FIITJEE

Diagnostic cum Scholarship Tests

SAMPLE PAPER

For Students of Class XI

Paper 4 Mathematical Olympiad, Physics & Astronomy Olympiad & Chemistry Olympiad

Duration : 120 minutes **Paper Code: 1011-4** *Maximum Marks : 168*

Please read the instructions and guidelines carefully :

Important Note : Please ensure to accurately input the details for the Question Paper Code as indicated at the top of this sheet (Side 2) into the corresponding columns / fields on the OMR sheet before proceeding with the paper. Incorrectly filled information regarding the class or paper may result in inaccurate outcomes or results.

> *"This paper has been scientifically designed to evaluate your potential – manifested and hidden for the target examinations mentioned in various sections of the paper. Thus, your adherence to the instructions is critical in the evaluation of the same"*

1. This Question paper consists of 3 sections.

2. Student should devote allotted time for each section. If a section is easy, then it is easy for everyone & was meant to be like that with a goal in mind. Do not switch over to another section if you find the section to be easy. If a section is tough, then it is tough for everyone. You are advised to spend 45 Minutes on Section-I, 45 Minutes on Section-II and 30 Minutes on Section-III. Opening the next section before completing the allotted time for the preceding section is not permitted. This adherence is crucial for assessing your true potential, as each section is meticulously crafted to evaluate your potential for the corresponding competitive examinations.

3. Candidate should open the seal of Section-II only after devoting 45 minutes on Section-I and Seal for Section-III is to be opened only after devoting 45 minutes on Section-II.

4. Sheets will be given to each candidate for rough work. Candidate must fill all details on the rough sheet and submit the same to invigilator along with OMR sheet. Candidate must mention the Question No. while doing the rough work in the sheet.

5. Please note candidates are not allowed to bring any prohibited items into the exam hall such as electronic devices, mobile phones, smart watch, earphones, calculators, books, notes, formula sheets, and bags.

6. Marking scheme is given in table below:

Section	Subject		Question no.	Marking Scheme for each question	
				Correct answer	**Wrong answer**
SECTION – I (Mathematical Olympiad) Time Allotted: 45 Minutess	MATHEMATICS	(PART-A)	1 to 10	**+3**	**–1**
	MATHEMATICS	(PART-B)	11 to 15	**+6 * Partial Marking**	**0**
SECTION – II (Physics & Astronomy Olympiad) Time Allotted: 45 Minutes	PHYSICS	(PART-A)	16 to 20	**+3**	**–1**
	MATHEMATICS	(PART-B)	21 to 25	**+3**	**–1**
	PHYSICS	(PART-C)	26 to 28	**+6 * Partial Marking**	**0**
	MATHEMATICS	(PART-D)	29 to 30	**+6 * Partial Marking**	**0**
SECTION – III (Chemistry Olympiad) Time Allotted: 30 Minutes	CHEMISTRY	(PART-A)	31 to 38	**+3**	**–1**
	CHEMISTRY	(PART-B)	39 to 42	**+6 * Partial Marking**	**0**

* Partial Marking: (Q. No. 11 to 15, Q. No. 26 to 30 & Q. No. 39 to 42):

   Full Marks   **: +6**   If only (all) the correct option(s) is(are) chosen;

   Partial Marks   **: +4.5** If all the four options are correct but ONLY three options are chosen;

   Partial Marks   **: +3**   If three or more options are correct but ONLY two options are chosen, both of which are correct;

   Partial Marks   **: +1.5** If two or more options are correct but ONLY one option is chosen and it is a correct option;

   **Zero Marks**   **: 0**   If unanswered/incorrect option(s) chosen;

Section – I

Time: 45 Minutes

MATHEMATICS – (PART – A)

*This part contains **10 Multiple Choice Questions** number **1 to 10**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

1. Suppose x and y are positive real numbers such that $x\sqrt{x} + y\sqrt{y} = 183$ and $x\sqrt{y} + y\sqrt{x} = 182$ then value of $\frac{18}{5}(x+y)$ is:
    (A) 73   (B) 146
    (C) 63   (D) 126

2. If the real numbers a, b, c are such that $a^2 + 4b^2 + 16c^2 = 48$ and $ab + 4bc + 2ca = 24$. Then what is the value of $a^2 + b^2 + c^2$.
    (A) 12   (B) 16
    (C) 21   (D) 31

3. The value of n for which the expression $x^4 + 4x^3 + nx^2 + 4x + 1$ becomes a perfect square is:
    (A) 3   (B) 4
    (C) 5   (D) 6

4. If $x^2 – 3x + 2$ is a factor of $x^4 – px^2 + q$, then the values of p and q respectively are:
    (A) – 5, 4   (B) – 5, – 5
    (C) 5, 4   (D) 5, – 4

5. If α and β are the zeroes of the polynomial $f(x) = x^2 – 5x + k$ such that $\alpha – \beta = 1$, then value of k is:
    (A) 8   (B) 6
    (C) $\frac{13}{2}$ (D) 4

6. If $\frac{x^2 - bx}{ax - c} = \frac{m-1}{m+1}$, has roots which are numerically equal but of opposite signs, the value of m must be:
    (A) (a – b)/(a + b)   (B) (a + b)/(a – b)
    (C) c   (D) 1/c

7. In $\triangle ABC$, $\overline{XY}$ is parallel to $\overline{AC}$ and divides the triangle into the two parts of equal area. Then the $\dfrac{AX}{AB}$ equals
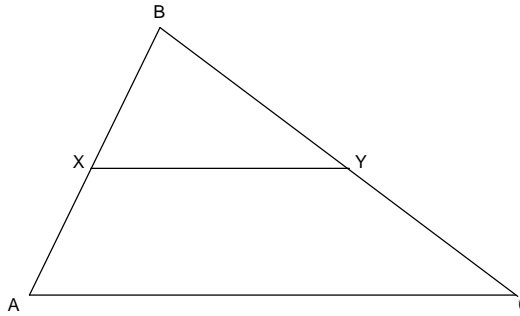
(A) $\dfrac{\sqrt{2}+1}{2}$

(B) $\dfrac{2-\sqrt{2}}{2}$

(C) $\dfrac{2+\sqrt{2}}{2}$

(D) $\dfrac{\sqrt{2}-1}{2}$

8. In the figure, ABC is a triangle in which AD bisects $\angle A$, $AC = BC$, $\angle B = 72^\circ$ and CD = 1 cm. Length of BD (in cm) is
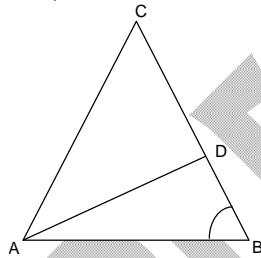
(A) 1

(B) $\dfrac{1}{2}$

(C) $\dfrac{\sqrt{5}-1}{2}$

(D) $\dfrac{\sqrt{3}+1}{2}$

9. If in a triangle ABC, D is the mid point of side BC, $\angle ADB = 45^\circ$ and $\angle ACD = 30^\circ$, then $\angle BAD$ and $\angle ABC$ are respectively equal to

(A) $15^\circ, 105^\circ$

(B) $30^\circ, 105^\circ$

(C) $30^\circ, 100^\circ$

(D) $60^\circ, 100^\circ$

10. If θ is an acute angle such that $\tan\theta = \dfrac{2}{3}$, then evaluate $\left(\dfrac{1+\tan\theta}{\sin\theta+\cos\theta}\right)\left(\dfrac{1-\cot\theta}{\sec\theta+\cos ec\theta}\right)$

(A) $-\dfrac{1}{5}$

(B) $\dfrac{-4}{\sqrt{13}}$

(C) $\dfrac{1}{5}$

(D) $\dfrac{4}{\sqrt{13}}$

MATHEMATICS – (PART – B)

This part contains **5 Multiple Choice Multi Correct Type Questions** *number* **11 to 15.** *Each question has 4 choices (A), (B), (C) and (D), out of which* **MORE THAN ONE** *are correct.*

11. Straight lines 2x + y = 5 and x − 2y = 3 intersect at the point A. Points B and C are chosen on these two lines such that AB = AC. Then the equation of a line BC passing through the point (2, 3) is :
    (A) 3x − y − 3 = 0
    (B) x + 3y − 11 = 0
    (C) 3x + y − 9 = 0
    (D) x − 3y + 7 = 0

12. Consider the equation $12abx^2 - \left(9a^2 - 8b^2\right)x - 6ab = 0$, which of the following are the roots of this equation?

    (A) $\dfrac{3a}{4b}$
    (B) $\dfrac{3b}{4a}$

    (C) $\dfrac{-2b}{3a}$
    (D) $\dfrac{-2a}{3b}$

13. The product of any four consecutive integers will always be a multiple of which of the following
    (A) 6
    (B) 8
    (C) 12
    (D) 24

14. If sin A − √6 cos A = √7 cos A, then the value of cos A + √6 sin A = ?
    (A) $\sqrt{7}\sin\left(180^\circ + A\right)$
    (B) $-\sqrt{7}\sin A$
    (C) $\sqrt{7}\sin\left(90^\circ + A\right)$
    (D) $\sqrt{7}\cos A$

15. If $0 \le \theta \le \pi$ and $\sin\dfrac{\theta}{2} = \sqrt{1 + \sin\theta} - \sqrt{1 - \sin\theta}$, then possible values of tan θ is

    (A) $\dfrac{4}{3}$
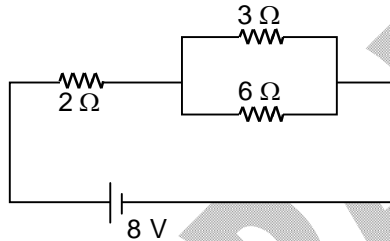   (B) 0

    (C) $\dfrac{-3}{4}$
    (D) $\dfrac{-4}{3}$

Section – II

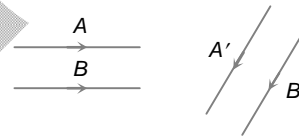# Time: 45 Minutes

PHYSICS – (PART – A)

*This part contains **5 Multiple Choice Questions** number **16 to 20**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

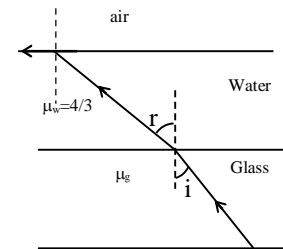16. In the given circuit the heat circuit the heat radiated by 3 Ω resistance in 3 seconds duration is

    (A) 12 J   (B) 18 J
    (C) 14 J   (D) 16 J

17. The figure shows two rays *A* and *B* being reflected by a mirror and going as *A'* and *B'*. The mirror is
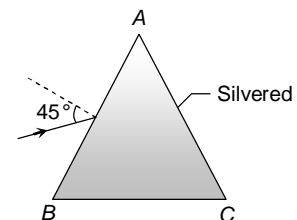   (A) Plane
    (B) Concave
    (C) Convex
    (D) May be any spherical mirror

18. A ray of light is incident at an angle i at the glass water interface as shown in figure. It emerges finally parallel to the surface of water then the value of μ_g would be
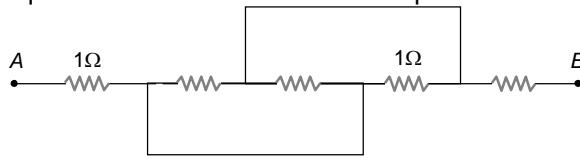   (A) 4/3 sin i
    (B) 1/sin i
    (C) sin i
    (D) 1

19. A prism *ABC* of angle 30° has its face *AC* silvered. A ray of light incident at an angle of 45° at the face *AB* retraces its path after refraction at face *AB* and reflection at face *AC*. The refractive index of the material of the prism is
    (A) 1.5
    (B) $\dfrac{3}{\sqrt{2}}$
    (C) $\sqrt{2}$
    (D) $\dfrac{4}{3}$

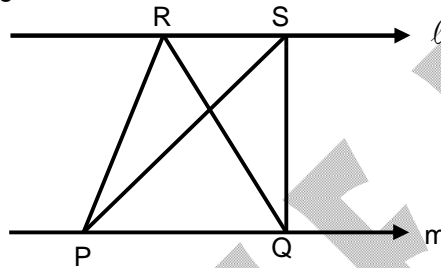20. Equivalent resistance between the points A and B is (in Ω)

(A) $\dfrac{1}{5}$

(B) $1\dfrac{1}{4}$

(C) $2\dfrac{1}{3}$

(D) none of these

MATHEMATICS – (PART – B)

*This part contains **5 Multiple Choice Questions** number **21 to 25**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

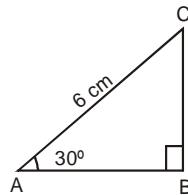21. In the given figure $\ell \parallel m$, RP = RQ also P(RPQ) means perimeter of $\triangle$RPQ, then which of the following is correct?

(A) P(RPQ) = P(SPQ) (B) P(RPQ) < P(SPQ)
(C) P(RPQ) > P(SPQ) (D) none of these

22. In $\triangle$ABC, BE and CD are medians on AC and AB respectively. If BE = 12 cm, CD = 9 cm and BC = 10 cm then ar($\triangle$BGC), where G is centroid of the $\triangle$ABC
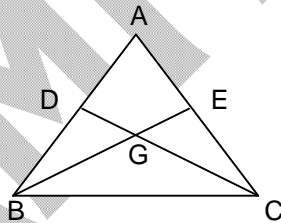
(A) 24 cm^2 (B) 32 cm^2
(C) 30 cm^2 (D) 20 cm^2

23. In the adjoining figure, the length of BC is

(A) $2\sqrt{3}$ cm (B) $3\sqrt{3}$ cm
(C) $4\sqrt{3}$ cm (D) 3 cm

24. A ladder 13 m long, placed against a wall, reaches a 12 m high window. If suppose, the foot of the ladder slipped by 7 m, then how high above the ground is the other end of ladder now :
(A) 7 m (B) 5 m
(C) 6 m (D) 8 m

25. The angles of elevation of the top of a tower from two points which are at the distances 'a' and 'b' from the base and in the same straight line with it are complementary. The height of the tower is _____

(A) $\sqrt{\dfrac{a}{b}}$ (B) $a\sqrt{b}$
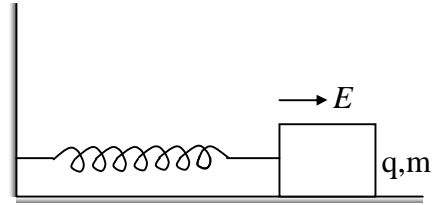
(C) $\sqrt{ab}$ (D) $b\sqrt{a}$

PHYSICS – (PART – C)

*This part contains **3 Multiple Choice Multi Correct Type Questions** number **26 to 28**. Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

26. Two equal negative charge $-q$ are fixed at the fixed points $(0, a)$ and $(0, -a)$ on the Y-axis. A positive charge Q is released from rest at the point $(2a, 0)$ on the X-axis. Then for charge Q which of the following options are incorrect
(A) Execute simple harmonic motion about the origin
(B) Move to the origin and remain at rest
(C) Move to infinity
(D) Execute oscillatory but not simple harmonic motion

27. Pulfrich refractometer is used to measure the refractive index of solids and liquid. It consists of right angled prism A having its two faces perfectly plane. One of the faces is horizontal and the other is vertical as shown in the figure. A glass slab B is placed on a prism. Light is incident in a direction parallel to the horizontal surface so that the light entering the prism A is at critical angle C. Finally, it emerges from the prism at an angle i. Let the refractive index of the slab be μ and that of the prism A be $\mu_0 = \sqrt{2}$.
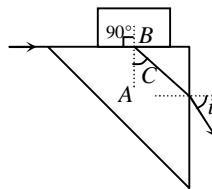
(A) If angle $i = 45°$, refractive index μ of the slab is $\sqrt{\dfrac{3}{2}}$

(B) If angle $i = 45°$, the value of $\sin C$ is $\dfrac{\sqrt{3}}{2}$

(C) If the ray just fail to emerge from the prism, refractive index μ of the slab will be equal to 1
(D) A ray incident on the slab at an angle of incidence equals to 53° on the vertical face of the slab. A ray fail to emerge from the prism, then refractive index of the slab will be equal to $\dfrac{\sqrt{41}}{5}$

28. A block having mass m and charge *q* is connected by spring of force constant *k*. The block lies on a frictionless horizontal track and a uniform electric field *E* acts on system as shown. The block is released from rest when spring is unstretched. Then


(A) maximum stretch in the spring is $\dfrac{2qE}{k}$

(B) in equilibrium position, stretch in the spring is $\dfrac{qE}{k}$

(C) amplitude of oscillation of block is $\dfrac{qE}{k}$

(D) amplitude of oscillation is $\dfrac{2qE}{k}$

MATHEMATICS – (PART – D)

*This part contains **2 Multiple Choice Multi Correct Type Questions** number **29 to 30**. Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

29. If A(3,4), B(2,5) & C(6,7) then triangle ABC has
    (A) circumcenter at (4,6) (B) orthocenter at (3,4)

    (C) $\angle BAC = \dfrac{\pi}{2}$ (D) $\angle BCA = \dfrac{\pi}{2}$

30. D, E and F are respectively the mid points of sides AB, BC and CA of △ABC. Find ratio of areas of △DEF and △ABC
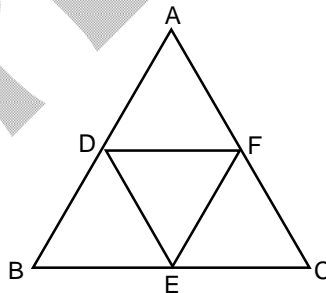
(A) 1 : 4 (B) 0.5 : 2
(C) 1 : 2 (D) 1 : 8

Section – III

Time: 30 Minutes

CHEMISTRY – (PART – A)

*This part contains **8 Multiple Choice Questions** number **31 to 38**. Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

31. According to Lewis acid-base concept, which is a correct statement?
    (A) Species in which central atom has completed octet cannot act as acid.
    (B) All negatively charged ions are acids.
    (C) Molecule in which the central atom has vacant "d" orbitals acts as acid.
    (D) All positively charged ions are bases.

32. Which statement is true about the most stable Lewis structure of CS_2?
    (A) There are no lone pairs
    (B) All bonds are double
    (C) The central atom does not have an octet of electrons
    (D) A sulphur atom must be central atom for structure to be stable

33. Which molecule has a sigma (σ) and two Pi(π) bonds between 2 carbons atoms?
    (A) C_2H_2 (B) C_2H_4
    (C) C_2H_6 (D) C_3H_6

34. Mohr's salt is a
    (A) Normal salt   (B) Acid salt
    (C) Basic salt   (D) Double salt

35. Which one of the following is true in case of base?
    (A) It acts as an electron pair donor.
    (B) It accepts electron
    (C) It turns blue litmus red
    (D) It is colourless in presence of phenolphthalein

36. Which of the following is a homogenous reaction?
    (A) $C(s) + O_2(g) \rightarrow CO_2(g)$ (B) $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$
    (C) $N_2(g) + O_2(g) \rightarrow 2NO(g)$ (D) $CaO(s) + H_2O(\ell) \rightarrow Ca(OH)_2(aq)$

37. Which of the following elements does not show disproportionation tendency?
    (A) Cl   (B) Br
    (C) F   (D) I

38. Which is not true for diamond?
    (A) all the four valence electrons are bonded to carbon atoms by covalent bonds
    (B) it is a giant molecule
    (C) it is made up of carbon atoms
    (D) it cannot be burnt at any temperature

CHEMISTRY – (PART – B)

*This part contains **4 Multiple Choice Multi Correct Type Questions** number **39 to 42**. Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

39. Select equations having endothermic step:
    (A) $S^-_{(g)} \longrightarrow S^{2-}_{(g)}$
    (B) $Na^+_{(g)} + Cl^-_{(g)} \longrightarrow NaCl_{(s)}$
    (C) $N_{(g)} \longrightarrow N^-_{(g)}$
    (D) $Al^{2+}_{(g)} \longrightarrow Al^{3+}_{(g)}$

40. Which of the following oxides is/are amphoteric?
    (A) Na_2O
    (B) CaO
    (C) Al_2O_3
    (D) SnO_2

41. The types of bonding found in dry ice is/are
    (A) Covalent
    (B) Ionic
    (C) Metallic
    (D) Vander Waal

42. Choose the correct sets which represents the oxides as acidic : basic : neutral : amphoteric respectively.
    (A) $CO_2 : MgO : N_2O : H_2O$
    (B) $P_2O_5 : ZnO : NO : Al_2O_3$
    (C) $SO_2 : NO : CO : Al_2O_3$
    (D) $SO_3 : CaO : N_2O : PbO$

FIITJEE

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SAMPLE PAPER
For Students of Class XI

Paper 4 Mathematical Olympiad, Physics & Astronomy Olympiad & Chemistry Olympiad

Paper Code: 1011-4

ANSWER KEY

1.	**B**	2.	**C**	3.	**D**	4.	**C**
5.	**B**	6.	**A**	7.	**B**	8.	**C**
9.	**B**	10.	**A**	11.	**A, B**	12.	**A, C**
13.	**A, B, C, D**	14.	**A, B**	15.	**B, D**	16.	**D**
17.	**A**	18.	**B**	19.	**C**	20.	**C**
21.	**B**	22.	**A**	23.	**D**	24.	**B**
25.	**C**	26.	**A, B, C**	27.	**A, B, C, D**	28.	**A, B, C**
29.	**A, B, C**	30.	**A, B**	31.	**C**	32.	**B**
33.	**A**	34.	**D**	35.	**A**	36.	**C**
37.	**C**	38.	**D**	39.	**A, C, D**	40.	**C, D**
41.	**A, D**	42.	**A, D**				