UNIVERSITY OF ENGINEERING & TECHNOLOGY, LAHORE
Engineering College Admission Test (ECAT) – 2019

Instructions:

- **Total Marks: 400**
- **Total Time Allowed: 100 Minutes**
- **Each Incorrect MCQ deducts -1 point**
- **Each Correct MCQ earns: 4 marks**

Note: Possible Correct Answers are bolded below

MATHEMATICS

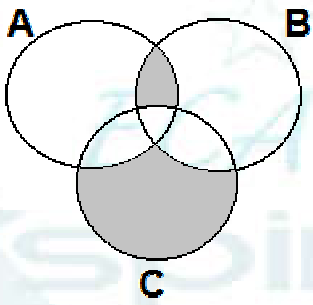
1) Which of the following is a rational number?

A) 16.3333…. B) π C) $\sqrt{2}$ D) e^1

2) Let $\mathbb{R}, \mathbb{Z}, \mathbb{Q}, \mathbb{N}$ denote the set of real numbers, integers, rational numbers and natural numbers respectively. Which of the following statement is correct?|

A) $\mathbb{N} \subset \mathbb{Q} \subset \mathbb{R}$
B) $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$
C) $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{R}$
D) All of the above

3) A valid expression for the shaded area in the following Venn Diagram is:



A) $(A \cap B) \cup C$
B) $(A \cap B \cap \bar{C}) \cup C$
C) $(A \cap B \cap \bar{C}) \cup (\bar{A} \cap C)$
D) $(\boldsymbol{A} \cap \boldsymbol{B} \cap \bar{\boldsymbol{C}}) \cup (\bar{\boldsymbol{A}} \cap \bar{\boldsymbol{B}} \cap \boldsymbol{C})$

4) The complex variable $z = e^{-i\theta t}$ is defined for t real. The modulus of z is:

A) 0 **B) 1** C) θ D) θt

5) Which of the following set of ordered pair is different from the others?

A) $\{(1,2),(3,4),(5,6)\}$
B) $\{(3,4),(1,2),(5,6)\}$
C) $\{(\mathbf{1},\mathbf{2}),(\mathbf{4},\mathbf{3}),(\mathbf{5},\mathbf{6})\}$
D) $\{(5,6),(3,4),(1,2)\}$

Following TWO questions relate to a system of linear homogeneous equation expressed in matrix form as below as follows:

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

6) The rank of the matrix is:

A) 3 **B) 2** C) 1 D) 0

7) How many solutions does this system have?

A) Infinite B) 4 C) 0 D) 1

8) For what value of b does the quadratic equation $y = ax^2 + 2bx + a$ intersect the x-axis at a single point?

A) $b = \pm\frac{a}{2}$ **B)** $\boldsymbol{b = \pm a}$

C) $b = \pm 2a$ D) None of the above

9) A committee of national assembly comprises of four male and three female members. If a subcommittee consisting of two male and two female members is to be formed. How many different combinations are possible?

A) 18 B) 12 C) 7 D) 4

10) A bag contains 4 red balls, 3 green balls and 1 blue ball. A student picks two balls from the bag one after another without any replacement. Given that the first ball picked is blue, what is probability that second ball is also blue?

A) $\boldsymbol{0}$ B) $\frac{1}{8}$ C) $\frac{1}{4}$ D) $\frac{1}{2}$

11) If $y = \boldsymbol{log_x}\left(\frac{\sqrt{x}\,.\,\sqrt{x^3}}{x^{-3}}\right)$, then

A) y= 1/2 B) $y = \sqrt{x}$ **C) y = 5** D) $y = x/2$

12) Find a positive value of x if $\log_3(x) = \log_9(2x - 1)$?

A) x=0 **B) x=1** C) x=3 D) x=9

13) A function $f(x) = \sin(2x + \theta)$. At what values of x (in radian) is $f(x) = 0$?

A) $x = k\pi + \theta, when\ k\ is\ any\ integer$ B) $x = k\pi - \theta, when\ k\ is\ any\ integer$

C) $x = (k\pi + \theta)/2,\ when\ k$ is any integer **D)** $\boldsymbol{x = (k\pi - \theta)/2,\ when\ k}$ **is any integer**

14) Which of the following functions is not continuous?

A) $cos\theta$ **B)** $\boldsymbol{sec\theta}$

C) $cos\theta + sin\theta$ D) $cos\theta - sin\theta$

15) If $x = \left(sin22.5^\circ - cos22.5^\circ\right)^2$, what is value of x?

A) $x = 0$ B) $x = 1 + \frac{1}{\sqrt{2}}$

C) $\boldsymbol{x = 1 - \frac{1}{\sqrt{2}}}$ D) $x = \frac{1}{\sqrt{2}}$

16) If $x = \sum_{n=-\infty}^{\infty}(\mathbf{0.5})^n$, what is the value of x?

A) Infinity B) 2 C) 1 D) 0

17) If $\frac{dy}{dt} = -y$, which of the following is true?

A) $y(t) = k, where\ k\ is\ non\ zero\ constant$ B) $y(t) = \cos(t)$

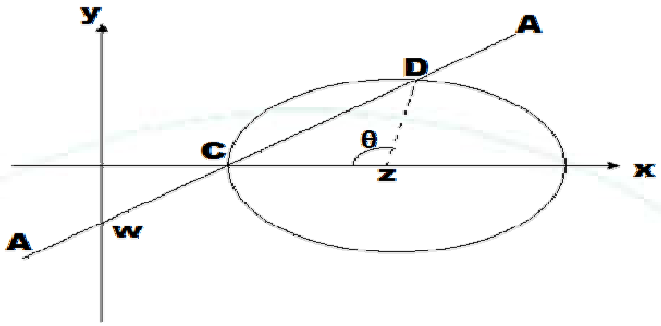
C) $\boldsymbol{y(t) = e^{-t}}$ D) Both A and C

18) If $\int_{-1}^{1} |t|\, dt$, which of the following is correct?

A) $\int_{-1}^{1} t\, dt$ B) $\int_{0}^{1} t\, dt$

C) $\boldsymbol{\int_0^1 t\, dt - \int_{-1}^0 t\, dt}$ D) $\int_0^1 t\, dt + \int_{-1}^0 t\, dt$

A circle with the radius 1 centered at coordinates (z, 0) intersects a straight line at two coordinates C and D as shown in the figure below. The figure is not drawn to the scale. Answer the following THREE questions using this information.



19) If w=-3 and z=4 , the equation of the circle and the straight line are:

A) $\boldsymbol{Circle: x^2 + y^2 - 8x + 15 = 0 \; and \; Line: \; y - x + 3 = 0}$

B) $Circle: x^2 + y^2 - 8x + 15 = 0 \; and \; Line: \; y + x + 3 = 0$

C) $Circle: x^2 + y^2 - 8y + 15 = 0 \; and \; Line: \; y - x + 3 = 0$

D) $Circle: x^2 + y^2 - 8y + 15 = 0 \; and \; Line: \; y + x + 3 = 0$

20) What are the point of intersection if the equation of circle and line are as follows:

$$x^2 + y^2 - 6x + 8 = 0$$
$$y - x + 2 = 0$$

A) $\boldsymbol{(2,0) \; and \; (3,1)}$ B) $(3,0) \; and \; (3,2)$

C) $(2,1) \; and \; (3,2)$ D) $(2,1) \; and \; (3,3)$

21) What is the angle θ if the equation of circle and line are as follows?

$$x^2 + y^2 - 6x + 8 = 0$$
$$y - x + 2 = 0$$

A) 45° B) 60° **C)** $\mathbf{90^\circ}$ D) 120°

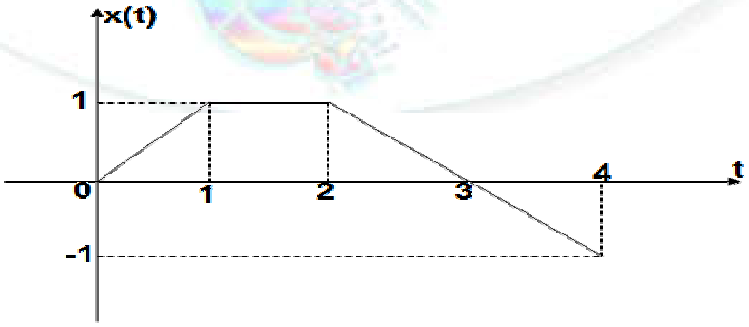
22) The determinant of $\begin{bmatrix} \alpha & \beta+\gamma & 1 \\ \beta & \gamma+\alpha & 1 \\ \gamma & \alpha+\beta & 1 \end{bmatrix}$ equals to:

A) $\mathbf{0}$ B) $\alpha\beta\gamma$ C) $\alpha + \beta + \gamma$ D) 1

23) The slope (gradient) of the curve $y = x^3 - 3x^2 - 9x + 11 \; is \; 15$ when x-coordinates are:

A) +2, -2 B) +3, +4 **C) -2, +4** D) +5, -5

A piecewise continuous function x (t) is shown below. Answer the following TWO questions using this figure.



24) What is the value of $\int_0^4 x(t)\,dt$?

A) 0.5 B) 1 **C) 1.5** D) 2.5

25) If $y(t) = \frac{dx}{dt}$, which of the following statements is correct?

A) $y(1.5) = 1\,,\ y(3) = 0$ B) $y(1.5) = 1\,,\ y(3) = -1$

C) $y(1.5) = 0\,,\ y(3) = 0$ **D) $y(1.5) = 0\,,\ y(3) = -1$**

26) The minimum value of $f(x) = (x-1)^2 - 2$ for feasible region $x \leq 2\ and\ x \geq -2$ is:

A) -1 at x = 2 B) 7 at x = -2

C) -1 at x = 0 **D) -2 at x = 1**

27) $$f_1(x) = \frac{1}{3}x^3 - 2x^2 + 3x + a$$
$$f_2(x) = \frac{1}{3}x^3 - 2x^2 + 3x + b$$

Which of the following statements is correct?

A) $f_1(x)$ and $f_2(x)$ have different minimum/maximum values as well as stationary point

B) $f_1(x)$ and $f_2(x)$ have same minimum/maximum values but different stationary point

C) $f_1(x)$ and $f_2(x)$ have different minimum/maximum values but same stationary point

D) $f_1(x)$ and $f_2(x)$ have same minimum/maximum values as well as stationary point

28) $$f(x) = \frac{1}{3}x^3 - 2x^2 + 3x + 1$$

Which of the following statements is correct?

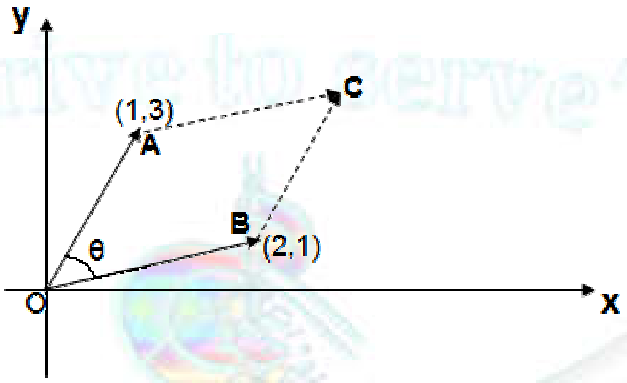
A) $f(x)$ has local minimum value at x=1 and local maximum at x=3

B) $f(x)$ has local maximum value at x=1 and local minimum at x=3

C) $f(x)$ has local minimum value at x=1 and local minimum at x=3

D) None of these

Answer the following TWO questions using this figure.



29) The angle θ between line segments OA and OB is:

A) 15° B) 30° **C) 45°** D) 60°

30) If OACB forms a parallelogram, the coordinates of point C are:

A) (+3 , +4) B) (+4 , +4)

C) (+4 , +5) D) (+5 , +6)

PHYSICS

31) A swing is held by two vertical ropes. If the maximum weight of a person is 1000 N, the breaking tension of each rope must be:

A) Greater than 1000 N
B) Greater than 500 N
C) Greater than $1000\sqrt{2}$ N
D) Greater than $500\sqrt{2}$ N

32) 1 kg ball moving in some direction at 8 m/sec hits another 4 kg ball moving at 6 m/sec in the same direction. Assume that the 1 kg ball stops after collision. What will be the velocity after the collision of the 4 kg ball if the 1 kg ball stops?

A) 10 m/s
B) 0 m/s
C) **8 m/s**
D) 12 m/s

33) A 2 kg packet is released by a spaceship moving at 3600 km/h, 10 km above the surface of a planet. If the packet reaches on the surface of planet in 100 seconds, what is the gravitational force g on this planet?

A) 20 m/s^2
B) 10 m/s^2
C) 2 m/s^2
D) 3 m/s^2

34) The kinetic energy of a moving truck is 10^5 kgm^2/s^2. The brakes of the truck fail and it runs into a sugar cane field, coming to the rest after 50 m. What is the average retarding force of the sugar cane field?

A) 2000 N
B) 4000 N
C) 1500 N
D) None of these

35) Assume Badar-I satellite orbits earth every 10 hours. After every how many hours will Badar-II orbits the earth if its orbital radius is twice the orbital radius of Badar-I?

A) $10/\sqrt{2}$ hours
B) 5 hours
C) 20 hours
D) $20\sqrt{2}$ hours

36) An electric fan attains the maximum angular velocity of 5 revolutions per second after 15 revolutions. Assume constant acceleration, how much the time interval will be taken by to attain its maximum angular velocity?

A) 3 seconds
B) 6 seconds
C) 4 seconds
D) 5 seconds

37) To calculate the orbital velocity of a satellite put into a circular orbit around the moon, we need to know:

A) The mass of satellite
B) The mass of earth
C) The mass of moon
D) The distance of moon from Earth

38) A soap bubble of radius 2cm falls in air at a constant speed of 0.1 m/sec. The drag force on the bubble is about $1\ \mu N$. The approximate mass of the bubble is:

A) 100 μg
B) 10 μg
C) 1 μg
D) 0.1 μg

39) A frictionless mass spring system is set in motion by pulling the mass down r meters from its resting position. The total energy given to the system is proportional to :

A) r
B) r^2
C) $1/r^2$
D) $\sqrt{r}$

40) If the speed of the sound on a cold day is V_c and its speed on a hot day is V_h?

A) $V_c = V_h$
B) $V_c < V_h$
C) $V_c > V_h$
D) V_c may be more or less than V_h

41) Telescope J gives the dim image of a star while telescope K gives the bright image of the same star. Which of the following statement is true?

A) K has a larger aperture
B) K has higher magnification
C) The focal length of objective of K is greater
D) Statements A,B and C are all true

42) When compressed gas is suddenly allowed to expand, which of the following equation determines P-V relationship with γ being the gas constant?

A) $PV = \gamma$
B) $PV^\gamma = constant$
C) $VP^\gamma = constant$
D) $PV/\gamma = constant$

43) An object carrying 3 coulombs charge is moved 10 cm from point A and point B by electric field if V_{AB}=700 V, the work done by the electric field is:

A) 2100 W B) 210 W C) 70 W D) 0.3 W

44) A 2 farad capacitor is charged to 100 V and then discharged through $10\ k\Omega$ resistance. What is the total energy dissipated in the resistance?

A) 2 kJ B) 200 kJ **C) 10 kJ** D) 2 kJ

45) An 8Ω resistance is connected to a battery with internal resistance draws 1.6 A and if a 30Ω resistance is connected to the same battery, it draws 0.5 A. What is the current drawn by a 6Ω resistance from this battery?

A) 2 A B) 2.2 A C) 2.5 A D) None of these

46) To produce a magnetic field of $2\pi \times 10^{-3} Wb/m^2$ inside a 10 meter long air core solenoid with 1000 turns/meter, the current must be:

A) 1 A B) 1000 A **C) 10 A** D) 100 A

47) The wing span of an airplane is 20 m. The potential difference across the tips of the wings must not be more than 20 V. If the magnetic field of earth can reach a maximum of 0.01 tesla, the maximum speed of the airplane must be:

A) 540 km/hr **B) 360 km/hr** C) 100 km/hr D) None of these

48) A 10 W device needs more than 1000 V input to operate. If the main supply is known to fluctuate between 200 V and 250 V, the turn ratio of the step up transformer required to operate the device must be:

A) More than 4 **B) More than 5**

C) Equal to 4.5 D) Less than 5

49) The peak value of an alternating 60 Hz power supply is 140 V. An A.C. voltmeter is connected to the power supply will give a reading of approximately:

A) 100 V B) 198 V C) 140 V D) 70 V

50) At 60 Hz, an inductive circuit has a reactance of 100 Ω and a resistance of 100 Ω. When connected to a 120 V, 60 Hz A.C supply, the current will approximately consume an average power of:

A) $120\sqrt{2}\ W$ **B) $72\ W$**

C) $72\sqrt{2}\ W$ D) $200\sqrt{2}\ W$

51) A 10m long metal wire 10 mm diameter is pulled by a force of 3142 N which produces a stretch of 10mm. The modulus of elasticity of the metal is:

A) $200 \times 10^9\ N/m^2$ B) $10^7\ N/m^2$

C) $10^{-3}\ N/m^2$ **D) $10^{10}\ N/m^2$**

52) When an operational amplifier (Op-amp) is used to compare two voltages $V_1$and V_2, its output is

A) $V_1 - V_2$ B) $V_2 - V_1$

C) $|V_1 - V_2|$ **D) None of these**

53) An object has a rest mass of 1 g. If the object is moving at $\sqrt{5} \times 10^8\ m/sec$, the force required to give the object an acceleration of 1000 m/s^2:

A) 1.5 N B) 1.0 N

C) 1000 N D) 1500 N

54) A transmitter radiates $30\ \mu W$ at 6.63 mm wavelength. The number of photons emitted per second are:

A) 6.63×10^{-34} B) 6.63×10^{34}

C) $\mathbf{10^{18}}$ D) 10^{11}

55) 1 kg mass moving at the velocity of 6.63 m/sec will have the de-Broglie wavelength equals to:

A) $6.63 \times 10^{-34} m$ **B) $\mathbf{10^{-34}\ m}$**

C) $6.63\ m$ D) None of these

56) When X-rays are produced by fast moving electrons striking a heavy metal, the X-ray spectrum contains:

A) Discrete Lines B) Continuous spectrum

C) Both Discrete Lines and continuous spectrum D) Only two Discrete lines

57) Suppose two isotopes A and B of an element contain $P_A\ and\ P_B$ protons and $N_A and\ N_B$ neutrons respectively, then

A) $P_A = P_B$ and $N_A \neq N_B$ B) $P_A \neq P_B$ and $N_A = N_B$

C) $P_A = P_B$ and $N_A = N_B$ D) $P_A \neq P_B$ and $N_A \neq N_B$

58) When an electron of an atom in its excited state returns in its ground state, the following type of radiations are emitted

A) $\alpha\ and\ \gamma$ B) $\beta\ and\ \gamma$ **C) γ** D) $\alpha, \beta\ and\ \gamma$

59) In nuclear reactions, it is possible to

A) transform an element into another element B) produce neutron

C) produce energy **D) All of the above**

60) If a material has superconducting properties at temperature $T_1 and\ T_2$, then:

A) $T_1 = T_2$ B) $T_1 < T_2$

C) $T_1 > T_2$ **D) $T_1 and\ T_2$ are less than some critical temperature T_C**

CHEMISTRY

Note: *First ten (**61-70**) questions from chemistry portion are missing in the records.*

71) At room temperature, iodine exits in the form of:

A) Purple solid
B) Purple liquid
C) Black liquid
D) Black solid

72) Why is the following reaction a disproportion reaction?

$$Cl_2 + 2OH^- \rightarrow Cl^{-1} + ClO^- + H_2O$$

A) Due to formation of 2Cl atoms
B) Due to formation of water from alkali
C) Oxidation number of one Cl atom has increased and that of other atom has decreased after reaction
D) Oxidation number of Cl atoms of products is more than that of the reactant Cl atom

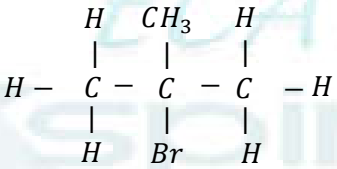
73) In all stable compounds, carbon has _____ electrons in its outer shell.

A) 2 **B) 4** C) 6 D) 8

74) Which of the following are possible products of chain reaction between bromine and alkane?

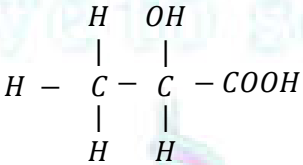
A) CH_2Br_2 B) CH_3Br C) CH_3CH_2Br **D) All of the above**

75) What is the name of the following compound?



A) 1-bromo – 2-methyl propane
B) 2-bromo – 2-methyl propane
C) 2-bromo – 2-dimethyle propane
D) 1-bromo – 1- methyl propane

76) What is the systematic name of the following compound?



A) 2-carboxy ethanol
B) 1-carboxy ethanol
C) 2-hydroy propanoic acid
D) Propane 1,2 diol

77) Why is propane 1, 2, 3- triol more viscous than propanal?

A) Due to considerable Van der Waal's forces
B) Due to considerable hydrogen bonding
C) No change in viscosity is observed
D) Due to dipole forces

78) An aqueous copper – II salt is electrolyzed between copper electrodes using constant current. What affects the mass of copper deposited on the cathode?

A) Time taken
B) Nature of anion present
C) Concentration of solution
D) All of the above

79) In a reaction:

$$CH_3OCCH_3 + I_2 \xrightarrow{H^+} CH_3IOCCH_3 + HI$$

The rate expression:

$$-\frac{d[I_2]}{dt} = [CH_3OCCH_3][H^+]$$

Why there is a minus sign in the rate expression?

A) Concentration of reactant 'I' is decreasing B) The '**I**' product is increasing
C) The reaction is slow D) All of the above reasons

80) What is reduced in the reaction?

$$Mg + 2HNO_3 \rightarrow Mg(NO_3) + H_2$$

A) Magnesium B) Oxygen
C) Hydrogen D) Nitrogen

81) Nitrogen dioxide and Sulphur dioxide show similar properties. Which of the following property is shown only by Sulphur dioxide?

A) Forms acid rain B) Is a reducing agent
C) Is insoluble in water **D) Is used a food preservative**

82)The typical property/properties of d-block elements of the periodic table that make the different from s-block elements is/are:

A) They are good conductors of heat **B) They have the variable oxidation number**
C) White compounds D) All of the above

83) Hydrogen is a unique element. Its properties resemble to that of elements of some group of the periodic table. The group to which its properties do not resemble, is:

A) IV-A **B) VI-A**
C) VII-A D) All of the above

84) Which of the following alkaline metal(s) react with the oxygen to form the oxide at room temperature?

A) Be **B) Mg** C) Ba D) All of the above

85) What is the oxidation state of the Cl in $HClO_3$?

A) 1 B) 3 **C) 5** D) 7

86) What is the geometry of PCl_5 complex?

A) Tetrahedral B) Square planar
C) Trigonal Bipyramidal D) Octahedral

87) The sequence of reactions which is followed in the reaction as given below, is:

$$CH_3CH_2MgBr + CHO_3 \xrightarrow{ether} CH_3CH_2CH_2 - OMgBr \xrightarrow{H_3O^+} CH_3CH_2CH_2OH + MgBrOH$$

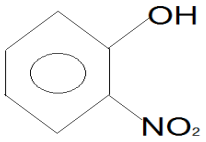
A) Reduction reaction, addition reaction B) Addition reaction, elimination reaction
C) Elimination , substitution reaction **D) Addition reaction , substitution reaction**

88) What takes places in the following reaction?

$$CH_3COOH + CH_3COOH \xrightarrow{P_2O_5,\ Heat} CH_3COOCOCH_3$$

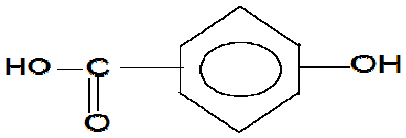
A) Reduction B) Oxidation
C) Substitution **D) Dehydration**

89) What will be the appropriate name for:



A) 2-nitrophenol
B) 1-nitrophenol
C) 1-hydroxy 2- nitrobenzene
D) 1-nitro 2-hydroxybenzene

90) How can a compound having the following structural formula be classified?



A) as an alcohol
B) as a phenol
C) as an ester
D) as a carboxylic acid

ENGLISH

Direction to solve (Question# 91-100)
Read the given passage to answer the questions

The three brothers Banū Mūsā, sons of Mūsā ibn Shākir al-Munajjim, are scholars from the 9th-century Baghdad, at that time the capital of the Abbasid dynasty that ruled the Muslim Empire for several centuries. Their names, in order of seniority, were Muhammad, Ahmad, and al-Hasan. Their works in different scientific areas are attributed to them jointly, although we do know that they had their own areas of expertise. Muhammad was mainly a specialist in geometry and astronomy, while Ahmad worked mainly on mechanics and al-Hasan excelled mainly in geometry.

Their father, Musa ibn Shakir, was a close friend of al-Ma'mun, the son of the Caliph Harun al-Rashid. When Musa ibn Shakir died, al-Ma'mun became the guardian of the three brothers. They were given a good education in Baghdad, studying geometry, mechanics, music, mathematics and astronomy. During the al-Ma'mun caliphate between 813 and 833, they carried on a successful career in science, engineering and patronage. After him, they continued their work under al-Mu'tasim (r. 833 – 842), al-Wathiq (r. 842-847) and al-Mutawakkil (r. 847-861). Muhammad and Ahmad Banū Mūsā were obviously in favour with al-Mutawakkil who employed them in engineering works related to the construction of canals of al-Dja'fariyya, a new city he founded near Baghdad.

In astronomy, the Banū Mūsā made observations and measurements, but it seems they did not document their research in a conserved writing. Under the request of the Caliph al-Ma'mun, they measured a degree of latitude of the Earth. For this purpose, they organized an expedition to Northern Mesopotamia, in a desert region, where they made precise measurements. They also made many observations of the sun and the moon from Baghdad. Muhammad and Ahmad measured the length of the year, obtaining the value of 365 days and 6 hours and observed the star Regulus in Baghdad in 255 H (840-41), 232 H (847-48), and 235 H (850-51).
The three brothers are most known by their achievements in mechanics. Their book *Kitāb al-hiyal* (The Book of Ingenious Devices) is an outstanding contribution in the field of mechanical sciences. Although it is ascribed to them jointly, certain testimonies ascribe it to Ahmad ibn Mūsā, who seems to be the mechanician of the group. This treatise, in the form of a catalogue of machines, is a large illustrated work on mechanical devices including automata. The book described a total of 100 devices and how to use them. It was based partly on the work of Heron of Alexandria and Philon of Byzantium, other ancient texts and contained original work by the brothers. Some of these inventions include: valve, float valve, feedback controller, automatic flute player, a programmable machine, trick devices, and self-trimming lamp. The work was first partly translated and interpreted into German by Eilhard Wiedemann and Friedrich Hauser. It was translated and annotated in English by Donald R. Hill, and its Arabic original text was edited by Ahmad Y. al-Hassan.

A total of 100 devices are taken up and explained in great detail in the book. 73 of these are related to trick vessels and the others consist of 15 automatic control systems, 7 water jets, 3 oil lamps, one bellow and one lifting mechanism system. Their application is generally based on aerostatic and hydrostatic pressure principles. The systems are more advanced than earlier ancient ones in that they can even satisfy contemporary technologic requirements. The book provides the first examples of various mechanic elements, technical drawings, logic and command systems and especially automatically controlled systems.

The trick vessels display a bewildering variety of effects: for example, a pitcher into which liquids of three different colours are poured in succession -when the tap is opened they discharge in the order in which they were poured; or a basin that is replenished when small amounts of liquid are extracted from it, but is not replenished if a larger amount is taken. These effects, and many others, are obtained by switching

mechanisms operated by small variations in aerostatic and hydraulic pressures, and by the use of automatically activated conical valves. The purpose of these devices was partly didactic and partly to amuse. They appear trivial to us, but the Banū Mūsā's mastery of delicate controls was unsurpassed until fairly recent times.

91) It can be deduced that Muhammad, Ahmad and al-Hasan were given a good education in Baghdad by:

A) Their father Musa Ibn Shakir
B) The Caliph al-Mu'tasim
C) The Caliph al-Ma'mum
D) The Caliph al-Wathiq

92) Al-Dja'fariyya, a new city was founded near the Baghdad by Abbasi Caliph al-Mutawakkil during:

A) Period 847 CE – 861 CE
B) Period 813 CE – 833 CE
C) Period 833 CE – 842 CE
D) Period 842 CE – 847 CE

93) The Banu Musa brothers made many observations of the sun and the moon from Baghdad.

A) Muhammad and al- Hasan measured the length of solar year as 365 days and 6 hours
B) Muhammad and Ahmad measured the length of solar year as 365 days and 6 hours
C) They measured the length of year, obtaining the value of 365 days.
D) Al-Hasan and Ahmad measured the length of solar year as 365 days and 6 hours

94) With the numerous contributions in the field of Mathematics, Astronomy and Science, they are particularly known for their work in:

A) Astronomy which is well documented in their book *Kitāb al-hiyal*
B) Measurement which is well documented in their book *Kitāb al-hiyal*
C) Geometry which is well documented in their book *Kitāb al-hiyal*
D) Mechanics which is well documented in their book *Kitāb al-hiyal*

95) Inventions including valve, float valve, feedback controller, automatic flute player, a programmable machine, trick devices and self- trimming lamp are attributed to:

A) Heron of the Alexandria and Philon of Byzantium
B) Banu Musa Brothers
C) Eilhard Wiedermann and Friedrich Hauser
D) Donald R. Hill

96) Break up of 100 devices explained in the detail in the book *Kitāb al-hiyal* is:

A) 73 trick vessels, 15 automatic control systems, 7 water jets, 3 oil lamps, one bellow and one lifting mechanism system
B) 80 trick vessels, 15 automatic control systems, 7 water jets, 3 oil lamps, one bellow and one lifting mechanism system
C) 73 trick vessels, 25 automatic control systems, 7 water jets, 3 oil lamps, one bellow and one lifting mechanism system
D) 73 trick vessels, 15 automatic control systems, 7 water jets, 13 oil lamps, one bellow and one lifting mechanism system

97) The trick vessels presented in the book *Kitāb al-hiyal*:

A) Mystify the reader
B) Baffle of the reader
C) Confound the reader
D) All of the above

98) The devices by Banu Musa in their books:

A) Show the trivial and rudimentary sciences
B) Show the mastery of delicate controls which was unsurpassed until fairly recent times
C) Show the knowledge of astronomy
D) Show understanding of lamps

99) The book *Kitāb al-hiyal* provides:

A) The first example of various mechanic elements.
B) Technical drawings of various mechanical devices
C) Logic and commands system of various of mechanical devices
D) All of the above

100) The main features of the devices presented by Banu Musa are:

A) Switching mechanism operated by aerostatics and hydraulic pressures
B) Automatically activated conical valves
C) Automatically controlled mechanical systems
D) All of the above