2016.

Set No. : 1

RET/16/TEST-B

Question Booklet No.

881 | **Physics**

(To be filled up by the candidate by blue/black ball point pen)

Roll No.

Roll No. (Write the digits in words) ....

Serial No. of OMR Answer Sheet ....

Day and Date ....

(Signature of Invigilator)

INSTRUCTIONS TO CANDIDATES

(Use only blue/black ball-point pen in the space above and on both sides of the Answer Sheet)

1. Within 30 minutes of the issue of the Question Booklet, Please ensure that you have got the correct booklet and it contains all the pages in correct sequence and no page/question is missing. In case of faulty Question Booklet, Bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.

2. Do not bring any loose paper, written or blank, inside the Examination Hall *except the Admit Card without its envelope.*

3. *A separate Answer Sheet is given. It should not be folded or mutilated. A second Answer Sheet shall not be provided.*

4. Write your Roll Number and Serial Number of the Answer Sheet by pen in the space provided above.

5. *On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top, and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.*

6. *No overwriting is allowed in the entries of Roll No., Question Booklet No. and Set No. (if any) on OMR sheet and Roll No. and OMR sheet no. on the Question Booklet.*

7. *Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfair means.*

8. *This Booklet contains 40 multiple choice questions followed by 10 short answer questions. For each MCQ, you are to record the correct option on the Answer Sheet by darkening the appropriate circle in the corresponding row of the Answer Sheet, by pen as mentioned in the guidelines given on the first page of the Answer Sheet. For answering any five short Answer Questions use five Blank pages attached at the end of this Question Booklet.*

9. For each question, darken only **one circle** on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.

10. *Note that the answer once filled in ink cannot be changed. If you do not wish to attempt a question, leave all the circles in the corresponding row blank (such question will be awarded zero marks).*

11. For rough work, use the inner back pages of the title cover and the blank page at the end of this Booklet.

12. *Deposit both OMR Answer Sheet and Question Booklet at the end of the Test.*

13. You are not permitted to leave the Examination Hall until the end of the Test.

14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

Total No. of Printed Pages : 20

46.

ROUGH WORK
रफ़ कार्य

ROUGH WORK
रफ़ कार्य

Research Entrance Test-2016

No. of Questions : 50

प्रश्नों की संख्या : 50

Time : 2 Hours   Full Marks : 200

समय : 2 घण्टे   पूर्णांक : 200

Note: **(1)** This Question Booklet contains **40** Multiple Choice Questions followed by **10** Short Answer Questions.

इस प्रश्न पुस्तिका में **40** वस्तुनिष्ठ व **10** लघु उत्तरीय प्रश्न हैं।

(2) Attempt as many MCQs as you can. Each MCQ carries 3 **(Three)** marks. 1 **(One)** mark will be deducted for each incorrect answer. **Zero** mark will be awarded for each unattempted question. If more than one alternative answers of MCQs seem to be approximate to the correct answer, choose the closest one.

अधिकाधिक वस्तुनिष्ठ प्रश्नों को हल करने का प्रयत्न करें। प्रत्येक वस्तुनिष्ठ प्रश्न **3 (तीन)** अंकों का है। प्रत्येक गलत उत्तर के लिए 1 **(एक)** अंक काटा जायेगा। प्रत्येक अनुत्तरित प्रश्न का प्राप्तांक शून्य होगा। यदि वस्तुनिष्ठ प्रश्नों के एकाधिक वैकल्पिक उत्तर सही उत्तर के निकट प्रतीत हों, तो निकटतम सही उत्तर दें।

(3) Answer only **5** Short Answer Questions. Each question carries **16 (Sixteen)** marks and should be answered in **150-200** words. Blank **5 (Five)** pages attached with this booklet shall only be used for the purpose. Answer each question on separate page, after writing Question No.

केवल **5 (पाँच)** लघुउत्तरीय प्रश्नों के उत्तर दें। प्रत्येक प्रश्न **16 (सोलह)** अंकों का है तथा उनका उत्तर 150-200 शब्दों के बीच होना चाहिए। इसके लिए इस पुस्तिका में लगे हुए साधे **5 (पाँच)** पृष्ठों का ही उपयोग आवश्यक है। प्रत्येक प्रश्न का उत्तर एक नए पृष्ठ से, प्रश्न संख्या लिखकर शुरू करें।

1. Which is not true for reactions by the S_N2 mechanism ?

   (1) proceeds through a backside attack and results in inversion

   (2) tends to proceed with weak nucleophiles solvents like CH_3OH, H_2O, CH_3CH_2OH.

   (3) rate of reaction proceeds from primary (fastest) > secondary >> tertiary (slowest)

   (4) occurs in one step

2. Which is the main product of the following reaction ?
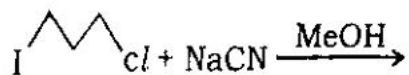
   (1)   (2)

   (3)   (4)

3. Which of the following conditions is necessary for a reaction to be spontaneous ?

   (1) $\Delta S_{sur} > 0$ (2) $\Delta S_{sys} > 0$

   (3) $\Delta S_{sur} + \Delta S_{sys} > 0$ (4) $\Delta S_{sur} + \Delta S_{sys} < 0$

4. Dead organs are generally stored in formalin. Formalin is :

   (1) aqueous formaldehyde   (2) aqueous ferrous sulphate

   (3) aqueous formic acid   (4) aqueous ferric alum

5. Regarding "carbon credits", which one of the following statement is **not** correct :

(1) The carbon credit system was ratified in conjunction with the Kyoto Protocol.

(2) Carbon credits are awarded to countires or groups that have reduced greenhouse gases below their emission quota.

(3) The goal of the carbon credit system is to limit the increase of carbon dioxide emission.

(4) Carbon credits are traded at a price fixed from time to time by the United Nations Environment Progrmme.

6. Ball bearings are used in bicycles, cars, etc., because :

(1) the actual area of contact between the wheel and axle is increased.

(2) the effective area of contact between the wheel and axle is increased

(3) the effective area of contact between the wheel and axle is reduced

(4) the actual area of contact between the wheel and axle is reduced.

7. During respiration, energy is released. It is stored in the form of :

(1) ADP   (2) ATP   (3) NADP   (4) APP

8. Which of the following is known as Royal disease :

(1) Sickle cell anemia   (2) Haemophilia

(3) Alzheimers disease   (4) Colour blindness

9. The xylem in plants is responsible for :

(1) transport of water   (2) transport of food

(3) transport of oxygen   (4) transport of amino acids

10. Two wires, of the same material, have their lenghts in the ratio 1:2 and their diameters in the ratio 2:1. If both are stretched separately by equal weights, the ratio of increase in their lengths, $L_1 : L_2$ would be :

(1) 1:2   (2) 2:1   (3) 1:8   (4) 8:1

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11. The displacement current arises due to :
    (1) Positive charge only   (2) Negative charge only
    (3) Time varying magnetic field   (4) Time varying electic field

12. The electric field in an electromagnetic wave is given by :

$$E = 50 \sin \omega \left(t - \frac{x}{c} \right) N/C$$

The energy contained in θ cylinder of cross – section $10cm^2$ and length 50 cm along x – axis is :

(1) 4.5×10^{-12} J   (2) 5.5×10^{-12} J

(3) 4.5×10^{-6} J   (4) 5.5×10^{-6} J

13. $\sqrt{\mu / \epsilon}$ has the dimension of :

    (1) Resistance   (2) Capacitance
    (3) Inductance   (4) Speed

14. How many generalized / quasi-generalized coordinates are required to describe the motion of solid sphere rolling with out slipping on an inclined plane ?

    (1) 2   (2) 3   (3) 4   (4) 5

15. For what values of α and β do equations $Q = q^\alpha \cos\beta p$, $P = q^\alpha \sin\beta p$ represent a canonical transformation ?

    (1) $\alpha = 1$, $\beta = 1$ (2) $\alpha = \frac{1}{2}$, $\beta = 1$

    (3) $\alpha = 2$, $\beta = \frac{1}{2}$ (4) $\alpha = \frac{1}{2}$, $\beta = 2$

16. A system is governed by the hamiltonian :

$H = \dfrac{1}{2}\left(p_x - ay\right)^2 + \dfrac{1}{2}\left(p_y - bx\right)^2$ where a and b are constraint and p_x, p_y are momenta conjugate to x and y respectively. For what values of a and b will the quantities $(p_x - 3y)$ and $(p_y + 2x)$ be conserved ?

(1) a = 3, b = – 2   (2) a = – 3, b = 2

(3) a = 3, b = 2   (4) a = – 2, b = 3

17. Which of the following functions of complex variable z = x + iy is analytic?

(1) $|z|$ (2) Re z

(3) log z   (4) z^{-1}

18. Given the velocity $v = \dfrac{ds}{dt} = 32t - 2$, and the initial position of the body as s (1/2) = 4. What will be the body position at time t ?

(1) $s = 16\,t^2 + 2t + 1$ (2) $s = 16\,t^2 - 2t + 1$

(3) $s = 16\,t^2 - 2t - 1$ (4) $s = -16\,t^2 - 2t + 1$

19. *The purpose of offset nulling is to* :

(1) reduce the gain

(2) equalize the input signal

(3) make zero the output error voltage

(4) none of these

20. A certain common emitter amplifier has a voltage gain of 100. If the emitter by pass capacitor is removed then :

(1) the circuit will become unstable

(2) the voltage gain will decrease

(3) the voltage gain will increase

(4) the Q-point will shift

21. If the base emitter junction of a transister is open, the collector voltage is.

(1) Vcc   (2) 10 V

(3) floating   (4) 10.2 V

22. An LED :

(1) emits light when reverse biased

(2) *senses light when reverse biased*

(3) emits light when forward biased

(4) acts as a variable resistance

23. The partition function of N- oscillator system is :

(1) $(\beta \lambda \omega)^{-N}$ (2) $(\beta \lambda \omega)^{N}$

(3) $N(\beta \lambda \omega)$ (4) $\dfrac{\beta \lambda \omega}{N}$

24. Magnetization scales in the Bragg-William's approximation or Bethe Peierls approximation of Ising model scales as :

(1) $|T - Tc|^{2}$ (2) $|T - Tc|^{1/2}$

(3) $|T - Tc|^{-1}$ (4) $|T - Tc|^{-2}$

25. Which particle will exert maximum force at T = OK

(1) Photon   (2) Electron

(3) Boson   (4) Higgs particle

26. In zinc crystallites in hcp structure, it r is the radius of zinc atom. The c parameter of the unit cell is :

(1) $2r\left(\dfrac{8}{3}\right)^{1/2}$ (2) $r\left(\dfrac{8}{3}\right)^{1/2}$ (3) $2r\left(\dfrac{3}{8}\right)^{1/2}$ (4) $r\left(\dfrac{3}{8}\right)^{1/2}$

27. A superconducting material when placed in a magnatic field will :
(1) attract the magnatic field towards its centre
(2) repel all the magnatic lines of force passing through it
(3) attract the magnatic field but transfer it into a concentrated zone
(4) not influence the magnatic field

28. If $\vec{a^*}$ is a reciprocal lattice parameter and $\vec{a}$, $\vec{b}$ and $\vec{c}$ are real lattice parameters, then $\vec{a^*}$ is equal to :

(1) $\dfrac{\bar{b} \times \bar{c}}{\bar{a} \cdot \bar{b} \times \bar{c}}$

(2) $\dfrac{\bar{c} \times \bar{a}}{\bar{a} \cdot \bar{b} \times \bar{c}}$

(3) $\dfrac{\bar{a} \times \bar{b}}{\bar{a} \cdot \bar{b} \times \bar{c}}$

(4) $\dfrac{\bar{c} \times \bar{b}}{\bar{a} \cdot \bar{b} \times \bar{c}}$

29. How many atoms are there in the unit cell of diamond ?
(1) 2   (2) 4   (3) 6   (4) 8

30. A particle in one dimension moves under the influence of a potential $V(x) = ax^6$, where a is real constant. The quantized energy level En depends on n as :

(1) $E_n \propto n^{4/3}$

(2) $E_n \propto n^3$

(3) $E_n \propto n^{3/2}$

(4) $E_n \propto n^{2/3}$

31. The de-Broglic wavelength of a particle at room temperature (27^0C) is 200 nm. At what temperature it will be 100 nm :
(1) 54^0C (2) 108^0C (3) 327^0C (4) 927^0C

32. If $\psi_{n,l,m}$ denotes the eigenfunctions of the Hamiltonian with potential $V = V(r)$ then the expectation value of the operator $L_x^2 + L_y^2$ in the state $\psi = \dfrac{1}{5}\left[3\psi_{211} + \psi_{210} - \sqrt{15}\ \psi_{21-1}\right]$ is :

(1) $\dfrac{39}{25}\lambda^2$

(2) $\dfrac{26}{25}\lambda^2$

(3) $\dfrac{24}{25}\lambda^2$

(4) $2\lambda^2$

33. The binding energy per neucleon is maximum for the nucleus :
(1) ^{56}Fe
(2) ^{208}Pb
(3) ^{4}He
(4) ^{16}O

34. The quark structure of Δ^{++} particle is :
(1) UUU
(2) SSS
(3) UCT
(4) UUd

35. Identify the reaction which has the same transition probability as $\pi^+ + p \to \pi + p$:

(1) $\pi^+ + n \to \pi^+ + n$
(2) $\pi^- + p \to \pi^0 + n$

(3) $\pi^- + n \to \pi^- + n$
(4) $\pi^0 + p \to \pi^+ + n$

36. Positronium is an atom obtained by replacing proton by e^+ in the H-atom. The binding energy of positronium atom is :
(1) 13.6 ev
(2) 6.8 ev
(3) 27.2 ev
(4) 54.6 ev

37. Assuming the L-S coupling scheme is valid the number of permitted transitions from $2p_{3/2} \rightarrow 2s_{1/2}$ due to a weak magnatic field will be :

(1) 2   (2) 4   (3) 6   (4) 8

38. In Stern-Gerlach experiment atomic beam of Pb atoms in $3P_0$ state is passed through the nonuniform magnatic field. How many traces do you observe on the screen ?

(1) 0   (2) 1   (3) 2   (4) 3

39. The half width of the gain profile of a He-Ne laser material is 2×10^{-3} nm. The length of the cavity is 30 cm. Assuming that the longitudinal modes falling within the half widht of gain profile are able to compensate losses at laser wavelength $6328 A^0$, the number of longitudinal modes present in the output beam are :

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

40. A 2 m W laser beam ($\lambda_0 = 6 \times 10^{-5}$ cm) is focused by the eye of focal length f = 2.5 cm. If the pupil diameter is 2 mm, the intensity on retina will approximately be :

(1) 3×10^3 W/m²   (2) 3×10^6 W/m²
(3) 3×10^9 W/m²   (4) 3×10^{12} W/m²

Short Answer Questions

Note: Attempt any **five** questions. Write answer in **150-200** words. Each question carries **16** marks. Answer each question on separate page, after writing Question Number.

01. Evaluate $\int_c \dfrac{z-1}{(z+1)^2 (z-2)} dz$, where c is $|z-i| = 2$

02. Find the fourier transform of the Gaussian function $e^{-\alpha x^2}$

03. A spherically symmetric charge distribution is given by

$$\rho(r) = \begin{cases} \rho_0 \left(1 - \dfrac{r^2}{a^2} \right) & \text{for } 0 \le r \le a \\ & \text{for } r > a \end{cases}$$

Where ρ denotes charge density. Calculate the electric field intensity E and potential V both inside and outside the charge distribution.

04. A particle of mass m is moving in the potential $V_{(x)} = -\dfrac{1}{2}ax^2 + \dfrac{1}{4}bx^4$, a and b are positive constants. Calculate the frequency of small oscillation about a stable equillibrium

05. Show that the entropy of a system in the grand canonical ensamble can be written as

$$S = -K\sum_{r,s} P_{r,s} \ln P_{r,s},$$

where $P_{r,s} = \dfrac{\exp(-\alpha N_r - \beta E_s)}{\sum\limits_{r,s} \exp(-\alpha N_r - \beta E_s)}$

Symbols have their usual meaning

12

06. The Hamiltonian for a spin $1/2$ particle in rest is given by $H = a\sigma_z + b\sigma_x$. a and b are constants and σ_z and σ_x are Pauli Matrices. Calculate the eigen function and eigen values of H.

07. Discuss the frequency response of an OP-AMP.

08. Calculate threshold kinetic energy of a proton which hits another proton at rest to produce anti – proton through the process

$$p + p \to p + p + P + P + \bar{p} + \bar{p}.$$

09. Derive Thomson equation for the scattering of X-ray beam by a single electron.

10. Discuss the splitting of sodium D_2 line $\left(^2P_{1/2} \to {}^2S_{1/2}\right)$ when the emitting Na- atom is placed in magnatic field weaker than the internal magnatic field.

Question No.   Page for Short Answer

P.T.O.

Question No.   Page for Short Answer

Question No.   **Page for Short Answer**

Question No.   **Page for Short Answer**

ROUGH WORK

अभ्यर्थियों के लिए निर्देश

(इस पुस्तिका के प्रथम आवरण पृष्ठ पर तथा उत्तर-पत्र के दोनों पृष्ठों पर केवल नीली-काली बाल-प्वाइंट पेन से ही लिखें)

1. प्रश्न पुस्तिका मिलने के 30 मिनट के अन्दर ही देख लें कि प्रश्नपत्र में सभी पृष्ठ मौजूद हैं और कोई प्रश्न छूटा नहीं है। पुस्तिका दोषयुक्त पाये जाने पर इसकी सूचना तत्काल कक्ष-निरीक्षक को देकर सम्पूर्ण प्रश्नपत्र की दूसरी पुस्तिका प्राप्त कर लें।

2. परीक्षा भवन में *लिफाफा रहित प्रवेश-पत्र के अतिरिक्त*, लिखा या सादा कोई भी खुला कागज साथ में न लायें।

3. उत्तर-पत्र अलग से दिया गया है। इसे न तो मोड़ें और न ही विकृत करें। दूसरा उत्तर-पत्र नहीं दिया जायेगा। केवल उत्तर-पत्र का ही मूल्यांकन किया जायेगा।

4. अपना अनुक्रमांक तथा उत्तर-पत्र का क्रमांक प्रथम आवरण-पृष्ठ पर पेन से निर्धारित स्थान पर लिखें।

5. उत्तर-पत्र के प्रथम पृष्ठ पर पेन से अपना अनुक्रमांक निर्धारित स्थान पर लिखें तथा नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक तथा सेट का नम्बर उचित स्थानों पर लिखें।

6. ओ० एम० आर० पत्र पर अनुक्रमांक संख्या, प्रश्नपुस्तिका संख्या व सेट संख्या (यदि कोई हो) तथा प्रश्नपुस्तिका पर अनुक्रमांक और ओ० एम० आर० पत्र संख्या की प्रविष्टियों में उपरिलेखन की अनुमति नहीं है।

7. उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुचित साधन का प्रयोग माना जायेगा।

8. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। प्रत्येक प्रश्न के वैकल्पिक उत्तर के लिए आपको उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्रथम पृष्ठ पर दिये गये निर्देशों के अनुसार पेन से गाढ़ा करना है।

9. प्रत्येक प्रश्न के उत्तर के लिए केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा करने पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।

10. ध्यान दें कि एक धार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का उत्तर नहीं देना चाहते हैं, तो संबंधित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शून्य अंक दिये जायेंगे।

11. रफ कार्य के लिए प्रश्न-पुस्तिका के मुखपृष्ठ के अंदर वाला पृष्ठ तथा उत्तर-पुस्तिका के अंतिम पृष्ठ का प्रयोग करें।

12. परीक्षा के उपरान्त केवल *ओ एम आर उत्तर-पत्र* परीक्षा भवन में जमा कर दें।

13. परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।

14. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धारित दंड का/की, भागी होगा/होगी।