SUBJECT - PHYSICS

Time : 3 :00 Hrs. समय : 3 घंटे   **Max. Marks (अधिकतम अंक): 720**

READ THE INSTRUCTIONS CAREFULLY (कृपया इन निर्देशों को ध्यान से पढें)

Important Instructions:	महत्वपूर्ण निर्देश :
1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on **Side-1** and **Side-2** carefully with **blue/black** ball point pen only.	1. उत्तर पत्र इस परीक्षा पुस्तिका के अन्दर रखा है। जब आपको परीक्षा पुस्तिका खोलने को कहा जाए, तो उत्तर पत्र निकाल कर **पृष्ठ-1** एवं **पृष्ठ-2** पर केवल **नीले/काले** बॉल पॉइंट पेन से विवरण भरें।
2. The test is of **3 hours** duration and Test Booklet contains **180 questions.** Each question carries 4 marks. For each correct response, the candidate will get **4 marks**. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **720**.	2. परीक्षा की अवधि **3 घंटे** है एवं परीक्षा पुस्तिका में **180** प्रश्न हैं। प्रत्येक प्रश्न **4 अंक** का है। प्रत्येक सही उत्तर के लिए परीक्षार्थी को **4 अंक** दिए जाएंगे। प्रत्येक गलत उत्तर के लिए कुल योग में से **एक अंक** घटाया जाएगा। अधिकतम अंक **720** हैं।
3. Use **Blue/Black Ball Point Pen** only for writing particulars on this page/marking response.	3. इस पृष्ठ पर विवरण अंकित करने एवं उत्तर पत्र पर निशान लगाने के लिए **केवल नीले/काले बॉल पॉइंट पेन** का प्रयोग करें।
4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.	4. रफ कार्य इस परीक्षा पुस्तिका में निर्धारित स्थान पर ही करें।
5. **On completion of the test, the candidate must handover the Answer Sheet to the invigilator in the Room/Hall. The candidates are allowed to take away this Test Booklet with them.**	5. **परीक्षा सम्पन्न होने पर, परीक्षार्थी कक्ष/हॉल छोडने से पूर्व उत्तर पत्र कक्ष निरीक्षक को अवश्य सौंप दें। परीक्षार्थी अपने साथ प्रश्न पुस्तिका को ले जा सकते हैं।**
6. The CODE for this **Booklet is _____**. Make sure that the CODE printed on **Side-2** of the Answer Sheet is the same as that on this Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklets and the Answer Sheets.	6. इस पुस्तिका का संकेत है **_____.** यह सुनिश्चित कर लें कि इस पुस्तिका का संकेत, उत्तर पत्र के **पृष्ठ-2** पद छपे संकेत से मिलता है। अगर यह भिन्न हो, तो परीक्षार्थी दूसरी परीक्षा पुस्तिका और उत्तर पत्र लेने के लिए निरीक्षक को तुरन्त अवगत कराएं।
7. The Candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your roll no. anywhere else except in the specified space in the Test Booklet/Answer Sheet.	7. परीक्षार्थी सुनिश्चित करें कि इस उत्तर पत्र को मोड़ा न जाए एवं उस पर कोई अन्य निशान न लगाएं। परीक्षार्थी अपना अनुक्रमांक प्रश्न पुस्तिका/उत्तर पत्र में निर्धारित स्थान के अतिरिक्त अन्यत्र न लिखें।
8. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.	8. उत्तर पत्र पर किसी प्रकार के संशोधन हेतु व्हाइट फ़्लूइड के प्रयोग की अनुमति **नहीं** है।

In case of any ambiguity in translation of any question, English version shall be treated as final.

प्रश्नों के अनुवाद में किसी अस्पष्टता की स्थिति में, अंग्रेजी संस्करण को ही अन्तिम माना जायेगा।

Name of the Candidate (in Capital letters) : _____

Roll Number : in figures : ☐☐☐☐☐☐☐☐ in words : _____

Name of Examination Centre (in Capital letters) : _____

Candidate's Signature: _____ Invigilator's Signature: _____

91. Two blocks A and B of masses 3m and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B immediately after the string is cut, are respectively :
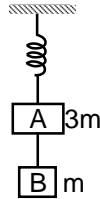
(1) $g, \dfrac{g}{3}$　　　　(2) $\dfrac{g}{3}, g$　　　　(3) g, g　　　　(4) $\dfrac{g}{3}, \dfrac{g}{3}$

Ans. **(2)**

92. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth d below the surface of earth. Then :

(1) $d = \dfrac{1}{2}$ km　　(2) d = 1km　　(3) $d = \dfrac{3}{2}$　　(4) d = 2km

Ans. **(4)**

93. A particle executes linear simple harmonic motion with an amplitude of 3 cm. When the particle is at 2 cm from the mean position, the magnitude of its velocity is equal to that of its acceleration. Then its time period in second is :

(1) $\dfrac{\sqrt{5}}{\pi}$　　　(2) $\dfrac{\sqrt{5}}{2\pi}$　　　(3) $\dfrac{4\pi}{\sqrt{5}}$　　　(4) $\dfrac{2\pi}{\sqrt{3}}$

Ans. **(3)**

94. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be

(1) nR　　　(2) $\dfrac{R}{n}$　　　(3) n^2R　　　(4) $\dfrac{R}{n^2}$

Ans. **(3)**

95. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system :
(1) increases by a factor of 4　　　　　(2) decreases by a factor 2
(3) remains the same　　　　　　　　(4) increases by a factor of 2

Ans. **(2)**

96. Two rods A and B of different materials are welded together as shown in figure. Their thermal conductivities are K_1 and K_2. The thermal conductivity of the composite rod will be
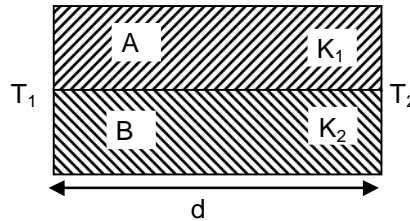
(1) $\dfrac{K_1+K_2}{2}$　　(2) $\dfrac{3(K_1+K_2)}{2}$　　(3) $K_1 +K_2$　　(4) $2(K_1 + K_2)$

Ans. **(1)**

97. The two nearest harmonics of a tube closed at one end and open at other end are 220 Hz and 260 Hz. What is the fundamental frequency of the system?

(1) 10 hz　　(2) 20 Hz　　(3) 30 Hz　　(4) 40 hz

Ans. **(2)**

98. The bulk modulus of a spherical object is'B'. If it is subjected to uniform pressure 'p', the fractional decrease in radius is :

(1) $\dfrac{p}{B}$　　(2) $\dfrac{B}{3p}$　　(3) $\dfrac{3p}{B}$　　(4) $\dfrac{p}{3B}$

Ans. **(4)**

99. A physical quantity of the dimensions of length that can be formed out of c, G and $\dfrac{e^2}{4\pi \in_0}$ is [c is velocity of light, G is universal constant of gravitation and e is charge] :

(1) $\dfrac{1}{c^2}\left[G\dfrac{e^2}{4\pi \in_0}\right]^{1/2}$　　(2) $c^2\left[G\dfrac{e^2}{4\pi \in_0}\right]^{1/2}$　　(3) $\dfrac{1}{c^2}\left[\dfrac{e^2}{G4\pi \in_0}\right]^{1/2}$　　(4) $\dfrac{1}{c}G\dfrac{e^2}{4\pi \in_0}$

Ans. **(1)**

100. Figure shows a circuit that contains three identical resistors with resistance R = 9.0 Ω each, two identical inductors with inductance L = 2.0 mH each and an ideal battery with emf ε = 18 V. The current 'i' through the battery just after the switch closed is.
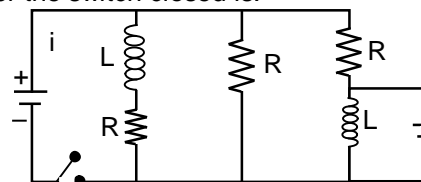
(1) 2 mA　　(2) 0.2 A　　(3) 2 A　　(4) 0 ampere

Ans. **Bonus**

101. One end of string of length ℓ is connected to a particle of mass 'm' and the other end is connected to a small peg on a smooth horizontal table. If the particle moves in circle with speed 'v' the net force on the particle (directed towards center) will be (T represents the tension in the string)

(1) T　　(2) $T + \dfrac{mv^2}{\ell}$　　(3) $T - \dfrac{mv^2}{\ell}$　　(4) zero

Ans. **(1)**

102. The photoelectric threshold wavelength of silver is 3250×10^{-10} m. The velocity of the electron ejected from a silver surface by ultraviolet light of wavelength 2536×10^{-10} m is :

(Given h = 4.14×10^{-15} eVs and c = 3×10^{8} ms^{-1})

(1) $\approx 6 \times 10^{5}$ ms^{-1} (2) $\approx 0.6 \times 10^{6}$ ms^{-1} (3) $\approx 61 \times 10^{3}$ ms^{-1} (4) $\approx 0.3 \times 10^{6}$ ms^{-1}

Ans. **(1, 2)**

103. Radioactive material 'A' has decay constant '8 λ' and material 'B' has decay constant 'λ'. Initially they have same number of nuclei. After what time, the ratio of number of nuclei of material 'B' to that 'A' will be $\dfrac{1}{e}$?

(1) $\dfrac{1}{\lambda}$ (2) $\dfrac{1}{7\lambda}$ (3) $\dfrac{1}{8\lambda}$ (4) $\dfrac{1}{9\lambda}$

Ans. **(2)**

104. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force of 30N?

(1) 25 m/s^2 (2) 0.25 rad/s^2 (3) 25 rad/s^2 (4) 5 m/s^2

Ans. **(3)**

105. Two cars moving in opposite directions approach each other with spped of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s] :

(1) 350 Hz   (2) 361 Hz   (3) 411 Hz   (4) 448 Hz

Ans. **(4)**

106. A 250 – Turn rectangular coil of length 2.1 cm and width 1.25 cm carries a current of 85 μA are subjected to a magnetic field of strength 0.85T. Work done for rotating the coil by 180º against the torque is :

(1) 9.1 μJ   (2) 4.55 μJ   (3) 2.3 μJ   (4) 1.15 μJ

Ans. **(1)**

107. A long solenoid of diameter 0.1 m has 2×10^{4} turn per meter. At the centre of the solenoid, a coil of 100 turns and radius 0.01 m is placed with its axis coinciding with the solenoid axis. The current in the solenoid reduces at a constant rate to 0A from 4 A in 0.05 s. If the resistance of the coil is $10\pi^{2}\Omega$, the total charge flowing through the coil during this time is :

(1) 32 $\pi\mu$C   (2) 16 μC   (3) 32 μC   (4) 16 $\pi\mu$C

Ans. **(3)**

108. Suppose the charge of a proton and an electron differ slightly. One of them is – e, the other is (e + Δe). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27}$ kg]

(1) 10^{-20} C   (2) 10^{-23} C   (3) 10^{-37} C   (4) 10^{-47} C

Ans. **(3)**

109. Two astronauts are floating in gravitational free space after having lost contact with their spaceship. The two will :

(1) keep floating at the same distance between them

(2) move towards each other

(3) move away from each other

(4) will become stationary

Ans. **(2)**

110. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

(1) 2   (2) 1   (3) 4   (4) 0.5

Ans. **(3)**

111. The de-Broglie wavelength of a neutron in thermal equilibrium with heavy water at a temperature T (Kelvin) and mass m, is :

(1) $\dfrac{h}{\sqrt{mkT}}$ (2) $\dfrac{h}{\sqrt{3mkT}}$ (3) $\dfrac{2h}{\sqrt{3mkT}}$ (4) $\dfrac{2h}{\sqrt{mkT}}$
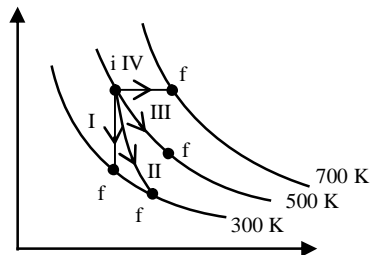
Ans. **(2)**

112. A thin prism having refracting angle 10^0 is made of glass of refractive index 1.42. This prism is combined with another thin prism of glass of refractive index 1.7. This combination produces dispersion without deviation. The refracting angle of second prism should be :

(1) 4^0 (2) 6^0 (3) 8^0 (4) 10^0

Ans. **(2)**

113. Thermodynaic processes are indicated in the following diagram:

Match the following :

	Column-I		Column-2
P	Process I	a.	Adiabatic
Q	Process II	b.	Isobaric
R	Process III	c.	Isochoric
S	Process IV	d.	Isothermal

(1) P → a, Q → c, R → d, S → b   (2) P → c, Q → a, R → d, S → b

(3) P → c, Q → d, R → b, S → a   (4) P → d, Q → b, R → a, S → c

Ans. **(2)**

114. A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is :
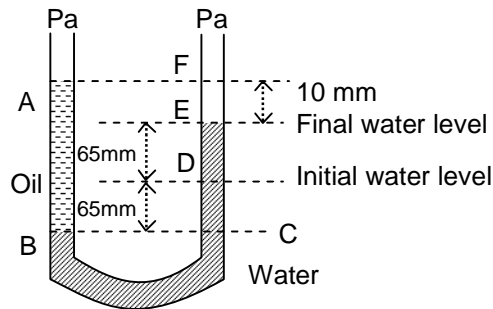
(1) 650 kg m^{-3} (2) 425 kg m^{-3} (3) 800 kg m^{-3} (4) 928 kg m^{-3}

Ans. **(4)**

115. A spring of force constant k is cut into lengths of ratio 1 : 2 : 3. They are connected in series and the new force constnt is k'. Then they are connected in parallel and force constant is k". Then k' : k" is :
(1) 1 : 6   (2) 1 : 9   (3) 1 : 11   (4) 1 : 14

Ans. **(3)**

116. Which of the following statements are **correct**?
(a) Centre of mass of a body always coincides with the centre of gravity of the body.
(b) Centre of mass of a body is the point at which the total gravitational torque on the body is zero.
(c) A couple on a body produce both translational and rotational motion in a body.
(d) Mechanical advantage greater that one means that small effort can be used to lift a large load.
(1) (b) and (d)   (2) (a) and (b)   (3) (b) and (c)   (4) (c) and (d)

Ans. **(1)**

117. A beam of light from a souce L is incident normally on a plane mirror fixed at a certain distance x from the source. The beam is reflected back as a spot on a scale placed just above the source L. When the mirror is rotated through a small angle θ, the spot of the light is found to move through a distance y on the scale. The angle θ is given by :

(1) $\dfrac{y}{2x}$ (2) $\dfrac{y}{x}$ (3) $\dfrac{x}{2y}$ (4) $\dfrac{x}{y}$

Ans. **(1)**

118. A gas mixture consists of 2 moles of O_2 and 4 moles of Ar at temperature T. Neglecting all vibrational modes, the total internal energy of the system is :
(1) 4 RT   (2) 15 RT   (3) 9 RT   (4) 11 RT

Ans. **(4)**

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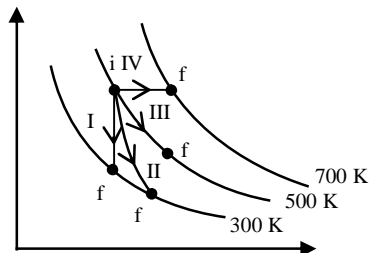
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R	Process III	c.	Isochoric
S	Process IV	d.	Isothermal

(1) P → a, Q → c, R → d, S → b   (2) P → c, Q → a, R → d, S → b

(3) P → c, Q → d, R → b, S → a   (4) P → d, Q → b, R → a, S → c

Ans. **(2)**

124. Preeti reached the metro station and found that the escalator was not working. She walked up the stationary escalator in time t_1. On other days, if she remains stationary on the moving escalator, then the escalator takes her up in time t_2. The time taken by her to walk up on the moving escalator will be :

(1) $\dfrac{t_1 + t_2}{2}$
(2) $\dfrac{t_1 t_2}{t_2 - t_1}$
(3) $\dfrac{t_1 t_2}{t_2 + t_1}$
(4) $t_1 - t_2$

Ans. **(3)**

125. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be :
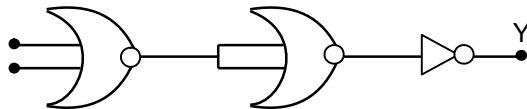
(1) 225   (2) 450   (3) 1000   (4) 1800

Ans. **(4)**

126. A potentiometer is an accurate and versatile device to meke electrical measurements of E.M.F. because the method involves :

(1) cells

(2) potential gradients

(3) a condition of no current flow through the galvanometer

(4) a combination of cells, galvanometer and resistance

Ans. **(3)**

127. The given electrical network is equivalent to

(1) AND gate   (2) OR gate   (3) NOR gate   (4) NOT gate

Ans. **(3)**

128. In a common emitter transistor amplifier the audio signal voltage across the collector is 3V. The resistance of collector is 3 kΩ. If current gain is 100 and the base resistance is 2kΩ, the voltage and power gain of the amplifier is :

(1) 200 and 1000   (2) 15 and 200   (3) 150 and 15000   (4) 20 and 2000

Ans **(3)**

129. Two discs of same moment of inertia rotating about their regular axis passing through centre and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought into contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is :

(1) $\dfrac{1}{2}(\omega_1 + \omega_2)^2$
(2) $\dfrac{1}{4}(\omega_1 - \omega_2)^2$
(3) $I\,(\omega_1 - \omega_2)^2$
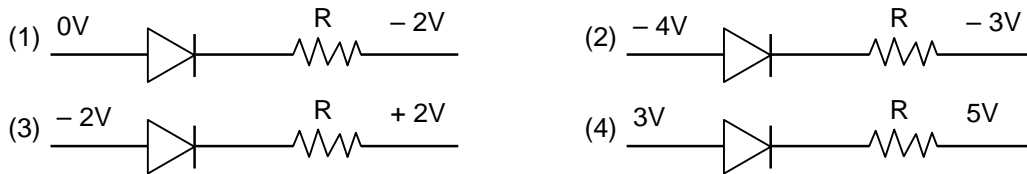(4) $\dfrac{1}{8}(\omega_1 - \omega_2)^2$

Ans. **(2)**

130. Young's double slit experiment is first performed in air and then in a medium other than air. It is found that 8th brigh fringe in the medium lies where 5th dark fringe lies in air. The refractive index of the medium is nearly :

(1) 1.25   (2) 1.59   (3) 1.69   (4) 1.78

Ans. **(4)**

131. Which one of the following represents forward bias diode?

(1) 0V ▷| —R—␣/\/\/— −2V   (2) −4V ▷| —R—␣/\/\/— −3V

(3) −2V ▷| —R—␣/\/\/— +2V   (4) 3V |◁ —R—␣/\/\/— 5V

Ans. **(1)**

132. Two polaroids P_1 and P_2 are placed with their axis perpendicular to each other. Unpolarised light I_0 is incident on P_1. A third Polaroid P_3 is kept in between P_1 and P_2 such that its axis makes an angle 45° with that of P_1. The intensity of transmitted light though P_2 is :

(1) $\dfrac{I_0}{2}$ (2) $\dfrac{I_0}{4}$ (3) $\dfrac{I_0}{8}$ (4) $\dfrac{I_0}{16}$

Ans. **(3)**

133. In an electromagnetic wave in free space the root mean square value of the electric field is $E_{rms} = 6V/m$. The peak value of the magnetic field is :

(1) 1.41×10^{-8} T   (2) 2.83×10^{-8} T   (3) 0.70×10^{-8} T   (4) 4.23×10^{-8} T
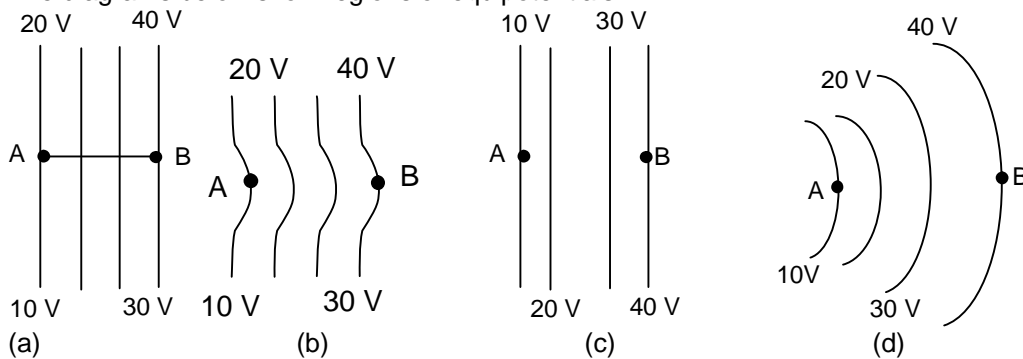
Ans. **(2)**

134. If θ_1 and θ_2 be the apparent angles of dip observed in two vertical planes at right angles to each other, then the true angle of dip θ is given by

(1) $\cot^2 \theta = \cot^2 \theta_1 + \cot^2 \theta_2$ (2) $\tan^2 \theta = \tan^2 \theta_1 + \tan^2 \theta_2$

(3) $\cot^2 \theta = \cot^2 \theta_1 - \cot^2 \theta_2$ (4) $\tan^2 \theta = \tan^2 \theta_1 - \tan^2 \theta_2$

Ans. **(1)**

135. The diagrams below show regions of equipotentials.

(a)   (b)   (c)   (d)

A positive charge is moved from A to B in each diagram

(1) Maximum work is required to move q in figure (c).

(2) In all the four cases the work done is the same.

(3) Minimum work is required to move q in figure (a)

(4) Maximum work is required to move q in figure (b).

Ans. **(2)**