

Booklet Series Code : A

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

Roll No.

In Figures

In Words

--	--	--	--	--	--

O.M.R. Answer Sheet Serial No.

--	--	--	--	--	--

Signature of the Candidate : _____

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 Question Booklet and also on the OMR Answer Sheet in the space provided and nowhere else.
2. Enter the Subject and Series Code of Question Booklet 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. To open the Question Booklet remove the staple(s) gently when asked to do so.
5. 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.
6. Each question has four alternative answers (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**.
7. If you do not want to answer a question, leave all the bubbles corresponding to that question blank in the Answer Sheet. No marks will be deducted in such cases.
8. Darken the bubbles in the OMR Answer Sheet according to the Serial No. of the questions given in the Question Booklet.
9. 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.
10. For calculations, use of simple log tables is permitted. Borrowing of log tables and any other material is not allowed.
11. For rough work only the sheets marked "Rough Work" at the end of the Question Booklet be used.
12. 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.**
13. After the test, hand over the Question Booklet and the Answer Sheet to the Assistant Superintendent on duty.
14. 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.
15. A candidate who creates disturbance of any kind or changes his/her seat or is found in possession of any paper possibly of any assistance or found giving or receiving assistance 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.
16. **Telecommunication equipment such as pager, cellular phone, wireless, scanner, etc., is not permitted inside the examination hall. Use of calculators is not allowed.**

Fundamental Constants

Charge of electron, $-e = -1.6 \times 10^{-19} \text{C}$

Planck constant, $h = 6.63 \times 10^{-34} \text{Js}$

Speed of light, $c = 3.0 \times 10^8 \text{m/s}$

$$\frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9 \text{Nm}^2\text{C}^{-2}$$

- Time period of oscillation, T , of an object is related to density of the medium ' d ', static pressure ' P ' and energy ' E ' via relation $T = P^a d^b E^c$. The value of ' c ' is :
 (A) $1/3$ (B) $-5/6$
 (C) $1/2$ (D) 0
- The number of bacteria grows exponentially with a doubling time of one minute. One bacterium is put in a bottle at 10.00 A.M. and the growth continues steadily until the bottle become full at 11.00 A.M. When does the bottle become half full ?
 (A) 10.02 A.M. (B) 10.30 A.M.
 (C) 10.24 A.M. (D) 10.59 A.M.
- Young's Modulus of a material is $29 \times 10^{10} \text{N/m}^2$. What is its value in CGS units ? (Dyne is the CGS unit of Force) :
 (A) $29 \times 10^{10} \text{Dyne/cm}^2$ (B) $29 \times 10^{11} \text{Dyne/cm}^2$
 (C) $29 \times 10^{12} \text{Dyne/cm}^2$ (D) $29 \times 10^9 \text{Dyne/cm}^2$
- A particle hanging from a spring stretches it by 1 cm at Earth's surface. How much will the same particle stretch the spring at a place 800 km above the Earth's surface ? Radius of Earth = 6400 km :
 (A) 5.12 cm (B) 0.79 cm
 (C) 0.125 cm (D) 8 cm
- The acceleration of a particle, starting from rest, varies with time according to the relation $a = -B\omega^2 \sin \omega t$. The displacement of the particle at time t will be :
 (A) $B \sin \omega t$ (B) $B \omega \cos \omega t$
 (C) $B \omega \sin \omega t$ (D) $B(\omega^2 \sin \omega t) t^2$

6. The moment of Inertia of a solid cylinder of Mass 'M', length ' ℓ ' and radius 'R' rotating along its geometrical axis is :
- (A) $MR^2/2$ (B) $M(R^2/2 + \ell^2/12)$
 (C) $M(R^2/4 + \ell^2/12)$ (D) MR^2
7. A uniform sphere of mass 'M' rolls without slipping on a plane surface, so that its centre moves at a speed 'v'. The kinetic energy of the body is :
- (A) Mv^2 (B) $(7/10)Mv^2$
 (C) $(3/5)Mv^2$ (D) $(1/2)Mv^2$
8. Two particles of equal mass go around a circle of radius R under the action of their mutual gravitational attraction. The speed 'v' of each particle is :
- (A) $(GM/4R)^{1/2}$ (B) $(GM/R)^{1/2}$
 (C) $(GM/2R)^{1/2}$ (D) Zero
9. A ball is thrown from a field with a speed of U at an angle θ with the horizontal. Neglect air resistance. The relation between time of flight (t_f) and time taken for the ball to reach maximum height (t_m) is :
- (A) $t_f < t_m$ (B) $t_f = t_m$
 (C) $t_f = 2t_m$ (D) $t_f > t_m$
10. The value of 'p' for which the vectors $2\hat{i} - \hat{j} + \hat{k}$, $3\hat{i} + p\hat{j} + 5\hat{k}$ (\hat{i} , \hat{j} , \hat{k} are unit vectors) are coplanar is :
- (A) 0 (B) -4
 (C) 4 (D) 1
11. A force, $2 + 3x + 4x^2$ acts on a particle moving along x-direction at an angle of $\cos^{-1}x$. The work done by this force for the movement of the particle from $x = 1$ to $x = 2$ is :
- (A) 0 (B) 5
 (C) 20 (D) 25

12. A spring loaded toy of mass 0.6 kg sits at rest on a frictionless horizontal surface. When spring releases, the toy breaks into 3 equal piece masses A, B and C which slide along the surface. The piece A moves along negative x-direction at 3 m/s and piece B moves along negative y-direction at 4 m/s. What is the speed of piece C ?
- (A) 7 m/s (B) 1 m/s
(C) 5 m/s (D) 12 m/s
13. If a force \vec{F} is applied on a particle and the particle moves with velocity \vec{v} then power will be :
- (A) Fv (B) F/v
(C) v/F (D) Fv^2
14. If radius of earth shrinks by 1% and its mass remains the same, the value of g on shrunken earth's surface will :
- (A) Increase by 2% (B) Increase by 1%
(C) Decrease by 1% (D) Decrease by 2%
15. We know that the value of acceleration due to gravity 'g' decreases with height ($h \ll R$) above the earth's surface and also with depth 'd' below the surface of earth. Consider the earth to be of uniform density of radius R. The relation between h and d where (Δg), then the reduction in the value of gravity, becomes same is :
- (A) $d = 2h$ (B) $d = h$
(C) $h = 2d$ (D) $h = d^2$
16. Which of the following statements is wrong for the bulk property of matter ?
- (A) Copper is more elastic than rubber
(B) The Young's modulus of a perfect rigid body is infinite
(C) The maximum load that can be supported by a wire gets doubled by doubling its radius
(D) The lower bulk modulus of the gases makes them more compressible than liquids
17. Determine the approximate force exerted on the hatch of a submarine that is operational at a depth of 100 m in sea. A sea level atmospheric pressure is maintained in the crew compartment. The hatch has an area of 1 m^2 . Assume the density of water to be 10^3 kg/m^3 :
- (A) $8.8 \times 10^5 \text{ N}$ (B) $9.8 \times 10^5 \text{ N}$
(C) $5.4 \times 10^5 \text{ N}$ (D) None of the above

18. Find the minimum average velocity of water flow through a pipe of diameter 1 cm so that the flow is definitely turbulent. The viscosity and density of water can be taken as 10^{-3} N s/m^2 and 10^3 kg/m^3 , respectively :
- (A) 0.3 m/s (B) 0.2 m/s
(C) 0.25 m/s (D) None of the above
19. Identify the statement that does not describe the general nature of the surface tension of a liquid :
- (A) Surface tension never acts within the liquid interiors
(B) The magnitude of the surface tension is equal to the surface energy
(C) The angle of contact between the liquid and solid inside a capillary depends upon the radius of capillary
(D) Liquid bubble has twice the excess pressure compared to liquid drop
20. A 100 kg iron slab at 700°C in an industry accidentally comes in contact with 25 kg water at 100°C . Estimate the approximate amount of steam that will be produced. The specific heat of iron is $0.11 \text{ cal/g } ^\circ\text{C}$ and the latent heat of vaporization of water is 540 cal/g :
- (A) 15.6 kg (B) 18.8 kg
(C) 12.2 kg (D) 25.0 kg
21. Identify the statement that is incorrect regarding the nature of a perfect blackbody radiator :
- (A) The body is capable of absorbing or emitting radiation at any wavelength
(B) An increase in temperature results in higher emissions at lower wavelength
(C) The body at high temperature cumulatively emits more radiation at higher wavelength compared to a body at low temperature
(D) The perfect condition for the blackbody emission does not hold at low temperatures.
22. Find the total power produced in terms of radiation by a forest fire with a temperature of 727°C , and spread over an area of 100 square meters :
- (A) $1.58 \times 10^5 \text{ W}$ (B) $5.67 \times 10^6 \text{ W}$
(C) $5.67 \times 10^4 \text{ W}$ (D) $1.58 \times 10^6 \text{ W}$
23. Estimate the amount of work done by an isothermal expansion of an ideal gas at a temperature T , from a state of initial pressure P_1 to final pressure P_2 :
- (A) $nRT \ell n(P_1/P_2)$ (B) $nRT \ell n(P_2/P_1)$
(C) $nRT (P_2/P_1)$ (D) Zero

24. Estimate the approximate percentage efficiency of a Carnot engine that doubles its volume during an adiabatic expansion. C_p can be taken as 1.5 times the value of C_v for the mixture of gas within the engine :
- (A) 49 % (B) 39 %
(C) 69 % (D) 29 %
25. Which of the following statements is thermodynamically wrong ?
- (A) Difference of C_p and C_v represents the work done in the expansion of gas
(B) For a fixed amount of volume change and initiating from identical P, the work done by isothermal expansion is less than the adiabatic expansion
(C) Heat can be added to a system without increasing its temperature
(D) An isochoric process raises only the internal energy of a system
26. The rms velocity of gas molecules in a container can be doubled by :
- (A) Lowering the density by a factor of 2 at constant pressure
(B) Raising the pressure by a factor of 4 at constant density
(C) Raising alone the temperature by a factor of 2
(D) Removing half of the gas from the cylinder
27. Which of the following will closely describe the nature of gas with a value of $C_v \sim 6 \text{ cal/mol}^\circ\text{C}$?
- (A) An ideal monoatomic gas
(B) An ideal diatomic gas
(C) An ideal polyatomic gas
(D) A mixture of ideal monoatomic gas with an ideal diatomic gas with rigid rotator
28. The gas molecules inside a container are colliding at a rate of one billion times a second. How can the collision rate be increased ?
- (A) Leaking a substantial fraction of gas from the container
(B) Increasing the volume of the container
(C) Reducing the temperature at constant pressure
(D) None of the above
29. Which of the following statements does not correctly describe the nature regarding simple pendulum, and Simple Harmonic Motion (SHM), in general ?
- (A) The particles executing SHM acquire maximum velocity at mean position
(B) The acceleration is directly proportional to displacement and is always directed away from the fixed position
(C) The simple pendulum condition is satisfied only for small angular separations of the bob from its mean position
(D) Doubling the length of a simple pendulum increases its time period by approximately 41.4 %

30. Consider the superposition of two harmonic waves.

$$y_1 = A \sin(kx - \omega t) \text{ and } y_2 = A \sin(kx - \omega t + \phi)$$

Which of the following statements will not hold for the resultant wave ?

- (A) $I_{\max} = 4 I_0$ is the intensity of the constituent wave
(B) $I_{\min} = 0$
(C) The phase angle of the resultant wave is $\pi/4$ if $\phi = \pi/4$
(D) The maximum amplitude of the resultant is twice the amplitude of the single wave

31. A gold foil weighing 60 mg/cm^2 is placed on a horizontal charged plate. What would be the density of charge so that the foil may just rise ?

- (A) $1.20 \times 10^{-6} \text{ C/m}^2$ (B) $1.02 \times 10^{-6} \text{ C/m}^2$
(C) $2.02 \times 10^{-6} \text{ C/m}^2$ (D) $2.20 \times 10^{-6} \text{ C/m}^2$

32. A solid sphere of radius R has a charge Q distributed in its volume with charge density $\rho = k r^a$ where k and a are constants and r is the distance from its center. If the electric field at $r = R/2$ is $1/16$ times that at $r = R$, find value of a .

- (A) 2 (B) 1
(C) 3 (D) 4

33. The Electric field at a point is :

- (A) Always continuous
(B) Continuous if there are no charge at that point
(C) Discontinuous only if there is a negative charge at that point
(D) Continuous if there is a charge at that point

34. Two resistors 400Ω and 800Ω are connected in series with a 6 V battery. What will be the reading in the ammeter of 10Ω resistance ?

- (A) $2.48 \times 10^{-3} \text{ A}$ (B) $3.48 \times 10^{-3} \text{ A}$
(C) $2.96 \times 10^{-3} \text{ A}$ (D) $4.96 \times 10^{-3} \text{ A}$

35. A potentiometer wire of length 1 m has a resistance of 100Ω . It is connected in series with a resistance and a battery of emf 2 V and of negligible resistance. A source of emf 10 mV is balanced against a length of 40 cm of the potentiometer wire. What is the value of external resistance ?

- (A) 790Ω (B) 1580Ω
(C) 690Ω (D) 1280Ω

36. The maximum power drawn out of the cell from a source is given by :

- (A) $\epsilon^2/2r$ (B) $\epsilon^2/4r$
(C) ϵ^2/r (D) $\epsilon^2/3r$

37. A closed circuit is in the form of a regular hexagon of a side a . If the circuit carries a current I , what is magnetic induction at the centre of the hexagon ?
- (A) $\mu_0 I / \pi a$ (B) $\sqrt{2} \mu_0 I / \pi a$
 (C) Zero (D) $\sqrt{3} \mu_0 I / \pi a$
38. A beam of protons with a velocity of 4×10^5 m/s enters a magnetic field of 0.3T at an angle of 60° to the magnetic field. Find the radius of the helical path taken by the proton beam :
- (A) 1.2 cm (B) 2.1 cm
 (C) 2.4 cm (D) 4.2 cm
39. A paramagnetic sample shows a net magnetization of 8 A/m when placed in an external magnetic field of 0.6T at a temperature of 4 K. When the same sample is placed in an external field of 0.2T at a temperature of 16 K, the magnetization will be :
- (A) $\frac{32}{3}$ A/m (B) $\frac{2}{3}$ A/m
 (C) 6 A/m (D) 2.4 A/m
40. A capacitor of $1 \mu\text{F}$ is first charged and then discharged through a resistance of $1 \text{ M}\Omega$. Calculate the time in which the charge of the capacitor will fall to 36.8% of its final value :
- (A) 2 s (B) 1.5 s
 (C) 1 s (D) 0.5 s
41. The mutual inductance M_{12} of coil 1 with respect to coil 2 :
- (A) Increases when they are brought nearer
 (B) Depends on the current passing through the coil
 (C) Increases when one of them is rotated about an axis
 (D) Is the same as M_{21} of coil 2 w.r.t. coil 1
42. A variable frequency AC generator with $E_0 = 24 \text{ V}$ is connected across a $7.96 \times 10^{-9} \text{ F}$ capacitor. At what frequency should the generator be operated to provide a maximum current of 6 A ?
- (A) 2.5 MHz (B) 5 MHz
 (C) 10 MHz (D) 15 MHz
43. An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity $\epsilon_r = 4$ then :
- (A) The wavelength and frequency both remain unchanged
 (B) The wavelength is doubled and frequency remains unchanged
 (C) The wavelength is doubled and frequency becomes half
 (D) The wavelength is half and frequency remains unchanged

44. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to :
- (A) The speed of light in vacuum
 (B) Reciprocal of speed of light in vacuum
 (C) The ratio of magnetic permeability to the electric susceptibility of vacuum
 (D) Unity
45. For a wave propagating in a medium, identify the property that is independent of the other :
- (A) Velocity
 (B) Wavelength
 (C) Frequency
 (D) All these depend on each other
46. The distance of normal vision is 25 cm. The spectacles of a person having least distance of distinct vision of 50 cm should be :
- (A) Convex with focal length 25 cm
 (B) Concave with focal length 25 cm
 (C) Convex with focal length 50 cm
 (D) Concave with focal length 50 cm
47. A fish is 2.00 m below the surface of a smooth lake with the index of refraction for water being 1.33. The angle above the horizontal at which it must look at to see the light from a small fire burning at the water's edge 100 m away is :
- (A) $90^\circ - \cos^{-1}(1/1.33)$
 (B) $90^\circ - \sin^{-1}(1/1.33)$
 (C) $\sin^{-1}(1/1.33) - \cos^{-1}(1/1.33)$
 (D) The fish will not be able to see the fire at any angle
48. The colour of sky as seen from the moon, where there is no atmosphere, is :
- (A) White
 (B) Blue
 (C) Black
 (D) Reddish
49. The geometrical shape of the wavefront of a light source in the form of a narrow slit is :
- (A) Plane
 (B) Parabolic
 (C) Spherical
 (D) Cylindrical

50. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case :
- (A) There shall be no interference fringes
 (B) There shall be alternate interference patterns of red and blue
 (C) There shall be an interference pattern for red mixing with one for blue
 (D) There shall be an interference pattern for red distinct from one for blue
51. We wish to use a glass plate with index of refraction 1.57 to polarise light in air. For the light reflected by the glass to be fully polarized, the angles of incidence and refraction will be, respectively :
- (A) $\tan^{-1}(1/1.57), 90^\circ - \tan^{-1}(1/1.57)$ (B) $90^\circ - \tan^{-1}(1/1.57), \tan^{-1}(1/1.57)$
 (C) $\tan^{-1}(1.57), 90^\circ - \tan^{-1}(1.57)$ (D) $90^\circ - \tan^{-1}(1.57), \tan^{-1}(1.57)$
52. Light from the sun arrives at the earth, an average of 1.5×10^{11} m away, at the rate of 1.4×10^3 W/m² of area perpendicular to the direction of the light. Assuming that sunlight is monochromatic with a frequency of 5×10^{14} Hz, the number of photons falling per second on each square meter of the earth's surface directly facing the sun is :
- (A) 8.4×10^6 photons/m² (B) 3.0×10^{18} photons/m²
 (C) 6.7×10^{20} photons/m² (D) 4.2×10^{21} photons/m²
53. The threshold wavelength for photoelectric emission in tungsten is 230 nm. In order for electrons with a maximum energy of 1.5 eV to be ejected, the wavelength of light used must be :
- (A) 110 nm (B) 180 nm
 (C) 276 nm (D) 326 nm
54. The distance of closest approach of 1.00 MeV protons incident on gold ($Z = 79$) nuclei will be :
- (A) 1.14×10^{-13} m (B) 6.28×10^{-13} m
 (C) 1.44×10^{-15} m (D) 8.99×10^{-15} m
55. The speed of an electron in the n^{th} orbit of a hydrogen atom according to the Bohr model is :
- (A) $e^2 n / 2\epsilon_0 h$ (B) $e^2 n^2 / 2\epsilon_0 h$
 (C) $e^2 / 2\epsilon_0 h n$ (D) $e^2 / 2\epsilon_0 h n^2$

56. The half-life of ^{24}Na is 15.0 hours. For 80 percent of a sample of this nuclide to decay, it will take (you may use : $\ln 2 = 0.693$, $\ln 8 = 2.079$, $\ln 10 = 2.303$)
- (A) 24.1 hours (B) 30.4 hours
(C) 34.8 hours (D) 43.8 hours
57. The alternating current gain of a transistor in common base arrangement is 0.98. Find the change in base current corresponding to a change of 5.0 MA in emitter current :
- (A) 1 mA (B) 5 mA
(C) 0.1 mA (D) 0.5 mA
58. For a transistor action, which of the following statements is correct ?
- (A) Collector current is equal to the sum of the base current and emitter current
(B) Input resistance depends on the current I_c in the transistor
(C) The emitter junction is reversed biased and collector junction is forward biased
(D) Both the emitter junction as well as collector junction is forward biased
59. The wavelength of electromagnetic waves employed for space communication lie in the range of :
- (A) 1 mm to 30 m (B) 1 mm to 300 m
(C) 1 mm to 3 Km (D) 1 mm to 30 Km
60. A TV tower has a height of 75 m. What is the maximum area upto which this TV communication can be possible ?
- (A) 6036 Km² (B) 3017 Km²
(C) 4528 Km² (D) 1509 Km²

Panjab University, Chandigarh
CET(UG)-2015

FINAL ANSWERS / KEY

Subject: PHYSICS

Booklet Series Code: A

1	2	3	4	5	6	7	8	9	10
A	D	B	B	A	A	B	A	C	B
11	12	13	14	15	16	17	18	19	20
D	C	B	A	A	C	A	A	C	C
21	22	23	24	25	26	27	28	29	30
D	B	A	D	B	B	C	C	B	C
31	32	33	34	35	36	37	38	39	40
B	C	B	D	A	B	D	A	B	C
41	42	43	44	45	46	47	48	49	50
A	B	B	B	C	C	B	C	D	A
51	52	53	54	55	56	57	58	59	60
C	D	B	A	C	C	C	B	D	B

Note: An 'X' in the key indicates that either the question is ambiguous or it has printing mistake. All candidates will be given credit for this question.