FIITJEE

Maharashtra Science Talent Search Examination

(only for Maharashtra State Students)

SAMPLE PAPER

Code	1102

Time: 180 minute (10:00 am - 01:00 pm) **Maximum Marks: 270**

Please read the instructions carefully. Additional 30 minutes (09:30 am - 10:00 am) will be provided for Reading the Examination Instructions and filling up the information on the ORS Sheet.

INSTRUCTIONS

A: General :

1. Please check this Question Paper contains all 90 questions in serial order. If not so, exchange for the correct Question Paper Booklet.
2. Please immediately fill in the particulars on this page of the Test Booklet with Blue/Black Ball point pen.
3. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed.
4. The answer sheet, a machine-gradable Objective Response Sheet (ORS) is provided separately.
5. Do not Tamper/mutilate the **ORS** or this booklet.
6. No additional sheets will be provided for rough work.
7. On completion of this test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. ***However, the candidates are allowed to take away this Test Booklet with them.***

B: Questions paper format & **Marking Schema:**

1. The question paper consists of **FOUR** **Parts: PART I** (IQ), **II** (Physics), **III** (Chemistry), **IV** (Mathematics)
2. PART I contains **30** single choice correct type questions. Each question has four choices (A), (B), (C) and (D) of which one and only one is correct.
3. PART II, III and IV each has got **20** single choice correct type questions in Physics. Each question has four choices (A), (B), (C) and (D) of which one and only one is correct.
4. **You are advised to devote 1 hour on PART I and 2 hours on PART II, III & IV.**
5. For each question, in all three PARTs**,** you will be awarded **3** **marks** if you darken the bubble corresponding to the correct answer **ONLY** and **zero (0) marks** if no bubbles are darkened. In all other cases, **minus one (–1) mark** will be awarded.

Registration No. : | | | | | | | | | | | | | | | | | | | | |

Name of Candidate : _____

Test Centre: _____

PART – I: IQ

SECTION A

Single Correct Choice Type

Each question has 4 choices (A), (B) (C) and (D) for its answer, out of which **ONLY ONE** is correct.

1. The product of two functions is 14/15 and their quotient is 35/24. The greater function is:
(A) 4/5 (B) 7/6
(C) 7/4 (D) 7/3

2. The cost of an article are Rs. 75. The cost was first increased by 20% and later on it was reduced by 20%. The present cost of the article is:
(A) 60 (B) 72
(C) 90 (D) 75

3. If 10 men or 20 boys can make 260 mats in 20 days , then how many mats will be made by 8 men and 4 boys in 20 days?
(A) 260 (B) 240
(C) 520 (D) 280

4. Four bells ring at interval 6, 12, 18, 24 seconds. They starts ringing simultaneously at 8'0 clock. When will they ring again together?
(A) 1 minutes 12 seconds past 8 (B) 2 minutes 24 seconds past 8
(C) 5 minutes 17 seconds past 8 (D) 2 minutes 27 seconds past 8

5. Reptile is to lizard as flower is to
(A) petal (B) stem
(C) daisy (D) alligator

6. A cricketer has a certain average of runs for his 64 innings. In his 65^{th} inning, he is bowled out for no score on his part. This brings down his average by 3 runs. His new average runs is:
(A) 195 (B) 130
(C) 192 (D) 128

7. A fruit seller buys bananas at 2 for a rupee and sells them at 5 for three rupees. His profit per cent is:
(A) 25 (B) 10
(C) 15 (D) 20

SPACE FOR ROUGH WORK

8. How many numbers between 11 and 90 are divisible by 7?
(A) 10 (B) 11
(C) 12 (D) 7

9. Ratio of milk is to water in certain solution of 75 litres in 2:1. How much water is to be mixed in solution so that ratio becomes 1:2 :
(A) 75 litres (B) 60 litres
(C) 65 litres (D) 80 litres

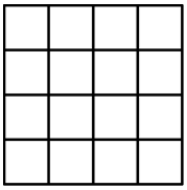
10. The average of the first 100 natural number is
(A) 51 (B) 100
(C) 50.5 (D) 101

11. The unit's digit in the expansion $(2317)^{759}$ is:
(A) 7 (B) 9
(C) 3 (D) 1

12. Choose the correct alternative which shows the same relationship with the word as the words of the given pair
bear:
sword : slaughter : : auger : ____
(A) Dig (B) carve
(C) Bore (D) grind

13. Select the wrong number in the series
6, 26, 62, 123, 214, 341
(A) 26 (B) 62
(C) 123 (D) 214

14. In given figures, how many squares are there?



(A) 28 (B) 32
(C) 16 (D) 30

15. Insert the missing number:
5 26 1
9 84 3
11 ? 5
(A) 104 (B) 146
(C) 126 (D) 60

SPACE FOR ROUGH WORK

Direction Question 16 – 18: Select the pair that has the same relationship as the original pair of Words / numbers:

16. 11: 1210
(A) 6: 216 (B) 7: 1029
(C) 8: 448 (D) 9: 729

17. ADG: KNQ: BEH: ___
(A) CFI (B) ILO
(C) LOR (D) MPS

18. Part: Whole:: Arc : ___
(A) Area (B) Chord
(C) Circumference (D) Segment

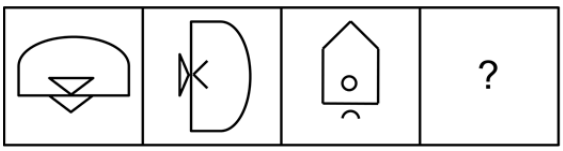
19. In a code language, 'LONDON' is written as MPOEPO, what is CPNCBZ?
(A) DQODCA (B) MADRAS
(C) BOMBAY (D) RAJKOT

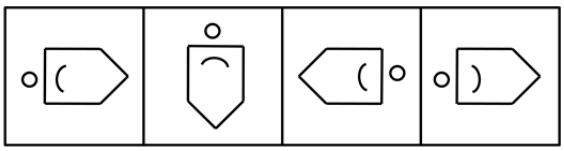
20. A man is facing East. He turns 135 in the anticlockwise direction and then 90 in the clockwise direction. Which direction is he facing now?
(A) North – East (B) North - West
(C) South – West (D) South – East

21. Which two months in a year have the same calendar?
(A) June, October (B) April, November
(C) April, July (D) October, December

22. Dipti is performing Shirshashan facing towards West. In which direction will her right Shoulder be?
(A) North (B) East
(C) West (D) South

23. There is a definite relationship between figures A and B. Establish a similar relationship between figures C and D by selecting a suitable figure form the answer set

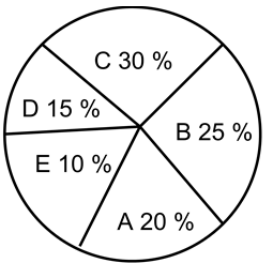




SPACE FOR ROUGH WORK

Direction Questions 24 – 25: Refer to following pie chart. The following pie diagram shows the expenditure incurred on the preparation of a book by publisher Under various head:

A. Paper 20%
B. Printing 25%
C. binding Designing 30%
D. Royalty 15% or
E. Miscellaneous 10%



24. What is the angle of Pie diagram showing the expenditure incurred on paying royalty
(A) 54 (B) 45
(C) 48 (D) 60

25. Which two expenditure together will form an angle of 108 at the centre of pie – diagram?
(A) B and E (B) A and E
(C) A and D (D) D and E

26. If the difference between the expenditure be represented by 18 in the pie diagram. These expenditure are:
(A) B and E (B) A and C
(C) B and D (D) B and C

27. If $x = \sqrt{136 + \sqrt{52 + \sqrt{144}}}$ then value of x equals:
(A) 12 (B) 11
(C) 10 (D) 13

28. A number whose double is 48 greater than its half: is-
(A) 30 (B) 32
(C) 31 (D) 29

29. Value of $1 + \dfrac{1}{1 + \dfrac{1}{1 - \dfrac{1}{6}}}$ is
(A) 16/11 (B) 1
(C) 11/16 (D) 10

30. Simple interest on a sum of money is 1/25 of the principle and the numbers of the years is equal to the rate percent per annum is:
(A) $2\frac{1}{2}\%$ (B) 2%
(C) $3\frac{1}{2}\%$ (4) $1\frac{1}{2}\%$

SPACE FOR ROUGH WORK

PART – II: Physics

Each question has 4 choices (A), (B) (C) and (D) for its answer, out of which **ONLY ONE** is correct.

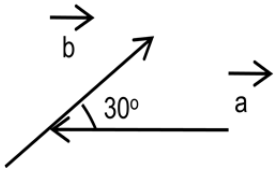
31. $\vec{A}$ and $\vec{B}$ are two vectors angle between then 90^o. Where $|\vec{A}| = |\vec{B}| = 5$ units. $\vec{C}$ is a vector such that $\vec{A}+\vec{B}+\vec{C} = 0$. What is the magnitude of $\vec{C}$?

(A) $5\sqrt{2}$ (B) $5/\sqrt{2}$
(C) 10 (D) zero

32. Which one is scalar
(A) force (B) work
(C) momentum (D) torque

33. At what angle should the two forces 2P and $\sqrt{2}$ P act so that the resultant force is P $\sqrt{10}$
(A) 45^o (B) 60^o
(C) 90^o (D) 120^o

34. The angle between the vectors as shown in figure given below is
(A) 30^o (B) 120^o
(C) 60^o (D) 150^o



35. A body is allowed to fall freely. The distance travelled by it in four seconds of its fall is equal to the distance travelled by it in the next three seconds of its fall and each is equal to d. The value of d is($g = 10\ m/s^2$)
(A) 220 m (B) 390 m
(C) 420 m (D) 470 m

36. A ball is dropped from the top of the tower of height h. It covers a distance of h/2 in the last second of its motion. The value of h is,
(A) 58.28 m (B) 68.28 m
(C) 8 m (D) 100 m

37. Two balls are dropped from the same point after an interval of 1 sec. If acceleration due to gravity is $10\ m/s^2$, the distance of separation between them 3 seconds after the release of first ball is
(A) 5 m (B) 10 m
(C) 25 m (D) 30 m

SPACE FOR ROUGH WORK

38. A paper weight is dropped from a roof of a block of multi storey flats, each storey being 3m high. It passes the ceiling of the 20th storey from the bottom at 30 m/s. If g=10 m/s^2, the number of storeys the building is
(A) 28 (B) 35
(C) 42 (D) 21

39. A body is projected vertically up with some velocity 'u'. It travels 35m in the last second of its total flight. If velocity of projection is doubled, the distance it travelled in the last second of its total flight is
(A) 70 m (B) 75 m
(C) 80 m (D) 60 m

40. A man in a lift ascending with certain acceleration throws a ball vertically up with a velocity 'V' and catches it after a time of 2 sec. If that lift descends with the same acceleration and throws the ball with same way with same velocity catches it after 3 sec., then V is
(A) 6 m/s (B) 24 m/s
(C) 12 m/s (D) 25/3 m/s

41. A body is projected vertically upwards. During its ascent the acceleration is $g\vec{j}$, during its descent acceleration acting on it is.
(A) $g\vec{j}$ (B) $-g\vec{j}$
(C) $g\vec{i}$ (D) zero

42. A rocket is fired vertically from the ground. It moves upwards with a constant acceleration 10 m/s^2 for 30 seconds after which the fuel is consumed. After what time from the instant of firing the rocket will attain the maximum height? ($g = 10ms^{-2}$)
(A) 30 sec (B) 45 sec
(C) 60 sec (D) 75 sec

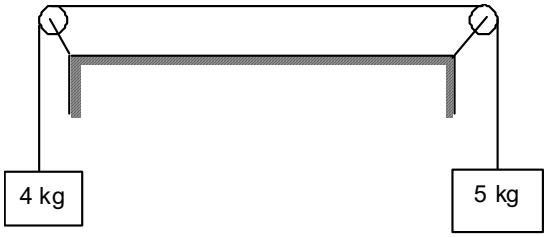
43. A ball is thrown upwards from the ground with an initial speed u. The ball is at a height of 80m at two times, the time interval being 6sec. The value of u is ($g = 10\ ms^{-2}$)
(A) 10 m/s (B) 25 m/s
(C) 50 m/s (D) 20 m/s

44. A 45 kg block is being pulled vertically up by a string whose breaking strength is 495N. With what maximum acceleration the block the block can be pulled up ($g = 10\ m/s^2$)
(A) 11 m/s^2 (B) 10 m/s^2
(C) 1 m/s^2 (D) 21 m/s^2

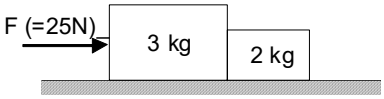
SPACE FOR ROUGH WORK

45. A lift is moving up with an acceleration of 3.675 m/s^2. The weight of a man
(A) increases by 36.75 %
(B) decreases by 37.5 %
(C) increases by 137.5 %
(D) remain the same

46. Two bodies of masse 5 kg and 4 kg are arranged as shown in figure. The acceleration of 5 kg block is
(A) $\frac{5}{9}g$
(B) $\frac{1}{9}g$
(C) $\frac{g}{4}$
(D) none



47. In the shown arrangement, the force exerted by 2 kg block on 3 kg block in absence of any friction will be
(A) 10 N
(B) 5 N
(C) 15 N
(D) zero



48. The relation between the displacement x and the time t for a body of mass 2 kg moving under the action of a force is given by $x = \frac{t^3}{3}$, where x is in meters and t is in seconds. The work done by the body in the first 2 seconds is
(A) 1.6 J
(B) 16 J
(C) 160 J
(D) 1600 J

49. A block is attached to a horizontal spring of stiffness k. The other end of the spring is attached to a fixed wall. The entire system lie on a horizontal surface and the spring is in natural state. The natural length of the spring is ℓ_0. If the block is slowly lifted up vertically to a height $\frac{5}{12}\ell_0$ from its initial position, which of the following is not correct?
(A) The work done by the gravity = $\frac{5}{12}mg\ell_0$
(B) The work done by the spring force = $-\frac{k\ell_0^2}{288}$
(C) The work done by the lifting force = $\frac{5}{12}mg\ell_0 + \frac{k\ell_0^2}{288}$
(D) The sum of works done by all the forces on the block is zero

50. A bullet of mass 10 gm is fired from a rifle with a velocity of 800 m/s. After passing through a mud wall 180 cm thick, the velocity drops to 100 m/s. The average resistance of the wall is
(A) 750 N
(B) 1250 N
(C) 1750 N
(D) 2250 N

SPACE FOR ROUGH WORK

PART – III: Chemistry

Each question has 4 choices (A), (B) (C) and (D) for its answer, out of which **ONLY ONE** is correct.

51. Calculate the weight of iron which will be converted into its oxide by the action of 18 g of steam on it.
(A) 37.3 gm (B) 3.73 gm
(C) 56 gm (D) 5.6 gm

52. The increasing order (lowest first) for the values of e/m (charge/mass) for electron (e), proton (p), neutron (n) and alpha particle (α) is
(A) e, p, n α (B) n, p, e, α
(C) n, p, α, e (D) n, α, p, e

53. The uncertainty in the momentum of a particle is 3.3×10^{-2} kg ms^{-1}. Calculate the uncertainty in its position.
(A) 1.6×10^{-33} m (B) 1.6×10^{-32} m
(C) 16×10^{-30} m (D) 1.6×10^{-30} m

54. Bond angle in PH_3 is
(A) much less than NH_3 (B) Much less than PF_3
(C) slightly more than NH_3 (D) much more than PF_3

55. Pressure of 1 g of an ideal gas A at 27^oC is found to be 2 bar. When 2 g of another ideal gas B is introduced in the same flask at the same temperature, the pressure becomes 3 bar. Find a relationship between their molecular masses.
(A) $M_A = 4M_B$ (B) $M_B = 4M_A$
(C) $M_A = 2M_B$ (D) $M_B = 2M_A$

56. A gas mixture of 3 litre of propane C_3H_8 and butane C_4H_{10} on complete combustion at 25^oC produced 10 litre CO_2. What is the composition of gas mixture?
(A) 1.5 litre, 1.5 litre (B) 2 litre, 1 litre
(C) 2.5 litre, 0.5 litre (D) 1.75 litre, 1.25 litre

57. How many moles of electrons are needed for the reduction of each mole of Cr in the reaction,

$$CrO_5 + H_2SO_4 \rightarrow Cr_2(SO_4)_3 + H_2O + O_2$$

(A) 4 (B) 3
(C) 5 (D) 7

58. If Hund's rule is applicable, p^3 configuration is | 1 | 1 | 1 | because in this arrangement
(A) electrostatic repulsion is minimum
(B) magnetic attraction with outer magnetic field is maximum
(C) half filled is more stable
(D) all of these

SPACE FOR ROUGH WORK

59. The first emission line in the atomic spectrum of hydrogen in the Balmer Series appears at

(A) $\frac{9R_H}{400}cm^{-1}$ (B) $\frac{7R_H}{144}cm^{-1}$

(C) $\frac{3R_H}{4}cm^{-1}$ (D) $\frac{5R_H}{36}cm^{-1}$

60. Among the following, the paramagnetic compound is

(A) Na_2O_2 (B) O_3

(C) N_2O (D) KO_2

61. In van der Waals equation of state for a non-ideal gas, the term that accounts for intermolecular forces is

(A) (V – b) (B) RT

(C) $\left(P + \frac{a}{V^2}\right)$ (D) $(RT)^{-1}$

62. What volume of H_2O_2 solution of 22.4 "vol" strength is required to liberate 2240 mL of O_2 at NTP?

(A) 300 mL (B) 200 mL

(C) 100 mL (D) 500 mL

63. $ZnCl_2 + NaHCO_3 \xrightarrow{Heat} (A) \xrightarrow{Heat} (B) + (C)\uparrow + H_2O \quad (B) + NaOH \rightarrow D$

Identify the compound (D) present in the solution:

(A) $ZnCO_3$ (B) $Zn(OH)_2$

(C) ZnO (D) Na_2ZnO_2

64. In redox reaction, H_2O_2 oxidizes $K_4[Fe(CN)_6]$ into K^+, Fe^{3+}, CO_3^{2-} and NO_3^- ions in acidic medium, then how many moles of H_2O_2 will react with 1 mole of $K_4[Fe(CN)_6]$

(A) 5 moles (B) 9 moles

(C) 8 moles (D) 30.5 moles

65. An electron in a H-like atom is in an excited state. It has a total energy of -3.4 eV, calculate the de-Broglie's wavelength?

(A) $66.5\,A^o$ (B) $6.66\,A^o$

(C) $60.6\,A^o$ (D) $6.06\,A^o$

SPACE FOR ROUGH WORK

66. The velocity of electron of H-atom in its ground state is 2.2×10^6 m/s. The de-Broglie wavelength of this electron would be

(A) 0.33 nm (B) 23.3 nm
(C) 45.6 nm (D) 100 nm

67. Among the following species, identify the isostructural pairs.

NF_3, NO_3^-, BF_3, H_3O^+, HN_3

(A) [NF_3, NO_3^-] and [BF_3, H_3O^+] (B) [NF_3, HN_3] and [NO_3^-, BF_3]
(C) [NF_3, H_3O^+] and [NO_3^-, BF_3] (D) [NF_3, H_3O^+] and [HN_3, BF_3]

68. The drain cleaner, Drainex contains small bits of aluminium which react with caustic soda to produce dihydrogen. What volume of dihydrogen at 20°C and one bar will be released when 0.15 g aluminum reacts?

(A) 200.5 ml (B) 102.5 ml
(C) 101.25 ml (D) 405.0 ml

69. A colourless solid (X) on heating evolved CO_2 and also gave a white residue, soluble in water. Residue also gave CO_2 when treated with dilute acid (X) is :

(A) Na_2CO_3 (B) $CaCO_3$
(C) $NaHCO_3$ (D) $Ca(HCO_3)_2$

70. Match the following:

List – I (Ion)	List – II (No. of unpaired e-s)
(A) Fe^{3+}	(1) 0
(B) Cr^{2+}	(2) 2
(C) Ti^{4+}	(3) 4
(D) Ni^{2+}	(4) 5

The correct match is

(A) A-4, B-1, C-2, D-3 (B) A-4, B-5, C-1, D-2
(C) A-2, B-5, C-3, D-4 (D) A-4, B-3, C-1, D-2

SPACE FOR ROUGH WORK

PART – III: Mathematics

Each question has 4 choices (A), (B) (C) and (D) for its answer, out of which **ONLY ONE** is correct.

71. If $\sec\theta + \tan\theta = p$, then $\tan\theta$ is equal to

(A) $\frac{2p}{p^2-1}$ (B) $\frac{p^2-1}{2p}$

(C) $\frac{p^2+1}{2p}$ (D) $\frac{2p}{p^2+1}$

72. The value of $e^{\log_{10}\tan1^\circ+\log_{10}\tan2^\circ+\log_{10}\tan3^\circ+.....+\log_{10}\tan89^\circ}$ is

(A) 0 (B) e

(C) 1/e (D) None of these

73. If $a\cos\theta + b\sin\theta = m$ and $a\sin\theta - b\cos\theta = n$, then $a^2 + b^2 =$

(A) $m+n$ (B) m^2-n^2

(C) m^2+n^2 (D) None of these

74. If the p^{th}, q^{th} and r^{th} term of an arithmetic sequence are a, b and c respectively, then the value of $[a(q-r) + b(r-p) + c(p-q)] =$

(A) 1 (B) -1

(C) 0 (D) 1/2

75. If p times the p^{th} term of an A.P. is equal to q times the q^{th} term of an A.P., then $(p+q)^{th}$ term is

(a) 0 (b) 1

(c) 2 (d) 3

76. If $3 + 3\alpha + 3\alpha^2 + ...\infty = \frac{45}{8}$, then the value of α will be

(A) 15/23 (B) 7/15

(C) 7/8 (D) 15/7

77. If the arithmetic, geometric and harmonic means between two positive real numbers be A, G and H, then

(A) $A^2 = GH$ (B) $H^2 = AG$

(C) $G = AH$ (D) $G^2 = AH$

78. The number of real solutions of the equation $|x|^2 - 3|x| + 2 = 0$ are

(A) 1 (B) 2

(C) 3 (D) 4

SPACE FOR ROUGH WORK

79. The roots of the given equation $(p-q)x^2+(q-r)x+(r-p)=0$ are

(A) $\frac{p-q}{r-p},1$ (B) $\frac{q-r}{p-q},1$

(C) $\frac{r-p}{p-q},1$ (D) $1,\frac{q-r}{p-q}$

80. If a root of the equation $x^2+px+12=0$ is 4, while the roots of the equation $x^2+px+q=0$ are same, then the value of q will be

(A) 4 (B) 4/49

(C) 49/4 (D) None of these

81. How many roots the equation $x-\frac{2}{x-1}=1-\frac{2}{x-1}$ have

(A) One (B) Two

(C) Infinite (D) None

82. If x be real, then the maximum value of $5+4x-4x^2$ will be equal to

(A) 5 (B) 6

(C) 1 (D) 2

83. The equation of the straight line passing through the point (3, 2) and perpendicular to the line y = x is

(A) $x-y=5$ (B) $x+y=5$

(C) $x+y=1$ (D) $x-y=1$

84. A line passes through the point (3, 4) and cuts off intercepts from the coordinates axes such that their sum is 14. The equation of the line is

(A) $4x-3y=24$ (B) $4x+3y=24$

(C) $3x-4y=24$ (D) $3x+4y=24$

85. If the intercept made by the line between the axis is bisected at the point (5, 2), then its equation is

(A) $5x+2y=20$ (B) $2x+5y=20$

(C) $5x-2y=20$ (D) $2x-5y=20$

86. The lines 2x – 3y = 5 and 3x – 4y = 7 are the diameters of a circle of area 154 square units. The equation of the circle is

(A) $x^2+y^2+2x-2y=62$ (B) $x^2+y^2-2x+2y=47$

(C) $x^2+y^2+2x-2y=47$ (D) $x^2+y^2-2x+2y=62$

87. A circle touches the y-axis at the point (0, 4) and cuts the x-axis in a chord of length 6 units. The radius of the circle is

(A) 3 (B) 4

(C) 5 (D) 6

SPACE FOR ROUGH WORK

88. The centre of the circle $x = 2 + 3\cos\theta$, $y = 3\sin\theta - 1$ is

(A) (3, 3) (B) $(2, -1)$

(C) $(-2, 1)$ (D) $(-1, 2)$

89. The value of c, for which the line $y = 2x + c$ is a tangent to the circle $x^2 + y^2 = 16$, is

(A) $-16\sqrt{5}$ (B) 20

(C) $4\sqrt{5}$ (D) $16\sqrt{5}$

90. If $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + ... + \infty = \frac{\pi^4}{90}$, then the value of $\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + ...\infty$ is

(A) $\frac{\pi^4}{96}$ (B) $\frac{\pi^4}{45}$

(C) $\frac{89}{90}\pi^4$ (D) None of these

SPACE FOR ROUGH WORK