2020

PHYSICS (Honours)

Paper Code : V - A & B

[New Syllabus]

Important Instructions for Multiple Choice Question (MCQ)

- Write Subject Name and Code, Registration number, Session and Roll number in the space provided on the Answer Script.

  Example : Such as for Paper III-A (MCQ) and III-B (Descriptive).

  Subject Code : | III | A | & | B |

  Subject Name : | |

- Candidates are required to attempt all questions (MCQ). Below each question, four alternatives are given [i.e. (A), (B), (C), (D)]. Only one of these alternatives is 'CORRECT' answer. The candidate has to write the Correct Alternative [i.e. (A)/(B)/(C)/(D)] against each Question No. in the Answer Script.

  Example — If alternative A of 1 is correct, then write :
  1. — A

- There is no negative marking for wrong answer.

মাল্টিপল চয়েস প্রশ্নের (MCQ) জন্য জরুরী নির্দেশাবলী

- উত্তরপত্রে নির্দেশিত স্থানে বিষয়ের (Subject) নাম এবং কোড, রেজিস্ট্রেশন নম্বর, সেশন এবং রোল নম্বর লিখতে হবে।

  উদাহরণ — যেমন Paper III-A (MCQ) এবং III-B (Descriptive)।

  Subject Code : | III | A | & | B |

  Subject Name : [ ]

- পরীক্ষার্থীদের সবগুলি প্রশ্নের (MCQ) উত্তর দিতে হবে। প্রতিটি প্রশ্নে চারটি করে সম্ভাব্য উত্তর, যথাক্রমে (A), (B), (C) এবং (D) করে দেওয়া আছে। পরীক্ষার্থীকে তার উত্তরের স্বপক্ষে (A) / (B) / (C) / (D) সঠিক বিকল্পটিকে প্রশ্ন নম্বর উল্লেখসহ উত্তরপত্রে লিখতে হবে।

  উদাহরণ — যদি 1 নম্বর প্রশ্নের সঠিক উত্তর **A** হয় তবে লিখতে হবে :

  1. — A

- ভুল উত্তরের জন্য কোন নেগেটিভ মার্কিং নেই।

Paper Code : V - A

Full Marks : 15 Time : Thirty Minutes

Answer *all* the Questions.
Choose the Correct Answer.
Each Question Carries 1.5 Marks.

1. The slopes of isothermal and adiabatic curves for an ideal gas are related as —

   (A) Isothermal slope = adiabatic slope

   (B) Isothermal slope = $\gamma \times$ adiabatic slope

   (C) adiabatic slope = $\gamma \times$ Isothermal slope

   (D) none of the above is true

2. The efficiency of a Carnot engine is 100%. The temperature of the sink must be —

   (A) 0 K

   (B) 273 K

   (C) 0°C

   (D) None of the above

3. Volume of a gas expands isothermally to 4 times its initial volume. The change in entropy in terms of gas constants R is —

   (A) $R \ln 2$

   (B) $R \ln 4$

   (C) $2R \ln 2$

   (D) Both (B) and (C)

4. The expression $\left(\frac{\partial P}{\partial V}\right)_T \left(\frac{\partial T}{\partial P}\right)_S \left(\frac{\partial S}{\partial T}\right)_P$ is equivalent to —

(A) $\left(\frac{\partial S}{\partial V}\right)_T$

(B) $\left(\frac{\partial P}{\partial T}\right)_V$

(C) $\left(\frac{\partial V}{\partial T}\right)_S$

(D) $-\left(\frac{\partial P}{\partial V}\right)_V$

5. The first law of thermodynamics is a restatement of the law of conservation of —

(A) Mass

(B) Momentum

(C) Energy

(D) None of the above

6. Magnetic flux has the dimensions —

(A) $[ML^2T^{-2}I^{-1}]$

(B) $[ML^2T^{-1}I^{-1}]$

(C) $[MLT^2I]$

(D) $[ML^2T^2]$

7. Lenz's law is a consequence of the law of conservation of —

(A) Charge

(B) Energy

(C) Momentum

(D) Mass

8. The differential form of Faraday's law of electromagnetic induction is —

(A) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

(B) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$

(C) $\vec{\nabla} \times \vec{B} = -\frac{\partial \vec{E}}{\partial t}$

(D) $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$

9. Time constant of a CR circuit is —

(A) $\frac{1}{CR}$

(B) $\frac{R}{C}$

(C) CR

(D) C/R

10. The average value of the sinusoidal voltage, $v = V_0 \sin wt$ over a complete cycle is —

(A) $\frac{2V_0}{\pi}$

(B) $\frac{V_0}{2}$

(C) $\frac{V_0}{\pi}$

(D) zero

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PHYSICS (Honours)

Paper Code : V - B

[New Syllabus]

Full Marks : 55 Time : Three Hours Thirty Minutes

The figures in the margin indicate full marks.

Answer *five* questions taking at least *one* from each group.

Group - A

[Thermodynamics]

1. (a) State and prove the Carnot's theorem. What is its significance?

   (b) Assuming the temperature to be a thermodynamic coordinate of the system, show how Kelvin derived a scale of temperature independent of the properties of the measuring system. Explain the relation between ideal gas scale and Kelvin scale of temperature. 5+6

2. Derive Maxwell's thermodynamic relations and hence prove the relation

$$C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P$$

Show that for a van dar Waals' gas $C_P - C_V = \dfrac{R\left(P + \dfrac{a}{V^2}\right)}{P - \dfrac{a}{V^2} + \dfrac{2ab}{V^3}}$. 5+2.5+3.5

3. (a) What is meant by 1st order phase transition? Establish the Clapeyron equation for system which can have first order phase transition.

   (b) Calculate the efficiency of Otto cycle. (2+4)+5

4. Explain the principle of cooling of a paramagnetic substance by adiabatic demagnetisation. Obtain an expression for the amount of cooling. What is the lowest temperature produced by this method? 4+5+2

Group - B

[Electricity - II]

5. (a) State and explain Biot-Savart law. Apply the law to find magnetic field due to a long straight current carrying conductor.

   (b) Self-inductances of two coils are L_1 and L_2, respectively and their mutual inductance is M. Show that in general $M^2 \leq L_1 L_2$. Define coefficient of coupling of two circuits. (3+4)+4

6. Describe the construction and working principle of a suspended coil ballistic galvanometer. Explain the meaning of critical damping. 9+2

7. (a) A dc source of voltage V is suddenly applied to a circuit consisting of a resistor R and an inductor L in series. Write down the instantaneous e-mf equation and hence, find the instantaneous current. Calculate the maximum energy stored in the inductor.

   (b) A sinusoidal voltage, $v = V_0 \cos \omega t$ is applied to series LCR circuit. Find an expression for instantaneous current in circuit. 6+5

8. (a) Draw the circuit diagram of Anderson Bridge. Find the conditions of balance for the bridge.

   (b) A thermocouple is comprised by two metals X and Y. Prove that

   $$\pi = T\frac{dE}{dT} \text{ and } \sigma_x - \sigma_y = -T\frac{d^2E}{dT^2}$$ 6+5
