FTRE

FIITJEE TALENT REWARD EXAM

SAMPLE PAPER

for Students presently in Class XI

Paper 4 Physics & Astronomy Olympiad & Mathematics Olympiad

Duration : 90 minutes *Maximum Marks : 120*

Please read the instructions and guidelines carefully :

Important Note : Please ensure to accurately input the details for the Class and Paper No. as indicated at the top of this sheet 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 2 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.** Please note that each section has been allocated a time limit of 45 minutes. Dedicating the full 45 minutes to finish each section successfully is essential. 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 completing 45 minutes of Section-I.
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 (Physics & Astronomy Olympiad) Time Allotted: 45 Minutes	PHYSICS	(PART-A)	1 to 5	**+3**	**–1**
	MATHEMATICS	(PART-B)	6 to 10	**+3**	**–1**
	PHYSICS	(PART-C)	11 to 13	**+6 * Partial Marking**	**0**
	MATHEMATICS	(PART-D)	14 to 15	**+6 * Partial Marking**	**0**
SECTION – II (Mathematics Olympiad) Time Allotted: 45 Minutes	MATHEMATICS	(PART-A)	16 to 25	**+3**	**–1**
	MATHEMATICS	(PART-B)	26 to 30	**+6 * Partial Marking**	**0**

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

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

PHYSICS – (PART – A)

*This part contains **5 Multiple Choice Questions** number **1 to 5.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

1. A particle is moving in a circle of radius $\frac{2}{3}$m and mass of the particle is 2 kg. The kinetic energy of the particle depends on distance 'S' travelled by the particle as K.E. = $4S^4$. The angle made by net acceleration with the radial acceleration when the particle rotate by 60°, is

(A) $\tan^{-1}\left(\frac{3}{\pi}\right)$ (B) $\tan^{-1}\left(\frac{6}{\pi}\right)$

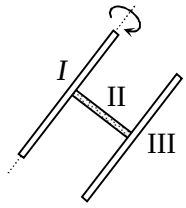
(C) $\tan^{-1}\left(\frac{1}{\pi}\right)$ (D) $\tan^{-1}\left(\frac{4}{\pi}\right)$

2. A person wants to drive on the vertical surface of a large cylindrical wooden 'well' commonly known as 'deathwell' in a circus. The radius of the 'well' is 2 meter, and the coefficient of friction between the tyres of the motorcycle and the wall of the well is 0.2 The minimum speed the motorcyclist must have in order to prevent slipping should be (take g = 10 m/s^2)

(A) 10 m/s (B) 15 m/s

(C) 20 m/s (D) 25 m/s

3. A structure in the shape of letter *H* is formed with the help of three identical rods each of length *l*. The system can rotate along axis *I*. The angular speed of the system when plane of *H* becomes vertical from its original position of rest along the horizontal.



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

(C) $\frac{1}{3}\sqrt{\frac{g}{l}}$ (D) $\frac{3}{4}\sqrt{\frac{g}{l}}$

4. A body of mass m and radius r is released from rest along a smooth inclined plane of angle of inclination θ. The angular momentum of the body about the instantaneous point of contact on the incline from the instant of release is equal to

(A) mgrt cos θ (B) mgrt sin θ

(C) (3/2) mgrt sin θ (D) None of these

5. A bus can be stopped by applying a retarding force F when it is moving with speed 'v' on a level. road. The distance covered by it before coming to rest is 's'. If the load of the bus increases by 50% because of passengers, for the same speed and same retarding force, the distance covered by the bus to come to rest shall be

(A) 1.5 s (B) 2 s

(C) 1 s (D) 2.5 s

MATHEMATICS – (PART – B)

*This part contains **5 Multiple Choice Questions** number **6 to 10.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

6. If $f(\theta) = \frac{1-\sin 2\theta+\cos 2\theta}{2\cos 2\theta}$, then f(11°) f(34°) = ?

(A) $\frac{1}{2}$ (B) $\frac{3}{2}$

(C) 1 (D) None of these

7. A chord of parabola $y^2 = 4ax$ touches another parabola $y^2 = 4bx$. The locus of point of intersection of tangents to extremities of this chord is conic whose latus rectum is

(A) $\frac{4a^2}{b}$ (B) $\frac{4b^2}{a}$

(C) $\frac{4a^2}{b^2}$ (D) None of these

8. Number of integral value/s of 'α' for which $z + \alpha |z - 1| + 2i = 0$ has a solution $(\alpha \in R)$ is

(A) 2 (B) 3

(C) 4 (D) None of these

9. Let $\alpha > 0$, $\beta > 0$ be such that $\alpha^3 + \beta^2 = 4$. If maximum value of term independent of x in $\left(\alpha x^{1/9} + \beta x^{-1/6}\right)^{10}$ is 10 k, then k =

(A) 336 (B) 633

(C) 335 (D) None of these

10. Let $P(t_1)$, $Q(t_2)$ and $R(t_3)$ be three points on $y^2 = 4ax$ forms a triangle PQR with orthocentre at focus then $(t_1 - 1)(t_2 - 1)(t_3 - 1)$ =

(A) 3 (B) 2

(C) 4 (D) None of these

PHYSICS – (PART – C)

*This part contains **3 Multiple Choice Multi Correct Type Questions** number **11 to 13.** Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

11. At time t = 0, car moving along a straight line has a velocity of 16 m/s. It slows down with an acceleration of $-0.5t\ m/s^2$, where t is in second. Mark the correct statement(s)

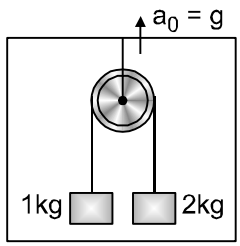
(A) The direction of velocity changes at t = 8 sec

(B) The distance travelled in 4 sec is 58.67 m

(C) The distance travelled by the particle in 10 sec is 94 m

(D) The velocity at t_4 = 10 sec is - 9 m/s

12. The figure shows a pulley mass system (assume mass of pulley and string is negligible) which is kept in an elevator that is moving upward with an acceleration a = g. Then



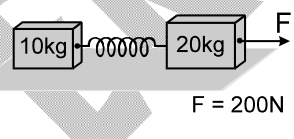
(A) tension in string is $\frac{8}{3}g$

(B) tension in string is $\frac{7}{3}g$

(C) acceleration of 1 kg mass with respect to ground is $\frac{4}{3}g$

(D) acceleration of 1 kg mass with respect to ground is $\frac{5}{3}g$

13. Two blocks of masses 10 kg and 20 kg are connected by a light spring as shown. A force of 200 N acts on the 20 kg mass as shown. At a certain instant the acceleration of 10 kg mass is 12 ms^{-2}.



(A) At that instant the 20 kg mass has an acceleration of 12 ms^{-2}.
(B) At that instant the 20 kg mass has an acceleration of 4 ms^{-2}.
(C) The stretching force in the spring is 120 N.
(D) The collective system moves with a common acceleration of 30 ms^{-2} when the extension in the connecting spring is the maximum.

MATHEMATICS – (PART – D)

*This part contains **2 Multiple Choice Multi Correct Type Questions** number **14 to 15.** Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

14. If $\alpha_1 < \alpha_2 < \alpha_3 < \alpha_4 < \alpha_5 < \alpha_6$, then equation $(x - \alpha_1)(x - \alpha_3)(x - \alpha_5) + 3(x - \alpha_2)(x - \alpha_4)(x - \alpha_6) = 0$ has

(A) 3 real roots
(B) no real root in $(-\infty, \alpha_1)$
(C) one real root in (α_1, α_2)
(D) no real root in (α_5, α_6)

15. If $\sqrt{2}\cos A = \cos B + \cos^3 B$ and $\sqrt{2}\sin A = \sin B - \sin^3 B$, then $\sin(A - B) =$

(A) $\frac{1}{3}$
(B) $\frac{-1}{3}$
(C) $\frac{1}{\sqrt{3}}$
(D) None of these

Section – II

Time: 45 Minutes

MATHEMATICS – (PART – A)

*This part contains **10 Multiple Choice Questions** number **16 to 25.** Each question has 4 choices (A), (B), (C) and (D), out of which **ONLY ONE** is correct.*

16. If $\cos x + \sec x = -2$, then for a positive integer n, $\cos^n x + \sec^n x$ is
(A) always 2 (B) always -2
(C) 2, if n is odd (D) 2, if n is even

17. The value of $\sum_{r=1}^{1024} [\log_2 r]$ is equal to, ([.] denotes the greatest integer function)
(A) 8192 (B) 8204
(C) 8194 (D) None of these

18. Domain of $\log_{1/2}\log_4\log_3[(x-4)^2]$ is, [.] denotes the integer function .
(A) $(-\infty, 2] \cup [6, \infty)$ (B) $(-\infty, 2] \cup [6, 8)$
(C) (2, 6) (D) [2, 6]

19. If P(x) be a polynomial satisfying the identity $P(x^2) + 2x^2 + 10x = 2x\,P(x+1) + 3$, then P(x) is
(A) 2x +3 (B) 3x- 4
(C) 3x + 2 (D) 2x –3

20. Let $f(x) = \left(\frac{e^{x\ln(2^x-1)} - (2^x-1)^x \sin x}{e^{x\ln x}}\right)^{\frac{1}{x}}$. Then right hand limit of f (x) at x = 0
(A) is equal to ln 2 (B) is equal to $\frac{\ln 2}{e}$
(C) is equal to e ln 2 (D) does not exist

21. The value of $1 + 2\sin^2\theta + 3\sin^4\theta + 4\sin^6\theta + ...\infty$ is $\left(\text{where } \theta \neq \frac{(2n+1)\pi}{2}\right)$
(A) $1 + \tan^4\theta$ (B) $(\sec^2\theta - \sec\theta\tan\theta)^2$
(C) $\sec^4\theta$ (D) None of these

22. Number of common terms in two Ap's 2, 5, 8, 11, …..179 and 3, 5, 7, 9….., 101 are
(A) 16 (B) 17
(C) 18 (D) None of these

23. Length of focal chord of the parabola $y^2 = 16x$. Inclined at an angle 30^0 with the x-axis, is
(A) 4 (B) 16
(C) 64 (D) 128

24. If lines x + y = c_1 and $x + y = c_2$ are two tangents to the circle $x^2 + y^2 = 16$, then $|c_1 + c_2|$ is equal to

(A) 0 (B) $2\sqrt{2}$

(C) $4\sqrt{2}$ (D) $8\sqrt{2}$

25. Let a, b, c, a_1, b_1, $c_1 \in R$ and $ax^2 + bx + c > 0 \ \forall \ x \in R$ and $a_1x^2 + b_1x + c_1 > 0 \ \forall \ x \in R$. Then

(A) $aa_1x^2 + bb_1x + cc_1 > 0 \ \forall \ x \in R$

(B) $aa_1x^2 + bb_1x + cc_1 < 0 \ \forall \ x \in R$

(C) $aa_1x^2 + bb_1x + cc_1 = 0$, will have real roots.

(D) Nothing can be said in general about the nature of roots of $aa_1x^2 + bb_1x + cc_1 = 0$,

MATHEMATICS – (PART – B)

*This part contains **5 Multiple Choice Multi Correct Type Questions** number **26 to 30.** Each question has 4 choices (A), (B), (C) and (D), out of which **MORE THAN ONE** are correct.*

26. A parabola S = 0 has its vertex at (-9, 3) and its touches the x-axis at the origin then equation of symmetry of parabola can be

(A) $x - y + 12 = 0$ (B) $x - 2y + 15 = 0$

(C) $2x - y + 21 = 0$ (D) $x + y + 6 = 0$

27. If graph of the equation $x^3 + 3x^2y + 3xy^2 + y^3 - x^2 + y^2 = 0$ comprises of a line L = 0 and a conic section S = 0 then

(A) Eccentricity of conic section is $\sqrt{2}$ (B) $L = 0$ is axis of conic

(C) Focus of conic is at (0, 0) (D) Length of L.R. of conic is $\frac{1}{\sqrt{2}}$

28. ΔABC is inscribed in $x^2 + y^2 = 16$ internal angular bisector of $\angle A$ intersects BC at D. If tangent drawn to circle at A intersects BC produced at P. If AB : AC = 3 : 2, then which of following is/are correct.

(A) $\frac{PA}{PD} = 1$ (B) $\frac{PA}{PD} = \frac{3}{2}$

(C) If $BC = \frac{5}{2}$, then $PA = 3$ (D) If $BC = \frac{5}{2}$, then PA = 4

29. If three positive unequal numbers a, b, c are in H. P., then

(A) a + c > 2b (B) $a^2 + c^2 > 2b^2$

(C) $a^2 + c^2 > 2ac$ (D) None of these.

30. If a, b and c are three terms of an A.P. such that $a \neq b$, then $\frac{b - c}{a - b}$ may be equal to

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

(C) 1 (D) 3

FIITJEE TALENT REWARD EXAM

for Students presently in Class XI (Paper 4)

ANSWER KEY

(SAMPLE PAPER)

1.	B	2.	A	3.	A	4.	B
5.	A	6.	A	7.	A	8.	B
9.	A	10.	C	11.	A, B, C, D	12.	A, D
13.	B, C	14.	A, B, C	15.	A, B	16.	D
17.	B	18.	A	19	A	20.	B
21.	C	22.	B	23.	C	24.	A
25.	D	26.	A, B	27.	B, D	28.	A, C
29.	A, B, C	30.	C, D				