

PARLIAMENT OF INDIA
(JOINT RECRUITMENT CELL)

MAIN EXAMINATION FOR POSTS OF EXECUTIVE/LEGISLATIVE/COMMITTEE/PROTOCOL OFFICER
AND RESEARCH/REFERENCE OFFICER IN LOK SABHA SECRETARIAT
6th JUNE, 2009
PHYSICS - PAPER- I

INSTRUCTIONS : Answers must be written in English only. Candidates should attempt at least 2 questions from each section and a total of 5 questions. The number of marks carried by each question is indicated against the same.

Time : 3 hours

Marks : 300

SECTION -A

- 1(a). Show that the laws of conservation of momentum and energy in a collision process are invariant under Galilean transformation. (30)
- (b) What is Coriolis forces. Derive an expression for Coriolis acceleration. (20)
- (c). Write down the Lagrangean for simple harmonic motion and set-up the Lagrange's equation of motion. (10)
- 2(a) Describe Michelson - Morley experiment and obtain an expression for fringe shift expected in this experiment. (30)
- (b). What do you understand by Minkowski space? State Lorentz transformation in four dimensional space representation (20)
- (c) What is Eulerian angles. Draw a neat diagram showing the fixed and rotated (x, y, z) system. Give the range of various angles. (10)

3(a) What is aberration? Discuss the various types of spherical aberration and explain how they can be minimized? (30)

(b) Explain the phenomenon of beats with the derivation of appropriate equations (20)

(c) State Fermat principle and use it to explain the laws of refraction. (10)

4a. Derive the following expression for the intensity of emerging light in Fabry-Perot interferometer.

$$I = \frac{T^2}{(1-R)^2} \times \frac{1}{1 + \frac{4R}{(1-R^2)} \sin^2 \delta/2} \quad (30)$$

where symbols T , R & δ have usual meanings.

(b) Discuss the formation of fringes in the reflection mode by a thin film. Derive necessary formula for it. (20)

(c) Discuss the characteristic features and method of construction of hologram (10)

5(a) What is Polarization of light? Discuss the production and analysis of circularly polarized light. (30)

(b) Discuss the construction and working of He-Ne laser. (20)

5(c) What is numerical aperture (NA) in an optical fibre. Derive an expression for it. (40).
SECTION-B

6(a). Discuss the Gauss theorem in electrostatics. Derive the Poisson's & Laplace equations. Use the concepts of Gauss theorem to find the intensity near a charged infinite cylindrical conductor. (30)

(b) What is the 'strength of a magnetic shell? Derive an expression for the potential at a point due to magnetic shell. (20)

(c). Discuss and draw the hysteresis loop in the case of ferroelectric material. What informations you gather from the loop? (10)

7(a). What are self and mutual inductances. Define them by two different ways. Derive an expression for coefficient of coupling (k) for two magnetically coupled coils

$$k = \frac{M}{\sqrt{L_1 L_2}} \quad (30)$$

(b). What do you understand by the resonance in LCR series circuit. Derive an expression for current and discuss the quality factor (20)

(c) What is the origin of eddy currents. How it is minimized in transformer (10)

- 8(a). What is adiabatic demagnetization? Derive necessary thermodynamic expressions to explain how very low temperature can be obtained. Describe the method. (30)
- (b). Derive expressions for r.m.s. and most probable velocities of gas molecules using Maxwell Boltzmann distribution law. (20)
- (c). What is entropy? Derive an expression for entropy change in the case of free expansion of gas. (10)
- 9(a) Derive expression for energy distribution in a black body according to Planck radiation law. How Wien's law and Rayleigh-Jeans law follow from it. (30)
- (b). Derive expressions for work done in the case of isothermal and adiabatic processes. (20)
- (c). Draw the P-V diagrams for Otto and Diesel engines. (10)
- 10(a). What is virial theorem? Derive the van der Waals equation of state of a real gas. (30)

10(b) Discuss the diffusion phenomenon. Derive expression for coefficient of diffusion and diffusion current density. (20)

10(c) Write short note on Bose-Einstein condensation. (10)

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6th JUNE, 2009

PHYSICS – PAPER- II

INSTRUCTIONS : Answers must be written in English only. Candidates should attempt at least 2 questions from each section and a total of 5 questions. The number of marks carried by each question is indicated against the same.

Time : 3 hours

Marks : 300

SECTION –A

1.(a) A wave function of a particle defined in the interval $x = -a$ to $x = +a$ is given by $\psi(x) = N(a^2 - x^2)$, evaluate the normalisation constant N. (15 Marks)

(b) Show that the wave functions

$$\psi_1(x) = \sqrt{\frac{1}{2\pi}}, \psi_2(x) = \sqrt{\frac{1}{\pi}} \cos x \text{ and } \psi_3(x) = \sqrt{\frac{1}{\pi}} \sin x$$

defined in the interval $x = 0$ to $x = 2\pi$, are orthogonal to each other. (15 Marks)

(c) A diatomic molecule can be treated as a single quantum mechanical oscillator. Assume that $\Psi(x) = x e^{-\mu x^2}$ is an eigenfunction of this system which is in an excited state. Obtain the corresponding eigenvalue in terms of spring constant K and reduced mass μ . (30 Marks)

2. (a) Consider the normalised Gaussian wave packet $\psi(x) = N \exp(-\lambda^2 x^2)$ where $N = \left(\frac{2\lambda^2}{\pi}\right)^{1/4}$.

Show that $\Delta x \Delta p_x = \frac{\hbar}{2}$. (30 Marks)

(b) A particle of mass m is moving in a potential V(x).

Show that $i\hbar \frac{d}{dt} \langle x \rangle = \langle [X, H] \rangle$ (10 Marks)

(c) Show that Pauli spin matrices anticommute. (20 Marks)

3. (a) List all possible resultant term values by coupling angular momenta of 3P and 2D states in the LS coupling scheme. (15 Marks)

(b) Calculate the eigenvalues and eigenfunctions of a particle of mass m which is confined to move in one dimension in the range $x = -L/2$ to $x = +L/2$. (30 Marks)

(c) Write down three Uncertainty relations connecting conjugate variables and discuss their implications in various physical phenomena. (15 Marks)

4. (a) Obtain the term symbols for an electronic configuration $2p3d$ in LS and jj coupling. (20 Marks)

(b) If the doublet splitting of the first excited state $2^2P_{3/2}$ of He II is 5.84 cm^{-1} , calculate the corresponding separation of H atom. (10 Marks)

(c) Draw a suitable diagram to show the allowed transitions between magnetic sublevels of $^2D_{3/2} \rightarrow ^2P_{3/2}$ transition arising due to an applied weak magnetic field. For a strong magnetic field, show the splitting of 3S level. (20 Marks)

- 5. (a) The three alternative lines in the measured rotational spectrum of CO molecule are at 7.6900 cm^{-1} , 15.3786 cm^{-1} and 23.0650 cm^{-1} . Determine the rotational constant. Assign the lines to their appropriate J to J' transition. (15 Marks)
- (b) Calculate the fundamental frequency of DCl if the fundamental frequency of HCl is 2990 cm^{-1} , assuming the same force constant. (15 Marks)
- (c) Draw correlation diagrams, (which show the connection between united atom and separated atom limits) for homonuclear and heteronuclear diatomic molecules. (30 Marks)

SECTION -B

- 6. (a) The nucleus $^{27}\text{Si}_{14}$ decays to its mirror nucleus $^{27}\text{Al}_{13}$ by positron emission with a maximum energy of **3.48 MeV**. Find the difference in the coulomb energy between the two nuclei and hence estimate the value of r_0 in the expression for the nuclear radius $R = r_0 \times A^{1/3}$. (30 Marks)
- (b) Calculate the kinetic energy of the alpha particle emitted in the process $^{235}\text{U} \rightarrow \alpha + ^{231}\text{Th}$. The binding energy of the alpha particle is **28.3 MeV** and you may assume the following values (in MeV) for the five coefficients in the semi-empirical expression for the binding energy of heavier nuclei: volume **15.5**; surface **16.8**; Coulomb **0.72**; asymmetry **23**; pairing **34**. (15 Marks)
- (c) Using the values $\mu_{d(L=0)} = 0.8798 \mu_N$ and $\mu_{d(L=2)} = 0.3101 \mu_N$ find the percentage admixture of the ($L=2$) state if the deuteron magnetic moment were given by $\mu_d = 0.8325 \mu_N$. (15 Marks)
- 7. (a) Estimate the separation of the $1p_{1/2}$ and $1d_{5/2}$ energy levels for nuclei with mass number $A \sim 16$ given the following information: (15 Marks)

the ordering of the lowest nuclear energy levels is $1s_{1/2}; 1p_{3/2}; 1p_{1/2}; 1d_{5/2}; 1d_{3/2}$
 and the total binding energy for the oxygen isotopes is

^{15}O	111.96 MeV
^{16}O	127.62 MeV
^{17}O	131.76 MeV

- (b) A particular Mossbauer nucleus has spins $5/2$ and $3/2$ in its excited and ground states, respectively. Into how many lines will the gamma ray spectrum split if (i) the nucleus is under the influence of an internal electric field gradient, but no magnetic field is applied. (ii) there is no electric field gradient at the nucleus but an external magnetic field is applied (iii) both an internal electric field gradient and an external magnetic field are present. (30 Marks)
- (c) Explain the difference between nuclear fission and fusion with examples. (15 Marks)
- 8. (a) Write down the decay modes of the unstable elementary particles π^+ , π^0 , n , Σ^+ , Σ^0 . (15 Marks)
- (b) Explain the difference between strong, electromagnetic and weak forces with respect to laws of conservation of Parity, Baryon number, Isospin and Strangeness. (30 Marks)
- (c) Discuss the Quark structure of hadrons. (15 Marks)

9. (a) A cubic crystal is mounted with a (100) direction parallel to the incident x-ray beam. What are the positions of the beams diffracted from (110) and (111) planes? (20 Marks)
- (b) Explain the differences for the magnetization versus applied magnetic field curves for Type I and Type II superconductors. You need to draw both the curves. (20 Marks)
- (c) By using suitable diagrams, explain the differences between conductors, insulators and semiconductors on the basis of Band theory of solids. (20 Marks)
- 10.(a) Write down truth tables for AND, NAND, OR and XOR logical gates. (20 Marks)
- (b) Draw a diagram for a non-inverting operational amplifier. Derive an expression for the closed loop gain in terms of impedances. (10 Marks)
- (c) Draw a neat circuit diagram of a transistor phase shift oscillator and derive an expression for the frequency of oscillation. (30 Marks)

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6th JUNE, 2009

LAW - Paper-I

INSTRUCTIONS : Answers must be written in English only. Candidates should attempt at least 2 questions from each section and total 5 questions.

Time: 3 hours

Marks: 300

SECTION - A

1. (a) "The concept of instrumentality or agency of government is not limited to Corporations created by a statute but it is equally applicable to a company or society."
Analyze critically the above statement in the light of Supreme Court's interpretation of "State" in Art. 12 of Constitution of India. State whether Art. 12 also includes a private person? (30 marks)
- (b) What do you mean by the "doctrine of eclipse" as enunciated by the Supreme Court? Discuss the essential elements of this doctrine and state whether it applies to post-constitutional laws also. Do you think that a law which has been held ultra-vires by the Supreme Court necessitates re-enactment? (30 marks)
2. (a) Art. 14 of Constitution of India is pivotal to the functioning of State. That is precisely the reason that any action, whether legislative or administrative is open to challenge, if it is conflicting with the Constitution, or is arbitrary or is unreasonable, and can be struck down by the Courts in India. Critically analyze this statement in the light of constructs of Art. 14 and its enunciation by the Supreme Court. (30 marks)
- (b) Judicial review is the basic feature of the Constitution. However, the Supreme Court has laid down certain important constraints on the functioning of the judicial review. Discuss critically. (15 marks)
- (c) Elaborate the basis and the foundation of Public Interest Litigation in India, as enunciated by the Supreme Court. (15 marks)
3. (a) "Constitutionally the position of the President of India is akin to that of the Crown of England, and the real executive power vests in the Cabinet". Discuss this statement in the light of some judicial precedents. (20 marks)
- (b) What are the legislative powers of the President of India? (20 marks)
- (c) What are the pardoning powers (including the powers to suspend, remit and commute) of the President of India? Under what considerations are these powers exercised by the President? Are these powers subject to judicial review? (20 marks)
4. (a) "Basic features doctrine as espoused by the Supreme Court has continued to stay in our constitutional jurisprudence". Explain this doctrine in the light of I.R. Coelho v. State of Tamil Nadu. Are fundamental rights part and parcel of basic features which cannot be taken away even by a Constitutional amendment? (30 marks)
- (b) On what grounds would you challenge a Constitutional amendment, deleting "right to freedom of religion" from fundamental rights? Give reasons in support of your answer. (15 marks)
- (c) Can you and on what grounds would you challenge a Constitutional amendment deleting Art. 15 (4) and (5) from the Constitution? (15 marks)

5. (a) "Secularism is the basic feature of the Indian Constitution". Discuss critically. (20 marks)
- (b) Discuss the principles of interpretation of legislative entries as enunciated by the Supreme Court to resolve legislative conflicts between the Union Government and the State Governments. (20 marks)
- (c) Discuss the principles which have been evolved to exercise judicial control over delegated legislation. (20 marks)

SECTION - B

6. (a) "International law is the vanishing point of jurisprudence". Discuss critically. (20 marks)
- (b) "Consent is the basis of obligation in international law". Discuss critically. (20 marks)
- (c) What do you mean by subjects of law? How far do you accept that individuals are subjects of international law? (20 marks)
7. (a) "The relationship between international law and municipal law has posed difficult and complex problems". Discuss with special reference to practice of Indian Supreme Court. (30 marks)
- (b) What do you mean by sources of International Law? Explain custom as a source of international law. (30 marks)
8. (a) What do you understand by compulsory jurisdiction? Explain the compulsory jurisdiction of International Court of Justice. (30 marks)
- (b) Distinguish between recognition of State and recognition of Government. Explain critically the legal effects of recognition. (15 marks)
- (c) Write a critical but brief essay on reservations to multilateral treaties. (15 marks)
9. (a) "Asylum begins when extradition stops". Discuss critically. (20 marks)
- (b) Explain briefly veto and double veto under the United Nations Charter. (20 marks)
- (c) Write a brief essay on Self defence as available under the United Nations Charter. How far do you agree that U.N. Charter has undone the right of self defence available under the customary international law? (20 marks)
10. (a) Write a brief essay on the Dispute Settlement Body of the W.T.O. Would you suggest any changes to dispute settlement mechanism from India's point of view? (30 marks)
- (b) Discuss the means available for enforcement of human rights at the universal level. What changes would you suggest in this area? (15 marks)
- (c) What are the rights of the coastal States in respect of territorial sea? What do you understand by hot pursuit? (15 marks)

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6th JUNE, 2009

LAW - Paper- II

INSTRUCTIONS : Answers must be written in English only. Candidates should attempt at least 2 questions from each section and total 5 questions. All questions carry equal marks.

Time: 3 hours

Marks: 300

SECTION - A

1. What are the reasons for not punishing of offence of culpable homicide as severely as murder? Discuss the law of murder in India.
2. What is strict liability? Discuss the relevance of principle of strict liability in situations such as Bhopal gas tragedy.
3. (a) "Irresistible impulse by itself affords no valid defence, but should be a good defence only where there is evidence of an antecedent unsoundness of mind." Comment.
(b) A sacrificed his son B by thrusting a knife in his throat inside the mosque and went straight to inform his brother. Accused's story was that he believed that he had been directed by some one in paradise to sacrifice his son to God. Can he plead defence due to unsoundness of mind under Section 84 I.P.C for an offence of murder? Discuss.
4. (a) Discuss the open letter written by four law professors in India in 1979 to review the Supreme Court decision acquitting police officers in Mathura case. Explain the amendments made to rape law aftermath of Mathura case.
(b) Critically examine the Section 498 A and argue its relevance and necessity under Indian Law.
5. (a) What is medical negligence? Discuss the liability of doctors working in government hospitals in case of medical negligence.
(b) Critically examine the decision in Kasturi Lal case in the light of emerging compensatory jurisprudence in India.

SECTION - B

6. What is Agency by Ratification? Explain when an agent is personally liable for his acts to Third parties.
7. What do you mean by 'dissolution of partnership firm'? When dissolution of a firm takes place?
8. X, a legal successor of Y, the deceased person, signs a Bill of Exchange in his own name admitting a liability of Rs. 50,000 to the extent to which he inherits the assets from the deceased payable to Z after 3 months from 1st January, 2008. On maturity, when Z presents the bill to X, he (X) refuses to pay for the bill on the ground that since the original liability was that of Y, the Deceased and therefore he is not liable to pay for the bill.
Based on the provisions of the Negotiable Instruments Act, 1881 decide whether Z can succeed in recovering Rs. 50,000 from X. Would your answer be still the same in case X does not state the limit in the Bill and the liability is more than the assets he inherits from Y.
9. (a) M owes money to N under a contract. It is agreed between M, N and O that N shall henceforth accept O as his debtor instead of M. Referring to the provisions of the Indian Contract Act, 1872, state whether N can claim payment from O.
(b) X, had sold three acres of land to one Y, for Rs 60,000 in 2007. Where as X, had sold one acre of land in 2006 for Rs. 50,000. X contended that Y, had got him to execute the deed by getting him drunk. Y, denied the allegation. X was treated for alcoholic psychosis. Discuss the validity of the sale deed.
10. Compare and contrast Conciliation with Arbitration in the light of Arbitration and Conciliation Act, 1996.

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7th JUNE, 2009

ECONOMICS - Paper - I

INSTRUCTIONS : Answers must be written in English only. Candidates should attempt at least 2 questions from each section and total 5 questions. All questions carry equal marks.

Time: 3 hours

Marks: 300

SECTION - A

1. What are the main features of monopolistic competition? Discuss the price determination in monopolistic competition under the condition of price competition and free entry.
2. What are the factors responsible for declining public expenditures? Do you think that in a modern day public sector has to play bigger role in stabilisation of market economy? Discuss.
3. What do you understand by inflationary gap? What are the measures to control inflation in an economy? Do you think monetary measures are sufficient to control inflation in India?
4. Discuss H-theory of money supply. Is it possible for the monetary authority to increase the rate of growth of the economy by printing money? Do you think there is a need to put check on money supply growth?
5. "Trade works as an engine of economic growth for India but this growth has not benefitted equitably"- Do you agree to this? Justify your answer with empirical facts.

SECTION - B

6. Briefly discuss the role and functions of IMF and World Bank Group. Do you think IMF could play the role of maintaining global financial stability effectively in the present international financial environment? Comment.
7. Discuss with the help of diagram the effectiveness of monetary policy under the condition of fixed exchange rate and perfect capital mobility.
8. How are offer curves derived? Explain diagrammatically how offer curves help determining equilibrium relative commodity prices at which trade takes place.
9. Outline the major distorting provisions of WTO for developing countries. Discuss how the Regional Trading Blocks play barriers to free international trade.
10. (i) Discuss Solow's neo-classical growth model with technical change.
(ii) Discuss the changing pattern of the sectoral compositions of GDP in India. Do you think there is still potential of agriculture to lead the growth in India?

