

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
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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
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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, $v = V_0 \sin \omega t$ over a complete cycle is —

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

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

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

(D) zero

2020

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]

- (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

- 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 der Waals' gas $C_P - C_V = \frac{R \left(P + \frac{a}{V^2} \right)}{P - \frac{a}{V^2} + \frac{2ab}{V^3}}$. 5+2.5+3.5

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