

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION
TATA INSTITUTE OF FUNDAMENTAL RESEARCH

Entrance Test for Ph.D. Programme in Science Education – 2011

Section I: English Proficiency, Scientific Literacy and Quantitative Reasoning

Read the following instructions carefully.

- This section of the written test carries **60 marks** and is of **one hour** duration.
- This section of the question paper consists of 8 pages. It has in all 30 questions: nos. 1 to 10 on **English Proficiency** and nos. 11 to 30 on **Scientific Literacy** and **Quantitative Reasoning**. The answers must be marked on the separate **Answer Sheet** provided.
- All questions are of multiple choice type with four options out of which only ONE option is correct. Each correct answer earns 2 marks. An unanswered question or a wrong answer earns no mark.
- You must indicate your answers **only on the Answer Sheet provided**. Please read the instructions on the Answer Sheet.
- Before you start, please check that you have written your Name and Roll Number on both sides of the Answer Sheet.
- Use of non-programmable scientific calculators is permitted.
- For rough work, you may ask the invigilator for extra sheets of paper.
- At the end of one hour, please submit this question paper but **keep the Answer Sheet with you**.

1. 'Petrified' means
 - (A) something grown in a petri dish.
 - (B) frozen or motionless with fear.
 - (C) styled like a building in Petra.
 - (D) none of the above.

2. If someone is hospitable
 - (A) she is friendly and welcoming to strangers and guests.
 - (B) she has a health condition which can be treated at home, but can be treated better in a hospital.
 - (C) she can be easily taken to the hospital and admitted.
 - (D) she is a friendly and welcome guest.

3. Something that is deserving of hatred and contempt, i.e of being despised is:
 - (A) Despable
 - (B) Despisable
 - (C) Despicious
 - (D) Despicable

4. If a person is pallid, he
 - (A) is friendly.
 - (B) earns a paltry sum.
 - (C) is stingy.
 - (D) is paler than usual.

5. Infallible means someone who
 - (A) cannot be made to fall down.
 - (B) falls down frequently.
 - (C) never makes errors.
 - (D) cannot be relied upon.

6. If you do research on the teaching and learning of biology, the area you work in would be
 - (A) Biotic education.
 - (B) Biological education.
 - (C) Biologic education.
 - (D) Biology education.

7. Which of these sentences is grammatically **INCORRECT**?
 - (A) Be sure to pay your tax on time.
 - (B) Make sure to pay your tax on time.
 - (C) Make sure you pay your tax on time.
 - (D) Ensure that your tax is paid on time.

8. In which of the following is it **INCORRECT** to use the definite article?

- (A) The Taj Hotel
- (B) The Patils
- (C) The Americas
- (D) The Europe

9. In the following sentence, point out how to correct the error(s), if any.

The company's business had grown so fast that it had trouble finding skilled man power.

- (A) There is no error, the sentence is fine as it is.
- (B) Replace company's by company.
- (C) Replace grown with grew.
- (D) Remove the space between man and power.

10. A newspaper report quoted a suspected criminal : 'they tortured me to confess'

- (A) The statement within quotes is grammatically correct.
- (B) The grammatically correct form is: 'they tortured me for confess'.
- (C) The grammatically correct form is: 'they tortured me to make me confess'
- (D) The grammatically correct form is: 'they tortured to confess.'

11.—15. Read the following passage, and then find the right answer to each of the next five questions from the choices provided:

Impetus theory of motion, widely endorsed between the 14th and 16th centuries, held that when an object is set in motion, it acquires an internal force called impetus that acts to keep it moving. The theory is contrary to fundamental principles of Newtonian mechanics, which hold that no force is needed to keep an object moving in a straight line at a constant speed.

The medieval impetus theory is incompatible with Newtonian mechanics in several fundamental ways. Newton's first law of motion holds that just as no force is required to keep an object at rest, so no force is required to keep an object moving at a constant velocity (that is, at a constant speed in a straight line). In fact, in Newtonian mechanics a state of rest and a state of uniform velocity are regarded as being equivalent. No physical distinction can be drawn between them, and so any object that is not changing its speed or its direction can be described as being at rest or in uniform motion, depending on the choice of a frame of reference. For example, it is equally valid to describe a passenger in a non-accelerating airplane as being at rest in the reference frame of the air plane or as being in motion in the reference frame of the earth. Coffee poured inside the airplane falls into a cup just as it does when it is poured at rest with respect to the ground; it does not splash back toward the rear of the airplane, as it would if the impetus theory were correct.

From the perspective of the impetus theory a fundamental distinction must be made between a state of rest and a state of motion: moving objects can have impetus but objects at rest cannot. As I have pointed out, in Newtonian mechanics no such distinction can be drawn. Moving objects do have momentum, however, and in some superficial respects the concept of impetus resembles the concept of momentum. There are two crucial differences: the first is that impetus was considered to be a cause of motion, where as momentum is merely quantity employed to describe motion. The second is that in the impetus theory an object is viewed as having impetus in an absolute sense. Where as in Newtonian mechanics momentum, like velocity, is defined relative to a frame of reference.

It is also incorrect to suppose a rolling object stops or a projectile falls because of the loss of impetus. In the Newtonian framework moving objects come to a stop or begin to fall because external forces act to change the speed or direction of their motion. A ball rolling across a floor is slowed down by friction, a force that acts in a direction opposite to the direction of the ball's motion. A projectile fired horizontally is accelerated downward by the constant force of the earth's gravity. The projectile's horizontal motion is independent of its vertical motion, although both are slowed by the resistance of the air. In a vacuum the horizontal velocity would remain constant from the moment the projectile was launched until the moment it hit the ground. For a projectile aimed above the horizontal the continuous action of gravity steadily reduces the initially positive upward velocity to zero and then reduces it to progressively larger negative values; in other words, after the projectile reaches its peak it is accelerated downward.

The effect of gravity on a projectile's vertical motion is not delayed by any horizontal component of motion; the projectile begins to deviate downward from the direction in which it was aimed the instant it is fired. Thus the impetus theorists were also incorrect in maintaining that a projectile travels along a straight line for sometime after it is launched.

11. The concept of impetus in some ways is similar to the concept of

- (A) velocity
- (B) speed
- (C) momentum
- (D) frame of reference

- 12.** A body is said to be in uniform motion with respect to a frame of reference if
- (A) only speed remains constant.
 - (B) only direction remains constant.
 - (C) either speed or direction remains constant.
 - (D) both speed and direction remains constant.
- 13.** Which of the following statement does not follow from the impetus theory of motion?
- (A) An internal force keeps a moving object in motion.
 - (B) An object at rest have zero impetus.
 - (C) Impetus is dependent on frame of reference.
 - (D) Impetus is independent of frame of reference.
- 14.** Which of the following statement is not correct?
- (A) Impetus theory came before Newton's theory.
 - (B) Impetus theory contradicts Newton's theory.
 - (C) A moving object can have zero impetus.
 - (D) As per impetus theory object has impetus in an absolute sense.
- 15.** As per Newton's theory for a projectile fired horizontally which of the following statement is correct.
- (A) Falls because of the loss of impetus.
 - (B) Have zero vertical acceleration.
 - (C) Horizontal velocity remains constant.
 - (D) Horizontal motion depends on vertical motion.

16.—20. Read the following passage, and then find the right answer to each of the next five questions from the choices provided:

Lavoisier clearly thought of organic chemistry as an integral part of chemistry, not as something uniquely related to living organisms merely because the organic compounds were produced by these organisms. He classified all the acids together, but subdivided them as mineral, vegetable, and animal acids as Lemery had done a century before. Some but by no means all chemists followed him in doing this. In his *Gundriss der Chemie* (1797) Gren treated all the organic compounds in a separate chapter; he considered them as proximate principles present in animal and vegetable organisms and incapable of being synthesized artificially.

A widespread belief, called vitalism, held that organic compounds were produced through the agency of a vital force that was present only in living plants and animals. These compounds could be converted into other compounds in the laboratory or in a brewer's or a vintner's establishment, but they could not be synthesized from the elements. However, vitalism received a serious blow at the hands of Friedrich Wohler in 1828. One of Wohler's greatest achievements in the field of organic chemistry was the synthesis of urea, which started the decline of the idea of vitalism. This occurred in 1828, when Wohler, who had been studying cyanates for several years, attempted to synthesize ammonium cyanate and obtained urea instead. He treated silver cyanate with ammonium chloride solution and obtained a white crystalline material which showed none of the properties of the cyanates. By treating lead cyanate with ammonium hydroxide, he obtained the white crystals in an uncontaminated state after separation from the lead oxide. The crystals had organic properties, and Wohler suspected the compound to be an alkaloid. It failed to give the tests typical of alkaloids, but behaved like the urea described by Proust and Prout, among others. Comparison with urea obtained from urine showed that the compounds were identical. Wohler triumphantly wrote to Berzelius, "I must tell you that I can make urea without the use of kidneys, either man or dog."

Wohler's synthesis of urea was recognized by his contemporaries although it had by no means a dramatic impact. Berzelius, Liebig, and Dumas, among others, commented favorably, and the synthesis was usually included in any listing of Wohler's accomplishments, but neither Wohler nor his associates put forth any claims that this marked the death of vitalism. The fact that vitalism could have no serious place in organic chemistry was realized gradually as knowledge of organic compounds and their synthesis accumulated.

16. Which of the following compounds was synthesized by Friedrich Wohler?

- | | |
|--------------------|-----------------|
| (A) silver cyanate | (B) urea |
| (C) alkaloid | (D) oxalic acid |

17. The idea of vitalism started to decline in

- | | | | |
|----------|----------|----------|----------|
| (A) 1828 | (B) 1831 | (C) 1835 | (D) 1836 |
|----------|----------|----------|----------|

18. Organic acids were divided into mineral, vegetable and animal acids by

- | | |
|----------------------|------------|
| (A) Proust and Prout | (B) Lemery |
| (C) Berzelius | (D) Gren |

19. Who considered organic compounds to be incapable of being synthesized artificially?
(A) Berzelius (B) Dumas (C) Liebig (D) Gren
20. The decline in the belief of vitalism started with the synthesis of
(A) Cyanates (B) Acetic acid (C) Urea (D) Alkaloid
21. *A* says to *B*, "If you give me one marble then I will have twice as many as you will have."
B says to *A*, "If you give me one marble then I will have as many as you will have."
The total number of marbles in possession of *A* and *B* is
(A) 10 (B) 11 (C) 12 (D) 13
22. The road from *A* to *B* is 6 Km uphill followed by 4 Km downhill. A person takes 5 hours to travel from *A* to *B* and back. If the speed of travelling uphill is half that of travelling downhill then the time taken to cover the uphill stretch of the entire path is
(A) 3 hours 20 minutes (B) 1 hour 40 minutes
(C) 2 hours 30 minutes (D) 3 hours 30 minutes
23. 100 g of a certain toothpaste cost Rs 10. Offering a discount of 20% on the cost price is equivalent to
(A) offering 120 g toothpaste at the cost price.
(B) offering 125 g toothpaste at the cost price.
(C) offering 130 g toothpaste at the cost price.
(D) offering 110 g toothpaste at the cost price.
24. In a canteen, a cup of tea costs Rs 3 and a cup of coffee costs Rs 4. On a certain day several cups of tea and coffee were sold and it was found that a revenue of Rs 77 was generated from the sale. The greatest possible value of the total number of cups (tea and coffee) of beverage sold is
(A) 22 (B) 23 (C) 24 (D) 25
25. The sides of a square are increased by 10%. The diagonal of the square increases by
(A) 10% (B) 14.14% (C) 11% (D) 9%
26. In ten years the area of a city has grown by 10% whereas its population has increased by 20%. To the nearest percent, the density of population in the city has increased by
(A) 8% (B) 9% (C) 10% (D) 8.5%

27. A is a two digit number and B is obtained from A by reversing its digits. For example, if A is 42 then B is 24. Assume that AB is greater than BA (AB is not A multiplied by B . It is just the decimal representation. For example, if A is 42 and B is 24 then AB is 4224 and BA is 2442). Which of the following is always true?
- (A) The largest prime factor of $AB - BA$ is 7.
 (B) The largest prime factor of $AB + BA$ is 11.
 (C) The largest prime factor of $AB + BA$ is 101.
 (D) The largest prime factor of $AB - BA$ is always equal to the smallest prime factor of $AB + BA$.
28. In a chess tournament, each of the 5 players plays against every other player. No game results in a draw and the winner of each game gets one point and the loser gets zero. Which one of the following sequences *cannot* represent the scores of the five players?
- (A) 4,4,1,1,0
 (B) 2,2,2,2,2
 (C) 3,2,2,2,1
 (D) 3,3,2,1,1
29. Let P , Q , R , S and T be statements such that if P is true then both Q and S are true, and if both R and S are true then T is false. We then have:
- (A) If T is true then both P and R must be true.
 (B) If T is true then both P and R must be false.
 (C) If T is true then at least one of P and R must be true.
 (D) If T is true then at least one of P and R must be false.
30. A box contains 100 balls of different colours: 28 red, 17 blue, 21 green, 10 white, 12 yellow and 12 black. The smallest number n such that any n balls drawn from the box will surely contain at least 15 balls of the same colour, is
- (A) 72 (B) 77 (C) 81 (D) 85

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Section II: Scientific Aptitude

Read the following instructions carefully.

- This section of the written test carries **150 marks** and is of **one hour** duration.
- This section focuses on scientific knowledge and aptitude. It covers broadly the areas of Biology, Chemistry, Mathematics, Physics, and general knowledge, including social sciences and education.
- This section of the question paper consists of 10 pages. It has 50 questions which can be categorised according to subject area as follows:

| Subject | Question nos. |
|-------------|---------------|
| Biology | 31–40 |
| Chemistry | 41–50 |
| Mathematics | 51–60 |
| Physics | 61–70 |
| General | 71–80 |

- **You may answer as many questions as you want from any subject area. While you might not be able to answer all the 50 questions in the time provided, you should try to maximise the number of correct answers.** It is a good idea to attempt the questions on your area of strength first.
- All questions are of multiple choice type with four options out of which only ONE option is correct. Each correct answer earns a credit of 3 marks. **A wrong answer carries a penalty of –1 mark.** An unanswered question carries no credit or penalty.
- You must indicate your answers **on the reverse side of the same Answer Sheet that you used for Section I of this test.**
- Use of non-programmable scientific calculators is permitted.
- For rough work, you may ask the invigilator for extra sheets of paper.
- At the end of the test, please submit this question paper, the Answer Sheet, and any extra sheets that you may have used.

37. Which of the following changes will increase the rate of transpiration in plants?
- (A) environmental humidity: low → high
 - (B) air conditions: still → windy
 - (C) light conditions: light → darkness
 - (D) salt concentration in soil: low → high
38. If the blood group of the parents are O Rh +ve and AB Rh -ve, the blood group of the child would be
- (A) A Rh +ve or AB Rh +ve
 - (B) B Rh -ve or O Rh -ve
 - (C) A Rh +ve or B Rh -ve
 - (D) O Rh -ve or AB Rh +ve
39. Artificial eutrophication is a rapidly growing environmental crisis in freshwater and marine systems. Important events that take place in eutrophication are listed below.
1. Excessive growth of aquatic vegetation.
 2. Depletion of dissolved oxygen.
 3. Feeding of micro-organisms of dead algal cells.
 4. Aquatic ecosystem becomes rich in phosphates and nitrates.
- The correct order in which these events occur is:
- (A) I→IV→III→II
 - (B) IV→I→III→II
 - (C) I→II→IV→III
 - (D) IV→III→II→I
40. Below are listed a few cell organelles.
1. Nucleus
 2. Lysosomes
 3. Endoplasmic Reticulum
 4. Peroxisomes
 5. Mitochondria
 6. Chloroplast
- Organelle/s that contain/s DNA and is/are enclosed by two phospholipid membranes is/are:
- (A) I, III and V
 - (B) I, V and VI
 - (C) I, II, III and V
 - (D) Only I

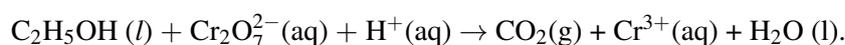
41. A radioactive element (atomic mass = 90 a.m.u) has a half-life of 28 years. The number of disintegrations per second is

- (A) 5.25×10^8 (B) 5.25×10^{12} (C) 2.25×10^{12} (D) 5.25×10^{10}

42. A buffer solution of pH 9 is to be prepared by mixing NH_4Cl and NH_4OH . Calculate the number of moles of NH_4Cl that should be added to one litre of 1.0 M NH_4OH ($K_b = 1.8 \times 10^{-3}$)

- (A) 3.4 (B) 2.6 (C) 1.5 (D) 1.99

43. Ethanol reacts with dichromate ions in acid solution according to the equation:



What is the coefficient of $\text{H}^+(\text{aq})$ when this equation is balanced with the smallest whole number coefficients?

- (A) 10 (B) 12 (C) 14 (D) 16

44. Which of the following can exist as geometric isomers?

- (A) 1,1-dichloroethane (B) 1,1-dichloroethene
(C) 1,2-dichloroethane (D) 1,2-dichloroethene

45. Which of the following ionic compounds has the smallest lattice energy?

- (A) NaF (B) MgO (C) AlN (D) MgCl_2

46. Which technique can be used to determine the number of components in a plant pigment?

- (A) titrimetry (B) chromatography
(C) colorimetry (D) gravimetry

47. One mole of an element contains 3.6×10^{24} electrons. What is the atomic number of the element?

- (A) 2 (B) 4 (C) 6 (D) 8

48. Which of the following is known as Chinese white?

- (A) ZnO (B) ZnCO_3 (C) $\text{Zn}(\text{OH})_2$ (D) Na_2ZnO_2

49. Which oxide produces an acidic solution when mixed with water?
(A) Al_2O_3 (B) CaO (C) CO (D) SO_2
50. What is the total number of pi bonds in $\text{H}-\text{C}\equiv\text{C}-\text{CH}_2-\text{NO}_2$?
(A) 1 (B) 2 (C) 3 (D) 4
51. The distances passed over by a pendulum bob in successive swings are 16, 12, 9, 6.75,...cm. Then the total distance traversed by the bob before it comes to rest is (in cm)
(A) 60 (B) 62 (C) 64 (D) 65
52. The points (2, 1), (8, 5) and (x, 7) lie on a straight line. The value of x is
(A) 10. (B) 11. (C) 12. (D) $11\frac{2}{3}$.
53. There are N boxes, each containing at most r balls. If the number of boxes containing at least i balls is N_i for $i = 1, 2, \dots, r$, then the total number of balls contained in these N boxes
(A) is exactly equal to $N_1 + N_2 + \dots + N_r$.
(B) is strictly larger than $N_1 + N_2 + \dots + N_r$.
(C) is strictly smaller than $N_1 + N_2 + \dots + N_r$.
(D) cannot be determined from the given information.
54. It is given that the expression $ax^2 + bx + c$ takes positive values for all x greater than 6. Then
(A) the equation $ax^2 + bx + c = 0$ has equal roots.
(B) $a > 0$ and $b < 0$.
(C) $a > 0$, but b may or may not be negative.
(D) $c > 6$.
55. Let f be a function from the set of all real numbers to itself defined by

$$f(x) = x^2 - \frac{x^2}{1+x^2}.$$

Then

- (A) f is one-one but not onto. (B) f is onto but not one-one.
(C) f is both one-one and onto. (D) f is neither one-one nor onto.

56. Consider the solutions of the equation $\sqrt{2}\tan^2 x - \sqrt{10}\tan x + \sqrt{2} = 0$ in the range $0 \leq x \leq \frac{\pi}{2}$. Then only one of the following statements is true. Which one is it?

- (A) No solutions for x exist in the given range.
(B) Two solutions x_1 and x_2 exist with $x_1 + x_2 = \frac{\pi}{4}$.
(C) Two solutions x_1 and x_2 exist with $x_1 + x_2 = \frac{\pi}{2}$.
(D) Two solutions x_1 and x_2 exist with $x_1 - x_2 = \frac{\pi}{4}$.

57. For a real number r , define $r^+ = \max\{r, 0\}$. For example, $2^+ = 2$, $(-3)^+ = 0$. Then for two real numbers a and b , the equality $(ab)^+ = (a^+)(b^+)$ holds *if and only if*

- (A) both a and b are positive.
(B) a and b have the same sign.
(C) at least one of a and b is greater than or equal to 0.
(D) $a = b = 0$.

58. The 300-digit number with all digits equal to 1 is

- (A) divisible by neither 37 nor 101.
(B) divisible by both 37 and 101.
(C) divisible by 37 but not by 101.
(D) divisible by 101 but not by 37.

59. If $f(x)$ is a non-negative continuous function such that $f(x) + f(\frac{1}{2} + x) = 1$ for all x , $0 \leq x \leq \frac{1}{2}$, then $\int_0^1 f(x)dx$ is equal to

- (A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) 1 (D) 2

60. Define $f(p) = p^m(1-p)^n$, $0 < p < 1$, m and n are positive integers. The value of p for which $f(p)$ attains its maximum value is

- (A) $\frac{n}{m}$. (B) $\frac{m}{n}$. (C) $\frac{n}{m+n}$. (D) $\frac{m}{m+n}$.

61. An energy of 24.6 eV is required to remove one of the electrons from a neutral helium atom. The energy (in eV) to remove both the electrons from a neutral Helium atom is (Hint: energy to remove 1 electron from H atom is 13.6 eV)
- (A) 38.2 eV (B) 49.2 eV (C) 12.3 eV (D) 79.0 eV
62. Which of the following is **NOT** correct
- (A) β rays are same as cathode rays
(B) γ rays are high energy neutrons
(C) α particles are doubly ionized Helium atoms
(D) protons and neutrons have different masses
63. If the radius of earth is reduced by 1% keeping the mass unchanged, the acceleration due to gravity, g , will change to
- (A) increase by 2 % (B) increase by 4 %
(C) no change (D) increase by 1%
64. Velocity of light in a medium is half its velocity in air. If a ray of light emerges from such a medium into air, the angle of incidence at which it will be totally internally reflected is
- (A) 30° (B) 45° (C) 60° (D) 15°
65. If a radioactive sample has half life of t seconds, then what is the time taken for nearly 94 % of the material to decay (choose the closest answer)
- (A) $0.94t$ (B) $3t$ (C) $1.94t$ (D) $4t$
66. Consider a CO_2 molecule with a simple linear structure where C and the O molecules are along a straight line. The number of vibrational degrees of freedom, (if the motion is along the original equilibrium line only) are
- (A) 1 (B) 2 (C) 6 (D) infinite
67. An energy of 1 eV corresponds to temperature of the order of
- (A) 10,000 K (B) 1 million K (C) 100 K (D) 0.001 K
68. A Geo-stationary satellite moving with linear velocity of 10,000 km/sec at a distance of 36000 Km is actually “continuously falling” toward earth due to its gravitational force.

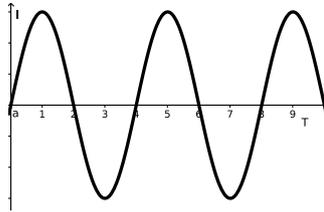
Calculate the work done by the satellite due to the gravitational force, in completing one orbital revolution around earth. $g=10 \text{ m/sec}^2$ and mass of the satellite is 1000 Kg.

- (A) $2.25 \times 10^9 \text{ Nm}$ (B) 2.25 Nm
 (C) $2.25 \times 10^2 \text{ Nm}$ (D) none of the above

69. Assume an equation $y=mx + c$ where m is the mass of a particle and c is velocity of light then the dimensions of x and y are

- (A) $y : \text{LT}^{-1}, x : \text{LT}^{-1}\text{M}^{-1}$ (B) $y : \text{L}^{-1}\text{T}, x : \text{M}^{-1}$
 (C) $y : \text{LT}^{-1}, x : \text{M}^{-1}$ (D) $y : \text{L}^{-1}\text{T}, x : \text{TML}^{-1}$

70. An alternating voltage of the type given in figure below is applied across a capacitor.



The output (qualitative only) will have the form ?

- (A) (B)
 (C) (D)

71. Geographical information can **NOT** be obtained from

- (A) Travellers' accounts. (B) Old maps.
 (C) Ancient epics. (D) Moon rock sample.

72. The expenditure of the Indian Government on education as a percentage of Gross Domestic Product (GDP) is closest to (in percent) :

- (A) 2 (B) 4 (C) 6 (D) 8

73. The sex ratio (female : male) in the Indian population is

- (A) continuously increasing since 1901.
- (B) continuously decreasing since 1901.
- (C) higher in 2011 than ever seen.
- (D) lower in 2011 than ever seen.

74. NREGA is meant to address the problem of :

- (A) Health care in susceptible populations.
- (B) Provision of education to all.
- (C) Housing for needy students.
- (D) Livelihood security in villages.

75. The *Right To Education Act 2010* : (i) Provides for free and compulsory education to all children between 6-14 years, (ii) Is applicable to elementary education only, (iii) Calls for a minimum teacher-student ratio, (iv) Is not applicable to Jammu and Kashmir.

- (A) (i), (ii) and (iii) are correct.
- (B) (ii), (iii) and (iv) are correct
- (C) (i), (iii) and (iv) are correct
- (D) All of the above

76. You are watching television and see a commercial where one of your favorite movie stars is discussing a nutritional supplement that you should buy. Because we like the star's movies, there is a tendency to believe that the star is also an expert on nutrition. This tendency is referred to as the . . . effect.

- (A) barnum
- (B) piezoelectric
- (C) star
- (D) halo

77. A psychologist is studying the relationship between verbal learning and mode of presentation. Upon analyzing the data, the psychologist finds a correlation of +1.50. On the basis of the correlation she would conclude that there is a

- (A) strong positive correlation
- (B) strong negative correlation
- (C) computational error
- (D) low positive correlation

78. The type of learning that is unique for humans is

- (A) classical conditioning
- (B) operant conditioning
- (C) verbal learning
- (D) discrimination learning

- 79.** Which of the following problems would require divergent thinking?
- (A) Adding numbers.
 - (B) Deciding whether to turn left or right at a crossroads while driving a car.
 - (C) Choosing the best move in a card game.
 - (D) Repairing a broken typewriter.
- 80.** The psychological point of view which emphasizes “wholeness” and is concerned with questions of perception is
- (A) gestalt psychology.
 - (B) psychoanalysis.
 - (C) associationism.
 - (D) S-R (stimulus-response) psychology.

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION
TATA INSTITUTE OF FUNDAMENTAL RESEARCH

Entrance Test for Ph.D. Programme in Science Education – 2011

Section III: Critical Reasoning

Read the following instructions carefully.

- This section of the written test carries **60 marks** and is of **one hour** duration.
- This section of the question paper consists of 11 pages. It has in all 7 questions of varying marks. The answers must be given on this question paper itself in the space provided after each question.
- Please be brief; write only the points. Do not exceed the space provided.
- Before you start answering, please check that you have written your Name and Roll Number in the space provided at the bottom of this page.
- At the end of one hour, please submit this question paper.

Name: _____

Roll Number:

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1. Share your opinion about the following in 3-5 lines each (Attempt any 4).

[16 marks]

(a) "1 + 1 is not always equal to 2."

(b) "Only non-essential products need advertising."

(c) "Digital materials should be available free of cost."

(d) "Fukushima events provide solid reason to abandon nuclear power option."

(e) “Unique Identification (UID) project will bring a welcome change in India.”

2. In year 2040, first astronauts land on the Mars and find a computer like object with strange symbols buried in Martian soil. They conclude that this object clearly proves existence of some intelligent life forms on Mars because such complex machine cannot be assembled purely out of random permutations. In 12th century exactly same argument was put forward that the existence of complex life forms we see around us is proof that they must have been created by a being with higher intelligence, such as God. Give your views/opinions.

[4 marks]

3. I purchased a blank DVD from store and weighed it. Its weight was 9.712gm. After writing my data on the DVD I weighed it again and found it to be marginally lighter.

Is the observation meaningful? Why?

[2 marks]

4. Give arguments in 2-3 lines each in favour of and against following statements. [20 marks]

(a) "Privacy of an individual can be compromised in favour of national security."

For

Against

(b) "Doing away with examinations till class 8th is correct way to reduce stress on students."

For

Against

(c) "Mercy killing is a boon for those with incurable diseases."

For

Against

- (d) "If a government does not truly represent its people, it should be toppled by any means available."

For

Against

5. Comment on following education related current issues (Attempt any 4). [12 marks]

- (a) "Merging of Universities Grants Commission, Medical Council of India, All India Council for Technical Education and several other agencies to form National Authority on Higher Education."

(b) "Astrology as a university subject."

(c) "A common curriculum can either suit the masses or the gifted but not both."

(d) "Social sciences as compulsory subjects at school level."

(e) "A common entrance test for all professional courses after class XII."

6. Consider following statements:

- (a) Most of the tunes of most of the recent bollywood music directors are inspired from some other sources.
- (b) M M Creem and Anu Malik are recent bollywood music directors.
- (c) Tum Mile Dil Khile (Criminal) was a song composed by M M Creem.
- (d) Tum Mile Dil Khile was inspired from another song.

Does statement (d) logically follow from (a) to (c)? Give reasons for your answer. [2 marks]

7. Suggest practical ways to de-congest traffic in Metropolitan cities. [4 marks]
