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Level - 1 : All Level-1 successful* participants will get certificate, aptitude report and online subscription, and school toppers will be eligible for school hero medals.

Level - 2 : School toppers* will be selected for level-2-National level - online computer based interactive test held at exam centres all over India. Besides selection for level-3, winner will get merit certificate, medals, educational CDs, laptop, scholarship and other prizes. There is no level 2 in G.K. and Biotech.

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- You are allowed additional 10 minutes to fill the required details in the **RESPONSE SHEET (OMR)**. **STUDENTS OF CLASS 1 & 2 HAVE TO UNDERLINE** THE CORRECT ANSWER IN THE QUESTION PAPER ITSELF. THEY ARE NOT REQUIRED TO USE THE RESPONSE SHEET (OMR). THEY HAVE TO FILL THEIR NAME, ROLL NUMBER, CLASS, SCHOOL NAME IN THE SPACE PROVIDED IN THE QUESTION PAPER.
- The question paper is made as per syllabus guidelines & pattern given in the information Booklet. The Question Paper for Classes 1 to 6 contains 25 Questions each to be answered in 40 minutes. The Question paper for classes 7 to 12 contains 50 Questions each to be answered in 60 minutes. All questions are compulsory. Further instructions are given in the instruction letter to the teacher.
- Use the response sheet to mark your responses by darkening the required circle. The response sheet has to be returned to the foundation, duly filled in. The student can retain the Question Paper except for classes 1 and 2.

NATIONAL IIT PMT OLYMPIAD

NIPO

11 Class **A1 Paper Code**

LEVEL - 1

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PHYSICS

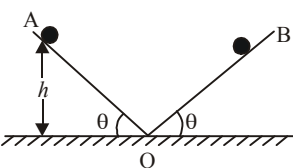
- Figure shows a frictionless double inclined plane each of angle θ . A ball starts sliding down from the top A . It oscillates with time period of

(A) $4\sqrt{\frac{2h}{g}} \sin \theta$ (B) $2\sqrt{\frac{2h}{g}} \sin \theta$

(C) $2\sqrt{\frac{2h}{g}} \left(\frac{1}{\sin \theta}\right)$ (D) $4\sqrt{\frac{2h}{g}} \left(\frac{1}{\sin \theta}\right)$
- A stone is dropped into a well in which the level of water is h below the top of the well. If v is velocity of sound, the time T after which the splash is heard is given by :

(A) $T = 2h/v$ (B) $T = \sqrt{\frac{2h}{g}} + \frac{h}{v}$

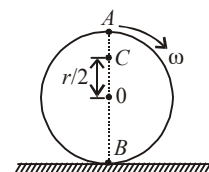
(C) $T = \sqrt{\frac{2h}{v}} + \frac{h}{g}$ (D) $T = \sqrt{\frac{h}{2g}} + \frac{2h}{v}$



- A disc of radius $r = 20$ cm is rotating about its axis with an angular speed of 20 rad s^{-1} . It is gently placed on a horizontal surface which is perfectly frictionless. What is the linear speed of point A on the disc ?

(A) 1 ms^{-1} (B) 2 ms^{-1}

(C) 3 ms^{-1} (D) 4 ms^{-1}



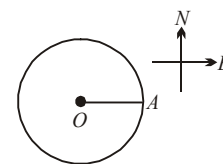
- A uniform circular disc can rotate freely about a rigid vertical axis through its centre O . A man stands at rest at A on the edge due east of O . The mass of the disc is 22 times the mass of the man. The man starts walking anti-clockwise. When he reaches the point A after completing one rotation relative to the disc he will be

(A) due east of O

(B) nearly N 60° E (60° east of north) of O

(C) nearly S 60° E (60° of south) of O

(D) nearly E 30° S of O .



5. Two particles instantaneously at A and B respectively, 4.5 metres apart, are moving with uniform velocities the former towards B at 1.5 m/sec and the later perpendicular to AB at 1.25 m/sec. The instant when they are nearest is

(A) $1\frac{23}{25}$ sec (B) 5.5 sec
(C) 3 sec (D) 4 sec

6. In a nuclear reactor, neutrons loss energy by making collisions with nuclei of atom of the materials that may be present in the core of the reactor. If a neutron of mass m_n has initial kinetic energy of 5.0 MeV, how much kinetic energy will it lose if it makes a head on elastic collision with nucleus of lead ? ($m_{pb} = 206 m_n$)

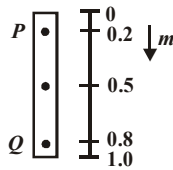
(A) 5.0 MeV (B) 4.9 MeV
(C) 0.5 MeV (D) 0.1 MeV

7. A block of mass m and a pan of equal mass are connected by a string going over a smooth light pulley. Initially the system is at rest when a particles of mass m falls on the pan and sticks to it. If the particle strikes the pan with a speed v , find the speed with which the system moves just after the collision.

(A) v (B) $v/2$
(C) $v/4$ (D) $v/3$

8. A box with sand having the mass M is suspended from a rope with a length L . The length of the rope is much greater than the linear dimension of the box. A bullet with mass m flies in horizontal direction, strikes the box and gets stuck in it. After this the rope is deflected by angle α from the vertical, the velocity of the bullet is

(A) $v = [(M + m) / m] \sqrt{Lg}$
(B) $v = \sin(\alpha / 2) \sqrt{Lg}$
(C) $v = 2 \sin(\alpha / 2) (M + m) / m \sqrt{Lg}$
(D) $v = 2 \sin(\alpha / 2) (M + m) / M \sqrt{Lg}$



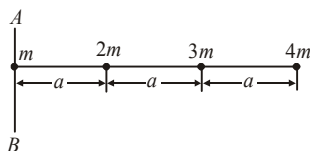
9. A cylinder of mass M , radius R is resting on a horizontal platform (which is parallel to x - y plane) with its fixed along the y -axis and free to rotate about its axis. The platform is given a motion in x -direction given by $x = A \cos \omega t$. There is no slipping between the cylinder and platform. The maximum torque acting on the cylinder during its motion is

(A) $\frac{1}{2} M R A \omega^2$ (B) $M R A \omega^2$
(C) $2 M R A \omega^2$ (D) $M R A \omega^2 \cos \omega t$

10. Four point-masses are connected by a rod of negligible mass as shown in figure. The moment of inertia and radius of gyration of the system about axis AB is

(A) a (B) $\sqrt{5}a$
(C) $\sqrt{3}a$ (D) $a/\sqrt{3}$

11. A metre stick oscillates as a compound pendulum about a horizontal axis through P . The length of the equivalent simple pendulum is :

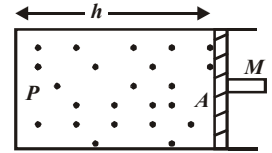


(A) 0.75 m (B) 0.3 m
(C) 0.59 m (D) 0.50 m

12. A meter stick swinging from one end oscillates with a frequency f_0 . If from the bottom one third of the stick wire cut off, then the frequency in term of f_0 will be :

(A) $1.22 f_0$ (B) f_0
(C) $5.66 f_0$ (D) $4.33 f_0$

13. A cylindrical piston of mass M slides smoothly inside a long cylinder closed at one end, enclosing a certain mass of gas. The cylinder is kept with its axis horizontal. If the piston is disturbed from its equilibrium position, it oscillates simple harmonically.



The period of oscillation will be

(A) $T = 2\pi\sqrt{Mh/P A}$ (B) $T = 2\pi\sqrt{M A/P h}$
(C) $T = 2\pi\sqrt{M/P A h}$ (D) $T = 2\pi\sqrt{M P h A}$

14. One end of a long metallic wire of length L is tied to the ceiling. The other end is tied to a massless spring of spring constant K . A mass m hangs freely from the free end of the spring. The area of cross-section and Young's modulus of the wire are A and Y respectively. If the mass is slightly pulled down and released, it will oscillate with a time period given by

(A) $2\pi\sqrt{\frac{m}{K}}$ (B) $2\pi\left[\frac{(YA + KL) m}{YAK}\right]^{\frac{1}{2}}$
(C) $2\pi\left(\frac{m YA}{KL}\right)^{\frac{1}{2}}$ (D) $2\pi\left(\frac{m L}{YA}\right)^{\frac{1}{2}}$

15. A simple pendulum is used on earth and moon.

(A) Its period will be the same in both the places because its mass is the same.
(B) The results will be the same of the pendulum is displaced through the same angle.
(C) The periods will be the same of the pendulum is displaced through the same angle.
(D) The periods are different because the temperatures are not the same.

CHEMISTRY

16. 0.7 g of $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ were dissolved in water and the volume was made to 100 ml, 20 ml of this solution required 19.8 ml of N/10 HCl for complete neutralization. The value of x is :

(A) 7 (B) 3
(C) 2 (D) 5

17. An electric bulb was filled with 100 cc of argon gas (at mass = 40) at 25°C and 1 atm pressure. The number of atoms of argon present in the bulb is :

(A) 40000 (B) 2.5×10^{21}
(C) 3.3×10^{24} (D) 5.4×10^{21}

18. If 0.5 mol of BaCl_2 is mixed with 0.2 mol of Na_3PO_4 , the maximum number of moles of $\text{Ba}_3(\text{PO}_4)_2$ that can be formed is :
 (A) 0.7 (B) 0.5 (C) 0.30 (D) 0.10
19. 0.5 g of a metal upon combustion (direct oxidation) yields a single oxide weighing 0.666 g. Calculate the equivalent weight of the metal.
 (A) 24 g (B) 22 g
 (C) 20 g (D) 12 g
20. Which of the following will have pH close to 1.0 ?
 (A) 100 ml of (M/20) HCl + 100 ml of (M/10) NaOH
 (B) 55 ml of (M/10) HCl + 45 ml of (M/10) NaOH
 (C) 10 ml of (M/10) HCl + 90 ml of (M/10) NaOH
 (D) 75 ml of (M/5) HCl + 25 ml of (M/5) NaOH
21. Which of the following statements is/are false :
 (A) the dissociation of a substance into free atoms is always an endothermic process
 (B) when a molecule contains several identical bonds e.g. CH_4 the same energy is required to dissociate each the bonds in turn.
 (C) the formation of a chemical bond from atoms in the gas phase is always an exothermic process.
 (D) the heat content of separate atoms in the gas phase is always greater than the heat content of the molecule formed when they combine.
22. The wave number of first line of Balmer series of hydrogen atom is 15200 cm^{-1} . What is the wave number of first line of Balmer series of Li^{2+} ion ?
 (A) 15200 cm^{-1} (B) 6080 cm^{-1}
 (C) 76000 cm^{-1} (D) 136800 cm^{-1}
23. Among NO_3^- , AsO_3^{3-} , CO_3^{2-} , ClO_3^- , SO_3^{2-} , and BO_3^{3-} the non-planar species are :
 (A) CO_3^{2-} , SO_3^{2-} and BO_3^{3-}
 (B) AsO_3^{3-} , ClO_3^- and SO_3^{2-}
 (C) NO_3^- , CO_3^{2-} and BO_3^{3-}
 (D) SO_3^{2-} , NO_3^- and BO_3^{3-}
24. In which of the following solvents should KBr be solution at 25°C ? (D is the dielectric constant)
 (A) C_6H_6 (D = 0)
 (B) CH_3OH (D = 32)
 (C) $(\text{CH}_3)_2\text{C}(\text{CH}_3)_2\text{CO}$ (D = 2)
 (D) CCl_4 (D = 0)
25. Suppose a photon of frequency ν causes photoelectric emission from a surface with a threshold frequency ν_0 , little lower than ν , what is the de-Broglie wavelength λ of the photoelectron of maximum kinetic energy in terms of $\Delta\nu = \nu - \nu_0$:
 (A) $\Delta\nu = h / \lambda$ (B) $\Delta\nu = h / \lambda$
 (C) $\left[\frac{1}{\nu_0} - \frac{1}{\nu} \right] = \frac{mc^2}{h}$ (D) $\lambda = \left(\frac{h}{2m\Delta\nu} \right)^{1/2}$
26. The precipitate of CaF_2 ($K_{sp} = 3.4 \times 10^{-11}$) is obtained when equal volumes of the following are mixed :
 (A) $10^{-4} \text{ M Ca}^{2+} + 10^{-4} \text{ MF}^-$
 (B) $10^{-3} \text{ M Ca}^{2+} + 10^{-3} \text{ MF}^-$
 (C) $10^{-5} \text{ M Ca}^{2+} + 10^{-4} \text{ MF}^-$
 (D) $10^{-3} \text{ M Ca}^{2+} + 10^{-5} \text{ MF}^-$
27. Pure water dissociates to a small extent according to equilibrium :
 $2 \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq})$
 The reaction between aqueous solutions to HCl and NaOH is strongly exothermic. The pH of pure water is almost 7 at 25°C . The pH of pure water at 37°C would be:
 (A) greater than 7 (B) less than 7
 (C) equal to 7 (D) none of these
28. Acetic acid is ionized into hydrogen ion and acetate ion, the initial concentration of the acid is $C \text{ mol l}^{-1}$ and α is the degree of dissociation. The equilibrium constant K_a for the ionization process is :
 (A) $\alpha C / (1 - \alpha)$ (B) $\alpha^2 C / (1 - \alpha)$
 (C) $\alpha C^2 / (1 - \alpha)$ (D) $\alpha^2 C / (1 - \alpha^2)$
29. H_2O is levelling solvent because HCl, HNO_3 , HClO_4 etc., cannot be differentiated – they all appear to be strong acids. Which of the following is not correct ?
 (A) Cl^- , NO_3^- and ClO_4^- all are very electronegative, so protons are easily formed (i.e., H^+ is easily donated)
 (B) All three dissociate 100% in H_2O
 (C) H_2O is a relatively good base
 (D) We could differentiate these acids, i.e. liquid ammonia is solvent
30. In the Ostwald process ($4 \text{NH}_3 + 5 \text{O}_2 \rightleftharpoons 4 \text{NO} + 6 \text{H}_2\text{O}$), platinum gauze is used as a catalyst. If the amount of catalyst is increased when the system has reached equilibrium, which one of the following will occur ?
 (A) More NO and H_2O will form
 (B) More NH_3 and O_2 will form
 (C) The reaction rate will be increased
 (D) No change will be evident

MATHEMATICS

31. The condition that the equation $(c^2 + a^2)x^2 - 2(a + b)cx + (b^2 + c^2) = 0$ has equal roots, is:
 (A) $c^2 = ab$ (B) $b^2 = ac$
 (C) $2b = a + c$ (D) None
32. If a, b, c be the roots of the equation $x^3 + px^2 + qx + r = 0$, then the cubic equation whose roots are $a(b + c), b(c + a), c(a + b)$ is :
 (A) $r^2 + px(x + q) + x(x + q)^2 = 0$
 (B) $r^2 - pr(x + q) + x(x + q)^2 = 0$
 (C) $r^2 - pr(x - q) + x(x - q)^2 = 0$
 (D) $r^2 + pr(x - q) + x(x - q)^2 = 0$
33. The value of 'k' for which one of the roots of $x^2 - x + 3k = 0$, is double of one of the roots $x^2 - x + k = 0$ is:

- (A) 1 (B) -2
(C) 2 (D) none of these
34. The value of a for which the equation $x^3 + ax + 1 = 0$ and $x^4 + ax^2 + 1 = 0$ have a common root, is :
(A) 2 (B) -2
(C) 0 (D) None of these
35. If $\log_2 x + \log_x 2 = 10/3 = \log_2 y + \log_y 2$ and $x \neq y$,
 $x^1 y$, then $x + y =$
(A) 2 (B) 65/8
(C) 37/6 (D) None of these
36. If the ratio of the roots of $x^2 + bx + c = 0$ and $x^2 + qx + r = 0$ be the same, then :
(A) $r^2 c = b^2 q$ (B) $r^2 b = c^2 q$
(C) $rb^2 = cq^2$ (D) $rc^2 = bq^2$
37. If $\log_3 2$, $\log_3(2^x - 5)$ and $\log_3(2^x - 7/2)$ are in A.P., then the value of x is :
(A) 2 (B) 3
(C) 4 (D) 5
38. If $ax + b$ is a decreasing function from $[-1, 1]$ onto $[0, 2]$ and $z_r = \cos \frac{\pi}{2^r} + i \sin \frac{\pi}{2^r}$, $r = 1, 2, \dots$, then $z_1 z_2 \dots$ to $\infty =$
(A) a (B) b
(C) $-a$ (D) none of these
39. If a complex number z satisfies
 $\log_{\frac{1}{2}} \left(\frac{|z|^2 + 2|z| + 6}{2|z|^2 - 2|z| + 1} \right) < 0$, then laws of point representing
by z is :
(A) $|z| < 5$ (B) $|z| > 3$
(C) $1 < |z| < 3$ (D) $|z| = 5$
40. The points representing complex number z for which $|z - 3| = |z - 5|$ lie on the locus given by :
(A) circle (B) ellipse
(C) straight line (D) none of these
41. The value of $\frac{\log_2 24}{\log_{96} 2} - \frac{\log_2 192}{\log_{12} 2}$ is :
(A) 3 (B) 0
(C) 2 (D) 1
42. Find the prime factorization of $10!$ i.e.
if $10! = 2^p 3^q 5^r 7^s$ then p, q, r and s are :
(A) 8, 4, 2, 1 (B) 4, 2, 8, 1
(C) 2, 2, 1, 3 (D) 2, 3, 3, 1
43. There are n points in a plane of which no three are in a straight line except ' m ' which are all in a straight line. Then the number of different quadrilaterals, that can be formed with the given points as vertices is :
(A) ${}^n C_4 - {}^m C_3 \cdot {}^{n-m+1} C_1 - {}^m C_4$

- (B) ${}^n C_4 - {}^m C_3 \cdot {}^{n-m} C_1 + {}^m C_4$
(C) ${}^n C_4 + {}^n C_3 \cdot {}^m C_1$
(D) ${}^n C_4 - {}^m C_3 \cdot ({}^{n-m} C_1) - {}^m C_4$
44. If $[x]$ denotes the greatest integer $\leq x$, then
 $\left[1 + \frac{1}{\sqrt{2}} + \frac{1}{\sqrt{3}} + \dots + \frac{1}{\sqrt{10^6}} \right]$ is equal to :
(A) 1998 (B) 1999
(C) 2000 (D) 2001
45. If the fourth term in the expansion of $\left[\sqrt{x^{\left(\frac{1}{\log_{10} x + 1} \right)} + x^{\frac{1}{2}} \right]^6$ is equal to 200 and $x^3 = 1$, then x is equal to :
(A) $10^{\sqrt{2}}$ (B) 10
(C) 10^4 (D) none of these
46. If S be the sum of coefficients in the expansion $(px + qy - rz)^n$ (where $p, q, r > 0$), then the value of
 $\lim_{n \rightarrow \infty} S / (S^{1/n} + 1)^n$ is :
(A) (pq/r) (B) $e^{\left(\frac{pq}{r} \right)}$
(C) $e^{\left(\frac{p+q-r}{p+q+r+1} \right)}$ (D) None
47. If in the expansion of $\left(2a - \frac{a^2}{4} \right)^9$; the sum of middle term is s , then which of the following is/are true :
(A) $s = \left(\frac{63}{32} \right) a^{14} (a + 3)$
(B) $s = \left(\frac{63}{32} \right) a^{14} (a - 8)$
(C) $s = \left(\frac{63}{32} \right) a^{13} (a - 8)$
(D) $s = \frac{63}{32} a^{13} (8 - a)$
48. The area bounded by the curves $x + 2|y| = 1$ and $x = 0$ is
(A) 1/4 (B) 1/2
(C) 1 (D) 2
49. A stick of length l rests against the floor and a wall of a room. If the stick begins to slide on the floor, then the locus of its middle point is :
(A) a straight line (B) a circle
(C) a parabola (D) an ellipse
50. For $0 < \theta < \theta/2$, $\tan \theta + \tan 2\theta + \tan 3\theta = 0$ if
(A) $\tan \theta = 0$ (B) $\tan 2\theta = 0$
(C) $\tan 3\theta = 0$ (D) $\tan \theta \tan 2\theta = 2$

BIOLOGY

31. Which of the following bacterium is photosynthetic free living aerobic N_2 fixer ?
(A) Azotobacter (B) Rhizobium
(C) Azospirillum (D) Anabaena
32. Since Dryopteris prothallus is bisexual, the type of gametes union is
(A) isogamous (B) self fertilization
(C) conjugation (D) cross fertilization
33. An extreme example of latency in which the DNA of the phage is integrated with the DNA of host cell chromosome is
(A) attenuated virus (B) prophage
(C) lysogeny (D) lysis
34. The important active ingredients of Ergot causing Ergotism are constituted by
(A) nucleic acids (B) alkaloids
(C) phenols (D) antibiotics
35. Bulliform cells are
(A) non-water filled and non-highly vacuolated cells
(B) prokaryotic cells
(C) eukaryotic cells
(D) none of these
36. The injured regions in the plants are repaired by
(A) intercalary meristem
(B) lateral meristem
(C) secondary meristem
(D) primary meristem
37. Parallel venation occurs in
(A) moss (B) grass
(C) fern (D) castor
38. Perisperms is
(A) remnant of nucellus
(B) degenerate secondary nucleus
(C) peripheral part of endosperm
(D) degenerate synergids
39. Which of the following is a wrong statement?
(A) all living plant cells contain chlorophyll.
(B) all cells do not contain a true nucleus.
(C) all living cells show the phenomenon of metabolism.
(D) viruses are in between living and non-living.
40. In the leaf cell has 8 chromosomes it is most likely that
(A) zygote will have 16 chromosomes
(B) zygote will have 4 chromosomes
(C) gametes will have 4 chromosomes
(D) gametes will have 8 chromosomes
41. Which is a microbial insecticide ?
(A) *B. subtilis*
(B) *Bacillus thuringensis*
(C) *B. polymixa*
(D) *B. brevis*
42. Endosulphan is
(A) herbicide (B) pesticide
(C) rodenticide (D) weedicide
43. *Leucaena*, a new plant for social forestry, is mainly recommended for
(A) firewood (B) fodder
(C) biofertilizer (D) bioherbicide
44. Protein synthesis in an animal cell, takes place
(A) in the nucleolus as well as in the cytoplasm
(B) only in the cytoplasm
(C) in cytoplasm as well as in mitochondria
(D) only on ribose attached to nucleon.
45. *Escherichia coli* is important for genetic experiments because
(A) it can be easily cultured
(B) it is haploid
(C) both (A) and (B).
(D) none of these
46. The sphere of living matter found on the surface of earth comprises
(A) lithosphere (B) hydrosphere
(C) biosphere (D) atmosphere
47. Scholars caught, marked and released 80 fishes in a pond. Later 100 fishes were caught at random. 40 of them were marked. The number of fishes in the pond is
(A) 200 (B) 400
(C) 100 (D) 50
48. Sound of Crickets and Cicadas is
(A) warning call (B) mating call
(C) circadian rhythm (D) circannual rhythm
49. Competition is the most severe between two
(A) closely related species growing in different niche
(B) closely related species growing in the same habitat
(C) distantly related species growing in the same habitat
(D) distantly related species growing in different niches
50. All of the following statements characterise DNA replication except
(A) DNA is synthesised in 3' to 5' direction in one strand and 5' to 3' in another
(B) second DNA strand is in form of Okazaki segments
(C) growth of DNA chain is discontinuous
(D) overall growth of DNA chain is bidirectional.



END OF THE EXAM