



Fakultät für Naturwissenschaften und Technik
Facoltà di Scienze e Tecnologie
Faculty of Science and Technology

ACADEMIC YEAR 2016 / 2017
ADMISSION TEST
BACHELOR IN INDUSTRIAL AND MECHANICAL ENGINEERING
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Each of the following questions has only one correct answer among the proposed five. Mark in this way the correct option (among (A), (B), (C), (D), (E)) on the answer sheet.

Remark The final grade of the admission test will be obtained by summing the points awarded to each answer using the following scheme:

- Right answer = 1 point.
- Wrong answer = -0.25 points.
- Unanswered question = 0 points.

Question 1. The police interrogate four suspects of robbery; they are sure that three of them are guilty. The accused make the following assertions:

Angela: I am innocent.

Benjamin: I am innocent.

Clarissa: Angela and Benjamin are lying.

Dylan: Only one of us is a liar.

How many of them are saying the truth?

- (A) No one
- (B) Exactly one
- (C) Exactly two
- (D) Exactly three
- (E) Either one or two

Question 2. The university campus where Andrea, Feray, Sarah and Jun study offers courses of tennis, climbing, basketball and hip hop.

Each of the students has chosen two courses and one of the courses has been chosen by three of them.

Sarah will play tennis and she is enrolled with Feray in the climbing course.

Andrea does not attend courses with Jun, but plays basketball with Feray.

Which of the following statements can be derived from the preceding facts?

- (A) Andrea and Sarah attend a course together.
- (B) Sarah and Jun do not attend courses together.
- (C) Andrea is enrolled in the climbing course.
- (D) One of the courses has been chosen only by one of them.
- (E) Jun has chosen the hip hop course.

Question 3. Let us consider the following inequalities:

- (i) $(x^2 + y^2)^n \geq (x + y)^n$
- (ii) $(x^2 + y^2)^n \geq x^2 + y^2$
- (iii) $(x^2 + y^2)^n \geq x^{n+2} + y^{n+2}$
- (iv) $(x^2 + y^2)^n \geq x^{2n} + y^{2n}$.

Which of them are true for any real x and y and any positive integer n ?

- (A) All.
- (B) None
- (C) Only (iv).
- (D) Just (i) and (ii).
- (E) Just (ii) and (iv).

Question 4. Let x and y be two positive integers, such that x is equal to 24% of y . Which of the following statements is true?

(LCM = Lowest Common Multiple; GCD = Greatest Common Divisor)

- (A) $\text{LCM} = 150 \cdot \text{GCD}$
- (B) $\text{LCM} = 2400$
- (C) $\text{GCD} = 4$
- (D) $\text{GCD} = 24$
- (E) $\text{LCM} = 300$

Question 5. Since $\log_{10} 2 \approx 0.30103$, how many digits has the decimal expansion of the number 2^{250} ?

- (A) 125
- (B) 83
- (C) 78
- (D) 75
- (E) 76

Question 6. Heron's formula states that the area A of a triangle whose sides' measures are a , b and c is $A = \sqrt{p \cdot (p - a) \cdot (p - b) \cdot (p - c)}$, where $p = \frac{a + b + c}{2}$.

Let us consider an equilateral triangle of side ℓ and area A and a square of side ℓ . Which of the following formulas gives the area of the square?

- (A) $\frac{4}{\sqrt{3}} A$
- (B) $\frac{\sqrt{6}}{12} A^2$
- (C) $2\sqrt{6} A$
- (D) $\frac{16}{3} A$
- (E) $\frac{4}{3} A$

Question 7. A triangular field has to be divided into two parts by a fence parallel to one of the sides (denoted by ℓ) so that the two resulting fields (of triangular and trapezoidal shapes) have equal areas.

Let r be the ratio between the distance of the fence from ℓ and the height of the field; which of the following statements is true?

- (A) $r = \frac{1}{2}$
- (B) $\frac{1}{3} < r < \frac{1}{2}$
- (C) $r = \frac{1}{3}$
- (D) $\frac{1}{4} < r < \frac{1}{3}$
- (E) $r = \frac{1}{4}$

Question 8. The set of numbers from 1 to 8 has to be split into two sets A and B containing the same number of elements and in such a way that the sum of the numbers in A equals the sum of the numbers in B .

How many ways are there to select B , if 1 and 7 belong to A ?

- (A) 1
- (B) 2
- (C) 3
- (D) 4
- (E) 15

Question 9. An urn contains 70 balls numbered from 1 to 70. What is the probability that, extracting a ball at random, its number is divisible by 5 or by 7?

- (A) $\frac{11}{35}$
- (B) $\frac{12}{35}$
- (C) $\frac{3}{10}$
- (D) $\frac{23}{70}$
- (E) $\frac{19}{70}$

Question 10. Let us be given a test with 10 questions, each with only two possible answers (A and B). Suppose that it is known that exactly half of the right questions is A.

What is the probability that answering questions at random, but using the above information, all answers are correct?

- (A) $\frac{1}{2^5}$
- (B) $\frac{1}{5!}$
- (C) $\frac{5!}{10!}$
- (D) $\frac{5! \cdot 5!}{10!}$
- (E) $\frac{1}{2}$

Question 11. A stone dropped from the top of a dried well takes 2 seconds to reach the bottom. Ignoring friction effects, what is the approximate height of the well?

- (A) About 2 m
- (B) About 4 m
- (C) About 10 m
- (D) About 20 m
- (E) About 40 m

Question 12. A car is travelling on a level curve with constant radius at the speed of 50 km/h. The acceleration of the car is:

- (A) zero
- (B) directed towards the ground
- (C) radial and directed to the exterior of the curve
- (D) tangent to the turn
- (E) radial and directed to the centre of the curve

Question 13. A pot located on a gas burner contains boiling water. What happens if the flame of the burner is raised?

- (A) The boiling process is quicker, but the temperature of the water remains constant.
- (B) The temperature of the water raises only in proximity of the flame.
- (C) The boiling process is quicker, but the temperature of the water reduces.
- (D) The temperature of the water raises, but the boiling process is not accelerated.
- (E) The boiling process is quicker and the temperature of the water raises.

Question 14. What is the energy required to bring a resting body with a mass of 10 kg to the speed of 10 m/s?

- (A) 1000 J
- (B) 500 J
- (C) 200 J
- (D) 100 J
- (E) 50 J

Question 15. A billiard ball has an initial velocity v . It hits a resting billiard ball having the same mass with a frontal elastic collision on a flat surface. After the collision:

- (A) the direction of the motion does not change and the two balls move with the same velocity v
- (B) the first ball moves backwards, while the second moves onwards, both with a velocity $v/2$
- (C) the first ball moves backwards with velocity v , while the second remains still
- (D) the first ball stops and the second moves with velocity v in the same direction the first ball was traveling
- (E) both balls move onwards in the same direction the first ball was traveling, but with different velocities

Question 16. How many calories does one have to subtract from a mass of water of 100 g to cool it down from a temperature of 20 °C to a temperature 10 °C?

- (A) 100 cal
- (B) 110 cal
- (C) 1000 cal
- (D) 2000 cal
- (E) 10000 cal

Question 17. The gravitational acceleration on the Moon is about 1/6 of the one on the Earth. Therefore, the mass of a body on the Moon is:

- (A) 1/6 of that on the Earth
- (B) 6 times that on the Earth
- (C) 1/36 of that on the Earth
- (D) around 5/3 of that on the Earth
- (E) the same as on the Earth

Question 18. An iron operated at a tension of 220 V consumes a power of 1.1 kW. What is the current intensity in the iron?

- (A) 0.5 A
- (B) 1.1 A
- (C) 5 A
- (D) 10 A
- (E) 20 A

Question 19. The overall effect of a catalyst on a chemical reaction is to change:

- (A) the velocities of both the direct and indirect reactions
- (B) the energy potential of the reactants
- (C) the energy potential of the products
- (D) the heat of the reaction
- (E) the energy needed to carry out the reaction

Question 20. The atomic number of an atom represents:

- (A) the number of neutrons in the atom
- (B) the sum of the number of neutrons and protons in the atom
- (C) the sum of the number of protons and electrons in the atom
- (D) the electric charge of the atom
- (E) the number of protons in the atom