
- (1) $1/2$
 - (2) $1/4$
 - (3) $1/\sqrt{2}$
 - (4) $3/4$
66. Which of the following does not change as a wave moves from one medium to another?
- (1) wavelength
 - (2) wave velocity
 - (3) frequency
 - (4) none of these
67. An organ pipe is closed at one end and open at the other. What is the ratio of frequencies of the 3rd and 4th fundamental modes of vibration?
- (1) $3/4$
 - (2) $5/7$
 - (3) $3/5$
 - (4) $9/11$
68. The Doppler shift in the frequency received by a stationary receiver when the source is moving towards it, was measured to be Δv_{air} when both receiver and source are in air, and it was measured to be Δv_{water} when both are under water. Then :
- (1) $\Delta v_{\text{air}} > \Delta v_{\text{water}}$
 - (2) $\Delta v_{\text{air}} < \Delta v_{\text{water}}$
 - (3) $\Delta v_{\text{air}} = \Delta v_{\text{water}}$
 - (4) $\Delta v_{\text{water}} = 0, \Delta v_{\text{air}} > 0$
69. Which of the following is false for electric lines of force?
- (1) they always start from positive charges and terminate on negative charges
 - (2) they are always perpendicular to the surface of a charged conductor
 - (3) they always form closed loops
 - (4) they are parallel and equally spaced in a region of uniform electric field

Space For Rough Work

Space For Rough Work

SEAL