



International
Olympiad of
Science



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Sample Paper

CLASS - 12 Duration : 60 Minutes Total Questions : 40 Maximum Marks :100

SCIENCE

iOS Roll Number

Student's Name

INSTRUCTIONS

- Write your 12 digit iOS roll number and your name on top of the question paper in the given space.
- Filling up improper roll number may lead to unavailability of 'Result'.
- This question paper consist of 40 questions. Each question carries equal marking of 2.5 marks each.
- This paper is divided into 4 sections. Section A and B are compulsory for all the candidates. However section C and D are to be answered by the candidates as per their choice of subject, i.e. either Mathematics or Biology.
- Mark your answer (A, B, C, D or E) on the Answer Sheet with HB Pencil or Black/Blue Ball point Pen.
- This question paper contains 6 pages.
- Do not start attempting the test paper until you are asked to do so.

Note: Return this question paper along with answer sheet

SECTION A: Physics

- A charge + q is fixed at each of the points $x = x_0$, $x = 3x_0$, $x = 5x_0$... upto infinity and a charge - q is fixed at each of the points $x = 2x_0$, $x = 4x_0$, $x = 6x_0$... upto infinity. Here x_0 is a positive constant. The potential at the origin to this system of charges is

(A) zero (B) $\frac{q}{4\pi\epsilon_0 x_0 \ln(2)}$

(C) infinity (D) $\frac{q \ln(2)}{4\pi\epsilon_0 x_0}$

(E) None of these
- A capacitor of capacitance $C_1 = 1.0 \mu\text{F}$ can withstand a maximum voltage $V_1 = 6.0 \text{ kV}$. Another capacitor of capacitance $C_2 = 2.0 \mu\text{F}$ can withstand a maximum voltage $V_2 = 4.0 \text{ kV}$. If the capacitors are connected in series, the combination can withstand a maximum voltage of

(A) 5 kV (B) 9 kV

(C) 12 kV (D) 15 kV

(E) None of these
- An electron emitted from a hot filament is accelerated through a potential difference of 2.88 kV and enters a region of a uniform magnetic field of 0.1 T at an angle of 30° with the field. Take the mass of an electron, $m_e = 9 \times 10^{-31} \text{ kg}$. The trajectory of the electron is a

(A) circle of radius 1.6 mm

(B) circle of radius 0.9 mm

(C) helix of radius 0.9 mm

(D) helix of radius 1.6 mm

(E) None of these
- A uniform metal rod is moving with a uniform velocity v parallel to a long straight wire carrying a current I . The rod is perpendicular to the wire with its ends at distances r_1 and r_2 (with $r_2 > r_1$) from it. The emf induced in the rod is

(A) zero (B) $\frac{\mu_0 I v}{2\pi} \log_e \left(\frac{r_2}{r_1} \right)$

(C) $\frac{\mu_0 I v}{2\pi} \log_e \left(\frac{r_1}{r_2} \right)$ (D) $\frac{\mu_0 I v}{4\pi} \left(1 - \frac{r_1}{r_2} \right)$

(E) None of these
- Light is incident at an angle α on one planar end of a transparent cylindrical rod of refractive index n . The least value of n so that the light entering the rod does not emerge from the curved surface of the rod for any value of α is

(A) $\frac{4}{3}$ (B) $\sqrt{2}$

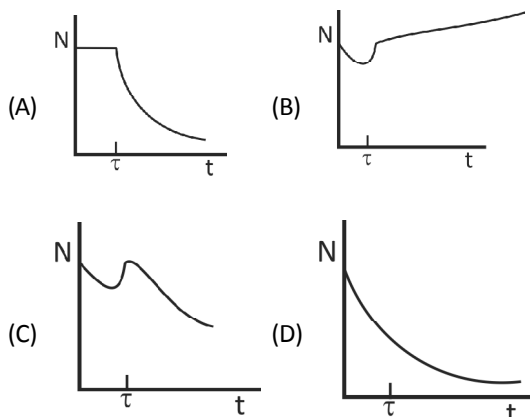
(C) 1.5 (D) $\sqrt{3}$

(E) None of these

6. A string of length 0.4 m and mass 10^{-2} kg is rigidly clamped at its ends. The tension in the string is 1.6 N. Identical wave pulses are produced at one end at equal intervals of time Δt . The minimum value of Δt which allows constructive interference between successive pulses is
- (A) 0.05 s (B) 0.10 s
(C) 0.20 s (D) 0.40 s
(E) None of these

7. In Young's double slit experiment the separation between the slits is 2 mm and the distance of the screen from the plane of the slits is 2.5 m. A light of wavelength in the range 200 nm to 800 nm is allowed to fall on the slits. The wavelengths in the visible region that will be present on the screen at 1 mm from the central maximum are
- (A) 400 nm (B) 500 nm
(C) 600 nm (D) 700 nm
(E) None of these

8. A radioactive sample consists of two distinct species having equal number of atoms initially. The mean life time of one species is τ and that of the other is 5τ . The decay products in both cases are stable. A plot is made of the total number of radioactive nuclei as a function of time. Which of the following figures best represents the plot ?



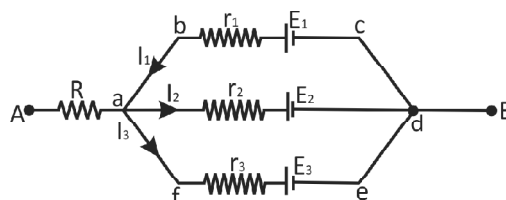
(E) None of these

9. Few identical diodes are available whose forward bias resistances are 25Ω each. Which of these rectifier circuits may give 61% efficiency of rectification?
- (A) A full wave rectifier with $R_L = 75.5\Omega$
(B) A half wave rectifier with $R_L = 40.6\Omega$
(C) A full wave rectifier with $R_L = 40.6\Omega$
(D) A half wave rectifier with $R_L = 75.5\Omega$
(E) None of these

10. A FM wave is represented by the voltage equation, $V = 12\sin(6 \times 10^8 t + 5\sin 1250t)$. What power will this FM wave dissipate in a 10Ω resistor ?
- (A) 0.129 W
(B) 7.2 W
(C) 12.2 W
(D) 19.9 W
(E) None of these

11. In Gauss's theorem, $\oint_s \mathbf{E} \cdot d\mathbf{s} = \frac{q}{\epsilon_0}$. The surface integral is evaluated by choosing a closed surface called the Gaussian surface. Here
- (A) the closed surface can be of any shape or size.
(B) q is the net charge enclosed inside the Gaussian surface; charges outside the surface are not considered.
(C) E is the electric field due to all the charges both inside and outside the surface.
(D) The exact location of the charges inside the surface does not affect the value of the integral.
(E) All of these

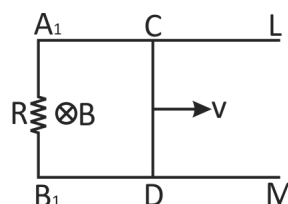
12. The circuit shown in the figure given below consists of the following:
 $E_1 = 3\text{ V}$, $E_2 = 2\text{ V}$, $E_3 = 1\text{ V}$ and $r_1 = r_2 = r_3 = R = 1\Omega$.



If r_2 is short-circuited and point A is connected to point B, then the current through resistor R would be

- (A) zero (B) 1.0 A
(C) 2.0 A (D) 3.0 A
(E) None of these

13. Two parallel wires A_1L and B_1M placed at a distance w are connected by a resistor R and placed in a magnetic field B which is perpendicular to the plane containing the wires as shown in the figure. Another wire CD now connects the two wires perpendicularly and made to slide with velocity v . Neglect the resistance of all wires and find which of the statements are correct?



- (A) The magnitude of induced emf is $\frac{Bv^2}{R}$.
- (B) The induced current is $\frac{Bvw}{R^2}$.
- (C) The magnetic force on wire CD tends to move it away from resistor R.
- (D) The work done per second needed to slide the wire CD is $\frac{(Bvw)^2}{R}$.
- (E) None of these

14. Electrons with energy 80 keV are incident on the tungsten target of an X-ray tube. K shell electrons of tungsten have – 72.5 keV energy. X-rays emitted by the tube contain

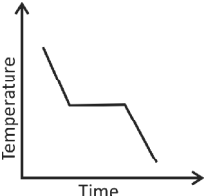
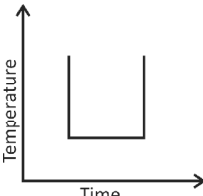
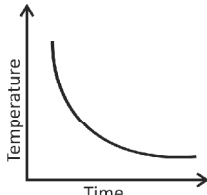
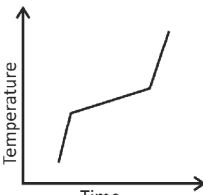
- (A) a continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of about 0.155 Å.
- (B) a continuous X-ray spectrum (Bremsstrahlung) with all wavelengths.
- (C) the characteristic X-ray spectrum of tungsten.
- (D) a continuous X-ray spectrum (Bremsstrahlung) with a minimum wavelength of about 0.155 Å and the characteristic X-ray spectrum of tungsten.
- (E) None of these

15. A transistor in common emitter configuration has a load of 500Ω in collector circuit. The voltage drop across the load is 0.49 V. If the value of α for the transistor used is 0.98, then the value of base current and emitter current in the circuit respectively are

- (A) 1 μA, 20 mA
- (B) 1 μA, 1 mA
- (C) 20 μA, 20 mA
- (D) 20 μA, 1 mA
- (E) None of these

SECTION B: Chemistry

16. Which of the following is the correct cooling curve for amorphous substances?

- (A) 
- (B) 
- (C) 
- (D) 
- (E) None of these

17. The bleeding from a wound is stopped by the application of ferric chloride as

- (A) blood starts flowing in the opposite direction
- (B) ferric chloride seals the blood vessels
- (C) blood reacts and a solid is formed which seals the blood vessels
- (D) blood gets coagulated and the blood vessels are sealed
- (E) None of these

18. Which of the following is a spallation reaction?

- (A) ${}^{16}_8\text{O} + {}^2_1\text{H} \longrightarrow {}^{14}_7\text{N} + {}^4_2\text{He}$
- (B) ${}^{63}_{29}\text{Cu} + {}^4_2\text{He} \longrightarrow {}^{37}_{17}\text{Cl} + 16{}_0^1\text{n} + 14{}_1^1\text{H}$
- (C) ${}^2_1\text{H} + {}^2_1\text{H} \longrightarrow {}^4_2\text{He} + \gamma$
- (D) ${}^{238}_{92}\text{U} + {}^1_0\text{n} \longrightarrow {}^{239}_{92}\text{U} + \gamma$
- (E) None of these

19. The degree of dissociation of $\text{Ca}(\text{NO}_3)_2$ in a dilute aqueous solution, containing 7.0 g of the salt per 100 g of water at 100°C is 70 %. If the vapour pressure of water at 100°C is 760 mmHg, then the vapour pressure of the solution is

- (A) 786.3 mmHg
- (B) 868.6 mmHg
- (C) 827.6 mmHg
- (D) 746.3 mmHg
- (E) None of these

20. For the reaction, $2\text{NO} + \text{H}_2 \rightarrow \text{N}_2\text{O} + \text{H}_2\text{O}$, the

value of $-\frac{dp}{dt}$ was found to be 1.50 torr s^{-1} for a

pressure of 359 torr of NO and 0.25 torr s^{-1} for a pressure of 152 torr of NO, the pressure of H_2 being constant. On the other hand, when the

pressure of NO was kept constant, $-\frac{dp}{dt}$ was 1.60

torr s^{-1} for a hydrogen pressure of 289 torr and 0.79 torr s^{-1} for a hydrogen pressure of 147 torr. Determine the order of the reaction.

- (A) 0
- (B) 1
- (C) 2
- (D) 3
- (E) None of these

21. Which of the following pairs is expected to exhibit the same colour?

- (A) ${}_{58}\text{Ce}^{3+}$, ${}_{67}\text{Ho}^{3+}$
- (B) ${}_{60}\text{Nd}^{3+}$, ${}_{68}\text{Er}^{3+}$
- (C) ${}_{61}\text{Pm}^{3+}$, ${}_{69}\text{Tm}^{3+}$
- (D) ${}_{63}\text{Sm}^{3+}$, ${}_{70}\text{Yb}^{3+}$
- (E) None of these

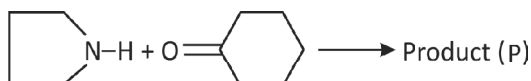
22. In nitroprusside ion, the iron and NO exists as Fe^{II} and NO^+ rather than Fe^{III} and NO. These forms can be differentiated by

- (A) estimating the concentration of iron
- (B) measuring the concentration of CN
- (C) measuring the solid state magnetic moment
- (D) thermally decomposing the compound
- (E) None of these

23. Which of the following salt solution gives white precipitate turning to grey on adding HgCl_2 solution?

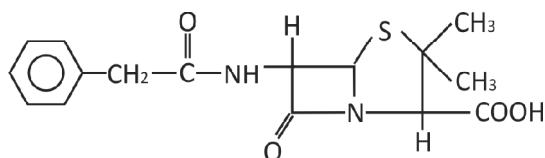
- (A) SnCl_2
 (B) CuCl_2
 (C) PbCl_2
 (D) ZnCO_3
 (E) None of these

24. The structure of the product (P) in the reaction is given by



- (A) (B)
 (C) (D)
 (E) None of these

25. The following structure is known as :



- (A) Ampicillin
 (B) Penicillin-K
 (C) Penicillin-G
 (D) Penicillin-F
 (E) None of these

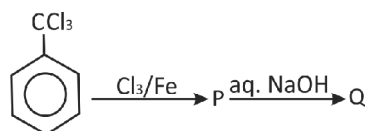
26. Which of the following reactions is not observed?

- (A) $2\text{F}_2 + 2\text{OH}^- \xrightarrow{\text{dilute}} 2\text{F}^- + \text{H}_2\text{O} + \text{OF}_2$
 (B) $2\text{F}_2 + 4\text{OH}^- \xrightarrow{\text{hot conc.}} 4\text{F}^- + 2\text{H}_2\text{O} + \text{O}_2$
 (C) $\text{X}_2 + 2\text{OH}^- \xrightarrow{\text{hot conc.}} \text{H}_2\text{O} + \text{X}^- + \text{XO}^-$
 ($\text{F}_2, \text{Cl}_2, \text{I}_2$)
 (D) $\text{Xe} + \text{F}_2 \xrightarrow{\text{Light}} \text{XeF}_2$
 (E) None of these

27. Which of the following statements is not correct?

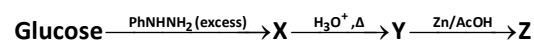
- (A) Stannic chloride is a colourless fuming liquid.
 (B) Stannic chloride is soluble in benzene.
 (C) Stannic chloride cannot be hydrolysed.
 (D) Stannic chloride forms more than one hydrated salt.
 (E) None of these

28. Identify the final product (Q).



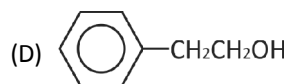
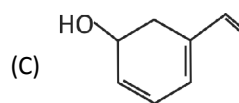
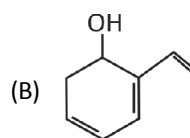
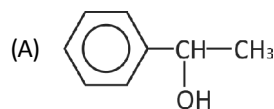
- (A) m-chloro benzene
 (B) m-chloro benzaldehyde
 (C) m-chloro benzoic acid
 (D) m-chloro benzyl alcohol
 (E) None of these

29. The product Z in the following sequence of reactions is



- (A) fructose
 (B) mannose
 (C) arabinose
 (D) Sorbitol
 (E) None of these

30. Compound (X) liberates hydrogen when treated with sodium metal. On oxidation, it gives a compound (Y) with the same number of carbons. Compound (Y) gives orange coloured crystalline 2,4-dinitrophenyl hydrazone derivative with 2,4-dinitrophenyl hydrazine hydrochloride. Compound (Y) on treatment with aqueous NaOH and iodine gives compound (Z). Compound (Z) on treatment with dilute acid yields benzoic acid. The structure of compound (X) is



- (E) None of these

SECTION C: Mathematics

31. The domain of the function,

$$f(x) = \sin^{-1} \left(\ln \left(\frac{x^2}{e} \right) \right) \text{ is}$$

- (A) $[1, e]$ (B) $[-e, -1]$
 (C) $[-e, -1] \cup [1, e]$ (D) $R - (-e, e)$
 (E) None of these

32. In a condenser discharging electricity, the

voltage V satisfies the equation $k \frac{dV}{dt} + V = 0$,

where k is a constant and t is the time measured in second, the time 't' in which V decreases by 75% from its original value is

- (A) $k \log 4$ second (B) $k \log(1/2)$ second
 (C) $k \log 2$ second (D) $k \log(3/4)$ second
 (E) None of these

33. Suppose three digit numbers
- $A28$
- ,
- $3B9$
- and
- $62C$
- , where
- A, B, C
- are integers between 0 and 9, are divisible by a fixed, integer
- r
- , then the

determinant $\begin{vmatrix} A & 3 & 6 \\ 8 & 9 & C \\ 2 & B & 2 \end{vmatrix}$ is divisible by

- (A) r (B) $10r$
 (C) r^3 (D) $3r$
 (E) None of these

34. If
- $\int \tan^7 x dx = f(x) + \log |\cos x|$
- , then

- (A) $f(x)$ is a polynomial of degree 8 in $\tan x$
 (B) $f(x)$ is a polynomial of degree 5 in $\tan x$
 (C) $f(x) = \tan^6 x - \frac{1}{4} \tan^4 x + \frac{1}{2} \tan^2 x + \log |\cos x| + C$
 (D) $f(x)$ is a polynomial of degree 6 in $\tan x$
 (E) None of these

35. The volume of the greatest cylinder which can be inscribed in a cone of height
- h
- and semi-vertical angle
- α
- is

- (A) $\frac{4}{9} \pi h^3 \tan \alpha$ (B) $\frac{5}{29} \pi h^3 \tan^2 \alpha$
 (C) $\frac{13}{25} \pi h^3 \tan \alpha$ (D) $\frac{4}{27} \pi h^3 \tan^2 \alpha$
 (E) None of these

36. The radius of the sphere,

$$\vec{r}^2 - \vec{r} \cdot (4\hat{i} + 2\hat{j} - 6\hat{k}) - 11 = 0, \text{ is}$$

- (A) 10 unit (B) 5 unit
 (C) $\frac{5}{2}$ unit (D) $\frac{15}{2}$ unit
 (E) None of these

37. At a busy traffic junction the probability
- P
- of an individual car having an accident is
- $P = 0.0001$
- . However, during a certain part of the day 1000 cars pass through the junction. The probability that 2 or more accidents occur during that period is (
- $e^{-0.01} = 0.9048$
-)

- (A) 0.0047
 (B) 0.0952
 (C) 0.0472
 (D) 0.0762
 (E) None of these

38. The mean and variance of
- x_1, x_2, \dots, x_n
- is calculated and later it was found that one of the values of
- x_i
- is wrong and should be replaced by
- y_i
- . If
- $T = x_1 + x_2 + \dots + x_n$
- , then the adjustment to the variance to correct this error is

- (A) $\frac{1}{n}(y_i - x_i) \left(x_i + y_i - \frac{y_i - x_i + 2T}{n} \right)$
 (B) $\frac{1}{n}(y_i + x_i) \left(x_i + y_i - \frac{x_i - y_i + 2T}{n} \right)$
 (C) $\frac{1}{n}(x_i + y_i) \left(x_i - y_i - \frac{x_i + y_i + 2T}{n} \right)$
 (D) $\frac{1}{n} \left\{ x_1^2 + x_2^2 + \dots + x_n^2 \right\} - \left\{ \frac{T - x_i + y_i}{2} \right\}^2$
 (E) None of these

39. The value of
- $\int_{-1/\sqrt{3}}^{1/\sqrt{3}} \frac{x^4}{1-x^4} \cos^{-1} \left(\frac{2x}{1+x^2} \right) dx$
- is

- (A) 0
 (B) $\frac{\pi}{\sqrt{3}} + \log \frac{\sqrt{3}+1}{\sqrt{3}-1}$
 (C) $\frac{1}{\sqrt{3}} + \frac{\pi}{2} \log \frac{\sqrt{3}+1}{\sqrt{3}-1}$
 (D) $-\frac{\pi}{\sqrt{3}} + \frac{\pi}{2} \left[\frac{1}{2} \log \frac{\sqrt{3}+1}{\sqrt{3}-1} + \frac{\pi}{6} \right]$
 (E) None of these

40. A is one of six horses entered for a race and is to be ridden by one of the two jockeys B and C. It is 2 to 1 that B rides A, in which case all the horses are equally likely to win, with rider C, A's chance is treble. The odds against A's winning is.

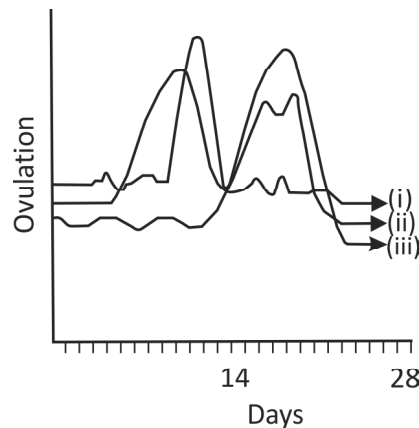
- (A) 12 : 7
 (B) 7 : 12
 (C) 13 : 5
 (D) 12 : 5
 (E) None of these

SECTION D: Biology

31. **Stolonic budding is the characteristic of :**
 (A) Scyphistomae cnidarians and Porifera
 (B) Porifera and tunicates
 (C) Scyphistomae cnidarians and tunicates
 (D) Porifera and Cnidaria
 (E) None of these
32. **Cathepsin is a type of :**
 (A) proteolytic enzyme working at pH 3.0-5.0
 (B) amylase that works in acidic medium
 (C) lipase that works in acidic medium
 (D) secretion of liver that helps in haemostasis
 (E) None of these
33. **Generally archesporium in an ovule is**
 (A) single celled and terminal in origin
 (B) single celled and lies in the centre of the ovule
 (C) single celled and hypodermal in origin
 (D) many celled and lie in the centre
 (E) none of these
34. **Regardless of taxonomic group of region, what is the value of Z in the equation, $\log S = \log c + Z \log a$?**
 (A) 0.6-1.2 (B) 1-1.5
 (C) 0.1-0.2 (D) 1-2
 (E) None of these
35. **Infertility cases due to inability of male partner to inseminate the female corrected by**
 (A) ICSI
 (B) ZIFT
 (C) GIFT
 (D) Artificial insemination
 (E) None of these
36. **pBR322 has two antibiotic resistance genes, they are**
 (A) Streptomycin and ampicillin resistant genes
 (B) Ampicillin and tetracycline resistant genes
 (C) Tetracycline and neomycin resistant genes
 (D) Chloromycetin and tetracycline resistant genes
 (E) None of these
37. **Which one of the following pairs is not correctly matched ?**
 (A) Serratia – Drug addiction
 (B) Rhizobium – Biofertiliser
 (C) Streptomyces – Antibiotic
 (D) Spirulina – Single cell protein
 (E) None of these

38. **Heat killed pathogenic NL cells and live non-pathogenic cells are mixed and injected into mice. The result would be**
 (A) mice develop disease and die
 (B) mice die without developing disease
 (C) mice remain healthy
 (D) 50% mice develop disease and die
 (E) None of these

39. **In the graph given below, (i),(ii) and (iii) respectively shows which of the following hormones?**



- (A) Estradiol, LH, Testosterone
 (B) Progesterone, LH, Estradiol
 (C) Estradiol, LH, Progesterone
 (D) LH, Estradiol, Progesterone
 (E) None of these
40. **Which of the following is/are incorrect statements?**
- Some strains of *Bacillus thuringiensis* produce proteins that kill certain insects such as *Lepidopterans*, *Coleopterans* and *Dipteran*.
 - RNA interference takes place in all eukaryote organisms as a method of cellular defence.
 - Genetically modified crops are more sensible abiotic stresses.
 - Golden rice is protein enriched rice.
 - Agrobacterium* is used to deliver desirable gene into animal cell.
- (A) Only 1 (B) 1, 2 and 3
 (C) 3, 4 and 5 (D) 1, 3 and 4
 (E) None of these



