Question Booklet Series: **A** *Question Booklet Serial No.* 122209

CET (UG) – 2018

Important: *Please consult your Admit Card/Roll No. slip before filling your Roll Number on the Test Booklet and Answer Sheet.*

Roll No. ***(In Figure)*** ***(In Words)***

O.M.R. Answer Sheet Serial No.

Signature of Candidate: _____ *Signature of Invigilator:* _____

Subject: Physics

Time: 70 Minutes **Number of Questions: 60** **Maximum Marks: 120**

DO NOT OPEN THE SEAL ON THE BOOKLET UNTIL ASKED TO DO SO.

INSTRUCTIONS:

1. Write your Roll No. on the Questions Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Question Booklet Serial No. on the OMR Answer Sheet. Darken the corresponding bubbles with **Black Ball Point/Black Gel Pen**.
3. Do not make any identification mark on the Answer Sheet or Question Booklet.
4. Please check that this Question Booklet contains **60** Questions. In case of any discrepancy, inform the Assistant Superintendent within 10 minutes of the start of Test.
5. Each question has four alternative answer (A,B,C,D) of which only one is correct. For each question, darken only one bubble (A or B or C or D), whichever you think is the correct answer, on the Answer Sheet with **Black Ball Point/Black Gel Pen.**
6. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Booklet. No marks will be deducted in such cases.
7. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the question given in the Question Booklet.
8. **Negative marking will be adopted for evaluation i.e. 1/4th of the marks of the question will be deducted for each wrong answer. A wrong answer means incorrect answer or wrong filling of bubble.**
9. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
10. For rough work only the blank sheet at the end of the Question Booklet be used.
11. The Answer Sheet is designed for computer evaluation. Therefore, if you do not follow the instructions given on the Answer Sheet, it may make evaluation by the computer difficult. **Any resultant loss to the candidate on the above account, i.e. not following the instructions completely, shall be of the candidate only.**
12. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
13. In no case the Answer Sheet, the Question Booklet, or its part or any material copied/noted from this Booklet is to be taken out of the examination hall. Any candidate found doing so would be expelled from the examination.
14. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistant or found giving or receiving assistant or found using any other unfair means during the examination will be expelled from the examination by the Centre Superintendent/Observer whose decision shall be final.
15. **Tele-communication equipment such as Cellular phones, pager, wireless, scanner, camera or any electronic/digital gadget etc., is not permitted inside the examination hall. Use of calculators is not allowed.**
16. The candidates will not be allowed to leave the Examination Hall/Room before the expiry of the allotted time.

1. **The pitch of a screw gauge is 1 mm. What would be its least count if the number of circular divisions is 50?**
   A) 0.2 mm B) 0.05 mm C) 0.02 mm D) 0.5 mm

2. **The length of a simple pendulum is doubled. What would be the associated change in the time period?**
   A) It remains same B) It gets doubled
   C) It reduces by a factor of ~1.414 D) It increases by a factor of ~1.414

3. **Consider a physical expression; E = constant R^2 T^4 What would be the relative error in E (in percentage) if the relative errors in R and T are 5% and 2%, respectively?**
   A) 5 % B) 18 % C) 7 % D) 3.5 %

4. **A car, travelling at a moderate velocity of 10 m s^{-1}(=36 km/hr.), suddenly apply brakes and comes to a halt with a deceleration of 5 m s^{-2}. How much distance the car might have travelled during the deceleration?**
   A) 2 m B) 50 m C) 10 m D) 36 m

5. **The position (in meters) of a moving particle on a x-y plane is defined by an expression; $r(t) = 6\ t^2\ \hat{i} + 8\ t\ \hat{j}$. Here, t is the elapsed time (in seconds) during the motion, and $\hat{i}$, $\hat{j}$ are the unit vectors along x and y directions, respectively. What would be the acceleration experienced by the particle?**
   A) 12 m s^{-2} along x direction
   B) 8 m s^{-2} along y direction
   C) 7 m s^{-2} in x-y plane at an angle of 45°
   D) 0 m s^{-2} in any direction

6. **A projectile is launched at an angle with respect to ground. Find out the incorrect choice regarding the trajectory.**
   A) The maximum height is achieved when the angle is 45°
   B) The maximum range is achieved when the angle is 45°
   C) The trajectory is a parabola.
   D) The time of flight depends inversely on the acceleration due to gravity.

7. **The radius of a circular and leveled car race-track is increased 4 times. What would be the change in the maximum velocity achievable by a car? There is no change in the friction.**
   A) It increases by a factor of 4 B) It decreases by a factor of 1.414
   C) It reduces by a factor of 2 D) It increases by a factor of 2

8. **A 100 kg bike weight is equally supported by two identical spring-loaded shock absorbers that follow Hooke's law. What is the maximum compression experienced by the shock absorbers if the spring constant is 5000 N m^{-1}? Assume g ~10 m s^{-2} for this problem.**
   A) 0.2 m B) 0.1 m C) 0.01 m D) 0.5 m

9. **In an elastic one dimensional collision of a 1 kg ball moving at a velocity v with a 0.5 kg ball kept at rest. What would be the final velocity of the lighter ball?**

A) 4v/3 B) 1v/3 C) 1v/2 D) 2v

10. **What is the moment of inertia of a solid sphere of mass M and radius R along a line that is tangential to the surface of the sphere?**

A) $3\ MR^2/5$ B) $7\ MR^2/5$ C) $1\ MR^2/5$ D) $2\ MR^2/5$

11. **The acceleration due to gravity decreases whether we go above or below the surface of Earth at a given location. At what altitude above the surface its value would be the same as its value at a depth of 100 km? Ignore the density variations and Earth's rotation.**

A) 100 km B) 200 km C) 150 km D) 50 km

12. **Which of the following statement is incorrect regarding the orbital motion of a satellite around Earth?**

A) The kinetic energy of the system is always half of the potential energy
B) The total energy of the system is always negative
C) In an elliptical orbit, the satellite will acquire the lowest velocity near the distance of closest approach from Earth
D) The square of the time period is proportional to the cube of the semi-major axis

13. **What are the dimensions of the Gravitational constant?**

A) $M^{-2} L^3 T^{-2}$ B) $M^{-1} L^3 T^{-2}$ C) $M^{-1} L^2 T^{-2}$ D) $M^{-1} L^3 T^{-3}$

14. **A long metallic bar, supported at the two ends and loaded by a weight at its center, sags. The breadth and the depth of the bar are 5 cm and 10 cm, respectively. How much increase in the sag would take place if the bar is turned around so that the breadth and depth are interchanged?**

A) 4 times B) 2 times C) 8 times D) 2.5 times

15. **Consider electrons (e) and protons (p) of energy 1 keV, each. Assume their velocities to be v1 and v2, respectively. Determine the approximate value of $(v1/v2)^2$.**

A) 1/1836 B) 1/1842 C) 1836 D) 1482

16. **The Young's modulus of a certain type of steel wire (X) is 3 times that of an aluminum wire (Y). The two wires have identical thickness and lengths. An equal amount of weights is suspended from these two wires. What would happen?**

A) X will stretch 3 times more compared to Y
B) X will stretch 9 times more compared to Y
C) X will stretch 6 times less compared to Y
D) X will stretch 3 times less compared to Y

17. **A nuclear submarine experiences a pressure of 21 atm. in a sea. Estimate the approximate depth of the vessel. Assume the value of the density of sea water and g to be 1000 kg m^{-3} and 10 m s^{-2}, respectively, for this problem. (1 atm. ~10^5 Pa.)**

A) 200 m B) 20 m C) 19 m D) 2000 m

18. **Identify the incorrect statement regarding fluid dynamics.**

A) Pressure above a moving aircraft wing is more than the pressure on its lower side

B) In a streamline flow through a pipe, the velocity of the flow becomes maximum where the cross-sectional area is minimum

C) An external pressure when applied to a fluid is transmitted equally in all directions

D) A spinning ball with rough surface experiences either upward or downward force

19. **What should be done in terms of change in the flow rate of a running tap water in order to achieve the minimum condition for a laminar flow from an existing turbulent condition that is almost close to the unsteady state?**

A) Increase at least by a factor of 2 B) Increase at least by a factor of 2000

C) Decrease at least by a factor of 2 D) Decrease at least by a factor of 1.5

20. **Which of the following entity, for a specific size, would have the highest-pressure difference across its interior and exterior? The surface tension of water is ~3 times more than that of ethanol at 20° C.**

A) A water drop B) A water bubble

C) An air cavity in water D) An ethanol bubble

21. **The coefficient of linear expansion of brass is 1.5 times that of iron. What would be the closest value by which the coefficient of volume expansion of brass is higher than that of iron?**

A) 1.5 B) 3.0 C) 4.5 D) 6.0

22. **The minimum daily energy requirement of a human being in terms of food is ~8000 kJ. What would be the approximate increase in the temperature of 100 kg of water if identical amount of energy is provided? Assume the specific heat of water to be ~4000 J kg^{-1} K^{-1}.**

A) 200 K B) 2 K C) 20 K D) 320 K

23. **Concrete has a thermal conductivity approximately 8 times than that of wood. In order to achieve identical heat flow rates what should be the thickness of a block of wood in comparison to a slab of concrete of same cross-sectional area?**

A) 64 times B) 8 times C) 16 times D) 1/8 times

24. **Which of the following is the fastest mode of heat transfer?**

A) Conduction B) Convection

C) Radiation D) Conduction and radiation combined

25. **What is the total energy of a system of N harmonic oscillators that forms a three-dimensional array? The system has an equilibrium temperature T.**

A) 3 N k T B) N k T C) (3/2) N k T D) (1/2) N kT

26. **What would be the approximate value of the thermal energy at a room temperature (~300 K)?**

A) 0.25 eV B) 0.0025 eV C) 0.025 eV D) 2.5 eV

27. **Identify the incorrect statement regarding the Carnot engine.**

A) Heat can be absorbed from high temperature reservoir and dumped to surrounding at low temperature.

B) Heat can be absorbed from low temperature reservoir and dumped to surrounding at high temperature by doing work.

C) Any engine operating in the temperature range defined by Carnot cycle can have efficiency higher than the Carnot cycle efficiency.

D) The cycle does not have 100% efficiency.

28. **Oxygen (O_2) molecules have a value of 21 J mol^{-1} K^{-1} for the specific heat at constant volume. What is the approximate value of the specific heat at constant pressure assuming that the oxygen molecules do not have vibration mode?**

A) 29.4 J mol^{-1} K^{-1} B) 35.1 J mol^{-1} K^{-1}

C) 27.1 J mol^{-1} K^{-1} D) 45.2J mol^{-1} K^{-1}

29. **Which of the following statement is wrong regarding simple harmonic motion (SHM)?**

A) Damping in SHM is generally due to the restoring force dependence upon velocity

B) Acceleration maximizes at the extreme points of oscillations.

C) SHM can be represented as the projection of a uniform circular motion on a plane orthogonal to the circle.

D) The restoring force is directed away from the center of oscillation

30. **Consider a black-body radiator at an equilibrium temperature of 2900 K. Determine the approximate wavelength corresponding to the maximum intensity emission.**

A) 100 nanometer B) 10 nanometer

C) 1000 nanometer D) 290 nanometer

31. **Identify the region of the electromagnetic spectrum corresponding to photon energy of 1.8-3 eV.**

A) Visible B) Radio-wave C) X-ray D) Infrared

32. **A person has the least distance of distinct vision as 25 cm. Advise the power for his reading glasses.**

A) 2 D B) 1 D C) 0 D D) 4 D

33. Identify the wrong statement regarding the optical phenomena.

A) The secondary rainbow involves double internal reflection within rain-drops

B) The refraction is less in diamonds compared to crown glass when both are in water

C) A mirage is an optical illusion caused by refractive index changes due to air heating

D) Sunset is red due to preferentially more scattering of light in the blue region of electromagnetic spectrum

34. A ray of light enters from a rarer to a denser medium. What will happen?

A) The frequency will increase and wavelength will decrease

B) The velocity will decrease and the frequency will increase

C) The velocity will decrease and wavelength will decrease

D) The velocity will decrease with no changes in frequency and wavelength

35. A light beacon is emitting a 480 nanometers wavelength of light. How fast should the beacon move either towards or away from an observer so that the observer notices a 0.1 % increase in the wavelength? Express the result in the velocity of light, c.

A) Away with a velocity of 0.001 c B) Away with a velocity of 0.01 c

C) Towards with a velocity of 0.048 c D) Towards with a velocity of 0.48 c

36. Determine the approximate limit of angular resolution of a human eye at 500 nanometers light. Assume the average circular aperture size of human eye pupil to be 5 mm that exclusively determines the resolution.

A) 1.22×10^{-5} radians B) 0.61×10^{-4} radians

C) 0.50×10^{-5} radians D) 1.22×10^{-4} radians

37. Find out the incorrect statement regarding the Photoelectric effect.

A) The maximum kinetic energy of the photoelectrons depends upon the intensity of the incident light

B) Above the stopping potential, the intensity can control the photoelectric current.

C) The photoelectric emission does not occur below the cut-off frequency

D) The work function of the metal determines the energy threshold for the process.

38. Estimate the approximate value of $(\lambda_C/\lambda_p)^2$, where λ_C and λ_p are the de Broglie wavelengths of a Carbon (^{12}C) atom and proton, respectively, having the energies of 12 keV, each?

A) ~1 B) ~1/12 C) ~12 D) ~1/144

39. Where will you find the Pfund series of the Hydrogen atom in the Electromagnetic spectrum?

A) Ultraviolet B) Visible C) X-rays D) Infrared

40. How much approximate energy is required to ionize an electron from the third energy state (n = 3) of a Hydrogen atom?

A) 3.40 eV B) 1.51 eV C) 13.6 eV D) 4.53 eV

41. **Consider N number of radioactive nuclides of an element at an initial time. How many half-lives are needed to reduce the initial number to N/32 ?**

A) 5 B) 4 C) 3 D) 6

42. **Identify the isotope with the highest binding energy per nucleon among the following nuclides.**

A) ^{4}He B) ^{1}H C) ^{235}U D) ^{56}Fe

43. **Find out the incorrect statement regarding semiconductors.**

A) Pentavalent donor atoms in Si produce n-type semiconductors
B) Trivalent acceptor atoms in Ge produce p-type semiconductors
C) Intrinsic semiconductors at room temperature behave as perfect insulators
D) Diffusion of charges across a PN junction produces a depletion region

44. **The DC current amplifier factor of a CE transistor-based circuit is 100. Find out the value of the base current if the emitter current is 2.02 mA.**

A) 0.01 mA B) 0.10 mA C) 0.02 mA D) 0.05 mA

45. **The difference in the frequency of the side bands of a message signal is 30 kHz for a carrier frequency of 1 MHz. What is the frequency of the message signal of a 5 volts peak voltage?**

A) 15 kHz B) 3 kHz C) 45 kHz D) 75 kHz

46. **Two perfectly neutral balls, of mass 0.1 kg each, kept at a distance of 0.2 m, do not attract or repel by electrostatic force. Identify the exact reason.**

A) The distance between the balls is huge for the force to be effective
B) The masses of the balls are large in order to allow the interaction
C) The gravity weakens-out the electrostatic interaction
D) The accumulative force of interaction of the positive and negative charges between the two cancels out

47. **Consider an electric field due to a point charge particle. Now consider a one-rupee coin held perpendicular to the field lines, initially at a distance, r_1, and later on moved away to a distance, r_2, from the charge. What happens to the number of field lines through the coin during the movement?**

A) It remains same B) It reduces by $(r_2/r_1)^2$
C) It increases by $(r_2/r_1)^2$ D) It increases by $4\pi (r_2/r_1)^2$

48. **Which of the following statement in wrong regarding a parallel plate air-based capacitor?**

A) The capacitance increases by placing a dielectric between the plates
B) The capacitor blocks the direct current (DC)
C) The capacitor can induce polarization in air molecules
D) Alternate current (AC) of only high frequency can flow through the capacitor

49. How will you avoid an electric disturbance, in the form of an electric field, that is created at some distance away from you?

A) Enclose yourself within a cavity inside a conductor
B) Enclose the disturbance within a cavity inside a conductor
C) Enclose yourself within a shell made up of some dielectric material
D) Enclose the disturbance inside a vacuum vessel

50. Assume that the resistivity of Tungsten (W) is almost twice that of Aluminum (Al) at 0^0 C. What should be the approximate value of, r_W/r_{Al}, if we want to achieve an identical value of the resistances in two wires made from these metals that have equal lengths? Here, r_W and r_{Al} are the radii of the two wires.

A) 0.707 B) 2 C) 1.414 D) 4

51. Identify the lowest velocity among the following in context to a conductor kept at room temperature through which a current is flowing?

A) The electric field propagation velocity associated with the current
B) The drift velocity of the free charge carriers
C) The velocity associated with the thermal oscillation of conductor atoms
D) The velocity of light in vacuum

52. Four isotopes, $^{28}Si^+$, $^{56}Fe^+$, $^{235}U^+$ and $^{238}U^+$, having equal energies and identical unit positive charge, are introduced in a plane perpendicular to a uniform magnetic field? Which isotope will receive the maximum bending from its initial trajectory?

A) $^{28}Si^+$ B) $^{56}Fe^+$ C) $^{235}U^+$ D) $^{238}U^+$

53. Identify the wrong statement regarding the magnetic field produced by a solenoid with, N, as the number of turns per unit length and a DC current, I, flowing through its wire.

A) The field is almost uniform inside except in the outer regions near the edge
B) The field gets enhanced linearly with the increase in either N or I
C) An introduction of an iron core enhances the magnetic field
D) The magnetic field lines diverge far away from the solenoid

54. A moving coil galvanometer can be converted into an ammeter by appropriately adding

A) A low value resistance in series B) A high value resistance in series
C) A low value resistance in parallel D) A high value resistance in parallel

55. The magnetic susceptibility of three materials at room temperature (in SI units) is, -5.06×10^{-9}, 2.3×10^{-5} and 600. Identify, in the sequential manner, the magnetic property of the materials among the types; Ferromagnetic (F), Diamagnetic (D), Paramagnetic (P).

A) D, P, F B) P, F, D C) D, F, P D) F, P, D

56. Identify the SI units of Henry.

A) $kg\,m\,s^{-2}\,A^{-2}$ B) $kg\,m^2\,s^{-1}\,A^{-2}$ C) $kg\,m\,s^{-2}\,A^{-1}$ D) $kg\,m^2\,s^{-2}\,A^{-2}$

57. Consider an LCR circuit, with 100 ohms, 2 mH and 10 nF values of the resistance, inductor and capacitor, respectively. Determine the current amplitude flowing through the circuit when a 100 volts amplitude signal is applied to the circuit in resonance.

A) 0.7 A B) 1 A C) 1.4 A D) 0.5 A

58. Identify the wrong statement in context to a general transformer.

A) The core provides a magnetic medium to enhance the concentration of magnetic field lines

B) The hysteresis losses are usually unavoidable

C) A step-down transformer has more number of turns in the secondary coil compared to the primary coil

D) The core is laminated in order to avoid heat losses due to eddy current

59. Identify the Maxwell's equation that explicitly involves the displacement current.

A) Faraday's law B) Ampere's law

C) Gauss law governing electrostatics D) Gauss law for magnetism

60. The wavelength of the microwaves in a microwave oven is ~12 cm. Assume that the water polar molecules make a complete rotation about their axis during one complete cycle of the wave in response to its varying electric field. Estimate the approximate time taken for the rotation.

A) 4×10^{-11} s B) 4×10^{-9} s C) 4×10^{-8} s D) 4×10^{-10} s

x-x-x