



STEM Careers Project



STEM Careers Project is a joint venture of the Higher Education Commission and Pakistan Atomic Energy Commission, for grooming talented students for careers in Science, Technology; Engineering & Mathematics (STEM).

Screening TEST: Mathematics NSTC-19, March 27, 2022

Maximum Marks: 100

Maximum Time: 3 hours

Check List: Before attempting this question paper please make sure that:

- i) Paper contains 7 pages including this page and no page is torn or missing
- ii) Part I consists of 20 multiple choice questions, Part II contain 50 multiple choice questions and Part III contains descriptive questions
- iii) Answer Sheet for MCQs of Part-I & II, and Answer Booklet for Part III

1. Part I has 5 multiple-choice questions (MCQs) from each of the subjects of Biology, Computer, Chemistry, Mathematics and Physics. There is a choice between Biology or Computer only, rest of the three subjects are compulsory for every candidate. For Biology or Computer one must blacken the corresponding circle in the answer sheet.
2. Part I has 20 MCQs and carries 20 marks. The MCQ portion of the relevant subject of Part II carries 50 Marks. Correct answer carries +1 mark; 1/3 mark will be deducted for each incorrect answer.
3. Write your name on the space provided in the Answer Sheet for Part I and Part II. There are four choices (a, b, c, d) corresponding to each multiple-choice question. Blacken one of these choices as shown in the example, which in your opinion is correct. Rough work may be done in the Answer Booklet for Part III by clearly specifying 'Rough Work'.
4. The descriptive question(s) of Part III should be solved in the Answer Booklet for Part III. This part carries 30 Marks.
5. You are recommended to give frank opinion about the test, including pointing out possible mistakes and legibility problems on the last page of the Answer Booklet. It is meant to motivate you to carefully read the question paper before attempting it. It may be used to discriminate between candidates having similar scores.
6. Recommended time for Part I is about 30 minutes and for Parts II and III is about one hour each. The rest of the time is for carefully reading the paper and commenting on it.
7. No leaf from the question paper or Answer Booklet is to be torn out as all these must be handed over to the examiner, even if no question has been attempted. Anyone found using unfair means would be disqualified.
8. You may use non-programmable calculators.
9. No questions will be entertained and no clarification will be made during the test. In case of doubt, please write down your remarks/comments on the last page of the Answer Booklet.
10. You must attempt all Parts of the paper. To qualify screening test one should pass both Parts I and the portion of Parts II and III that are relevant to the discipline in which you have applied to appear.
11. The term 'estimate' if used in the descriptive portion of Part II means that only an approximate answer is expected from the students. Similarly the term 'sketch' in Part III means drawing a rough graph, which looks like what you might expect from more careful considerations.
12. **Possession of CELL PHONE or any IMAGING DEVICE in the Examination Hall will be treated as an offence under unfair mean rules.**
13. Please put your pen down as soon as you hear the announcement of 'stop writing'.

Students will be short-listed for a one-week Training Camp on the basis of their performance on this Screening Test. Results will be posted on NSTC web page: www.stem.edu.pk. Successful candidates will also be informed about their result in about two months after the exam. Please make sure that we have your correct phone/fax number and e-mail address.

PART-I

[CANDIDATE MUST ATTEMPT THIS PART]

[It contains 20 MCQs, 5 from each biology/computer, chemistry, mathematics and physics, for selection to the next phase]

Choose either Biology or Computer and must blacken the correct option in the answer sheet.

BIOLOGY

1. In multicellular organisms, similar cells are organized into groups, called
a) Organ b) Organ system c) Tissues d) Individual
2. The process by which one diploid cell divides to generate four haploid daughter cells is called
a) Mitosis b) Prophase c) Meiosis d) Anaphase
3. Red blood cells are also called erythrocytes and transport
a) nerve impulse b) Oxygen c) water d) food
4. A series of hypothesis supported by the results of many tests is called
a) Scientific law b) Theory c) Data d) Deduction
5. Artificial cleaning of blood is known as:
a) Dialysis b) Diabetes c) Lithotripsy d) Both a & b

OR

COMPUTER

1. All the instructions from the users and various softwares are carried out by the _____.
a) ALU b) MU c) CPU d) DVD
2. In a multi-button mouse, one button must be designated as the _____ button.
a) first b) left c) primary d) user
3. Memory that loses its data when power is turned off is considered _____ memory.
a) static b) volatile c) dynamic d) refreshed
4. The more _____ a processor has, the more powerful it is.
a) microns b) transistors c) connections d) neurons
5. This _____ cache holds the most recently used data or instructions.
a) L1 b) L2 c) L3 d) L4

CHEMISTRY

6. Which acid is present in vinegar?
a) Acetic Acid b) Formic Acid c) Oxalic Acid d) Hydro Chloric Acid
7. Which metal exist in fluid form at standard temperature and pressure conditions?
a) Mercury b) Bromine c) Sodium d) Calcium
8. Which one is not the contribution of Dalton in Chemistry?
a) Atomic theory b) Dalton Law c) Law of multiple proportion d) Law of conservation of mass
- 9 What is the empirical formula of Urea?
a) CH_4ON_2 b) $\text{C}_3\text{H}_4\text{NO}_3$ (c) CH_3NO_2 d) $\text{C}_6\text{H}_5\text{NO}_2$
10. Which vitamin is known as ascorbic acid?
a) Vitamin A b) Vitamin B c) Vitamin C d) Vitamin D

MATHEMATICS

11. If $a * b = a-b+ab$, then $2 * 5 + 5 * 2$ is
a) 14 b) 16 c) 20 d) none of these
12. Which of the fractions below is closest to 1?
a) $\frac{8}{7}$ b) $\frac{9}{10}$ c) $\frac{10}{11}$ d) $\frac{11}{10}$
13. $6^2 + |6| + |-6| - 6^2$ is equal to
a) -6 b) 0 c) 6 d) 12
14. $\frac{5^5}{5^4}$ is equal to
a) 1 b) 5 c) 25 d) 125
15. $(a^m)^n =$
a) a^mn b) a^{m+n} c) a^{mn} d) None of these

PHYSICS

16. Which is a derived unit?
a) meter b) second c) kilogram d) newton
17. A boy weighing 500 newtons takes 50. Seconds to climb a flight of stairs 18 meters high. His power output vertically is
a) 9,000 W b) 4,000 W c) 1,400 W d) 180 W
18. Which net charge could be found on an object?
a) $+3.2 \times 10^{-18} \text{ C}$ b) $-1.8 \times 10^{-18} \text{ C}$ c) $+2.4 \times 10^{-19} \text{ C}$ d) $-0.80 \times 10^{-19} \text{ C}$
19. Compared to insulators, metals are better conductors of electricity because metals contain more free
a) protons b) electrons c) positive ions d) negative ions
20. Which two quantities are measured in the same units
a) momentum and work b) energy and power
c) mechanical energy and heat d) work and power

PART II – MATHEMATICS

21	For any integers $a, b, n \in \mathbb{Z}$ such that $n a$ and $n b$, then					
(a)	$n \gcd(a, b)$	(b)	$n \gcd(b, a)$	(c)	$n \gcd(a, b - a)$	(d) all of these
22	If $\gcd(a, b) = d$, then $\frac{a}{d}$ and $\frac{b}{d}$ are _____.					
(a)	composite	(b)	relative prime	(c)	perfect square	(d) none of these
23	If " p " is a prime and " n " is a positive integer, then					
(a)	$p n^p - n$	(b)	$p n^{p+1} - n$	(c)	$p n^{p-1} - n$	(d) none of these
24	If $\frac{a}{b} = \frac{2}{3}$ and $\frac{b}{c} = \frac{4}{5}$, then $\frac{a+b}{b+c}$ is equal to					
(a)	$\frac{27}{20}$	(b)	$\frac{15}{4}$	(c)	$\frac{4}{15}$	(d) $\frac{20}{27}$
25	If $x^2 - 2x + 1 = 0$, then $x^2 + \frac{1}{x^2}$ is					
(a)	0	(b)	-2	(c)	2	(d) none of these
26	$n^n >$					
(a)	2^n	(b)	n^2	(c)	$n!$	(d) All
27	$\lfloor -3.1 \rfloor =$					
(a)	-3	(b)	-4	(c)	-2	(d) None
28	Decimal representation of $(A35BOF)_{16}$ is					
(a)	$(10705679)_{10}$	(b)	$(10705671)_{10}$	(c)	$(10705629)_{10}$	(d) $(10105679)_{10}$
29	Which of the following integers is prime					
(a)	6783	(b)	156009	(c)	2311	(d) 232012
30	The least common multiple of 345, 453, 234 is					
(a)	4,063,310	(b)	4,064,410	(c)	4,062,410	(d) 4,063,410
31	In 3 fingers, the number of ways four rings can be worn isways.					
(a)	$4^3 - 1$	(b)	3^4	(c)	68	(d) 64
32	The number of 5 digit numbers all digits of which are odd is					
(a)	25	(b)	5^5	(c)	5^6	(d) 625
33	The product of r consecutive positive integers is divisible by					
(a)	$r!$	(b)	$(r - 1)!$	(c)	$(r + 1)!$	(d) r^5
34	Everybody in a room shakes hands with everybody else. The total number of shake hands is 66. The number of persons in the room is					
(a)	11	(b)	12	(c)	10	(d) 6
35	The number of rectangles that a chessboard has.....					
(a)	81	(b)	9^9	(c)	1296	(d) 6561

36	1 + 3 + 5 + 7 + + 17 is equal to						
(a)	101	(b)	81	(c)	71	(d)	61
37	6 men and 4 women are to be seated in a row so that no two women sit together. The number of ways they can be seated is						
(a)	604800	(b)	17280	(c)	120960	(d)	518400
38	The number of ways of painting the faces of a cube with six different colors is						
(a)	1	(b)	6	(c)	6!	(d)	None of these
39	If $b \neq 0 \in \mathbb{Z}$, then which of the following statements is correct?						
(a)	$b 0$	(b)	$b \nmid 0$	(c)	$0 b$	(d)	None of these
40	Which of the following equals to 8?						
(a)	$\gcd(1,8)$	(b)	$\gcd(-32,44)$	(c)	$\gcd(12,42)$	(d)	$\gcd(-32,96)$
41	If a is divisible by b , which of the following are true						
(a)	b divides into a evenly	(b)	when we divide a by b , the remainder is 0	(c)	$a = bq$, for some integer q	(d)	All of these
42	The three numbers are in the ratio $1/2 : 2/3 : 3/4$. The difference between greatest and smallest numbers is 36. Find the numbers						
(a)	72,84,108	(b)	60,72,96	(c)	72,84,96	(d)	72,96,108
43	Three bells beep at an interval of 12, 20, and 35 minutes. If they beep together at 10 a.m., then they will again beep together at						
(a)	12 pm	(b)	5 pm	(c)	4 pm	(d)	1 pm
44	What is the least number which when divided by the numbers 3, 5, 6, 8, 10 and 12 leaves in each case a remainder 2 but which when divided by 13 leaves no remainder?						
(a)	312	(b)	962	(c)	1586	(d)	1562
45	The sum of first five prime numbers is						
(a)	11	(b)	18	(c)	26	(d)	28
46	How many prime numbers are less than 50?						
(a)	16	(b)	15	(c)	14	(d)	18
47	In $\triangle XYZ$, XY and XZ are 20 cm and 25 cm respectively, XP is angle bisector of $\angle YXZ$, $YP = a$ cm and $PZ = (a+3)$ cm. If I is the incenter of the triangle, then find the ratio of $XI : IP$.						
(a)	5:3	(b)	4:5	(c)	3:5	(d)	5:4
48	A circle is circum-scribed of $\triangle ABC$. O is the center of the circle and CP is the tangent of the circle at the point C . If BC bisects the $\angle OCP$, then what is the supplementary angle of $\angle BAC$?						
(a)	160°	(b)	135°	(c)	140°	(d)	145°
49	The area of the triangle whose vertices are given by the coordinates (1,2), (-4, -3) and (4, 1) is						
(a)	7 sq. units	(b)	20 sq. units	(c)	10 sq. units	(d)	14 sq. units
50	If the angles, in degree, of a triangle, are x , $3x + 20$ and $6x$, the triangle must be						
(a)	Acute	(b)	Right	(c)	Isosceles	(d)	Obtuse

51	ΔABC is inscribed in a circle with center O. If $AB = 17$ cm, $BC = 10$ cm and $AC = 9$ cm, then find the length of AO.							
(a)	18 cm	(b)	10.6 cm	(c)	106 cm	(d)	36 cm	
52	If the measure of each interior angle of a regular polygon is 150° , then the number of its diagonals will be							
(a)	54	(b)	27	(c)	15	(d)	12	
53	If an arithmetic progression is 13, 11, 9..., then find 50 th term of that arithmetic progression.							
(a)	-90	(b)	-56	(c)	-112	(d)	-85	
54	From a group of 7 men and 6 women, five persons are to be selected to form a committee so that three men are there on the committee. In how many ways can it be done?							
(a)	564	(b)	645	(c)	735	(d)	756	
55	In a colony, there are 55 members. Every member posts a greeting card to all the members. How many greeting cards were posted by them?							
(a)	990	(b)	890	(c)	2970	(d)	1980	
56	If ${}^n P_r = 3024$ and ${}^n C_r = 126$ then find n and r.							
(a)	9, 4	(b)	10, 3	(c)	12, 4	(d)	11, 4	
57	There are six movie parts numbered from 1 to 6. Find the number of ways in which they be arranged so that part-1 and part-3 are never together.							
(a)	876	(b)	480	(c)	654	(d)	237	
58	Find the number of factors of the product $5^8 \times 7^5 \times 2^3$ which are perfect squares.							
(a)	47	(b)	30	(c)	65	(d)	19	
59	Midpoint of (-1,1) and (1,-1) is							
(a)	(1,1)	(b)	(-1,-1)	(c)	(1,1)	(d)	(0,0)	
60	Four non-parallel lines in a plan intersect at most at							
(a)	Zero Point	(b)	One Point	(c)	Four Points	(d)	Six Points	
61	If A and B are 2×2 matrices then $\text{Det}(A+B)$ is equal to							
(a)	$\text{Det}(A) + \text{Det}(B)$	(b)	Identity Matrix	(c)	$\text{Det}(A) \cdot \text{Det}(B)$	(d)	None of these.	
62	The solution of $2x-9 \geq 7$ is							
(a)	$[8, \infty)$	(b)	$(-\infty, \infty)$	(c)	$(8, \infty)$	(d)	$(-\infty, 8)$	
63	The inverse of the function $f(x) = 2x-9$ is							
(a)	$(x+9)/2$	(b)	$(x-9)/2$	(c)	$(x+2)/9$	(d)	$(x-2)/9$	
64	Polygon with 9 sides is called							
(a)	heptagon	(b)	nanogon	(c)	octagon	(d)	pentagon	
65	Area of a rhombus having diagonals equal to 6 cm and 8 cm is							
(a)	48 cm^2	(b)	36 cm^2	(c)	24 cm^2	(d)	64 cm^2	
66	The length of a rectangular screen is 15 cm. Its area is 180 sq. cm. Its width is							
(a)	18 cm	(b)	12 cm	(c)	10 cm	(d)	15 cm	

67	If $f(x-3) = 9x^2+2$ then $f(5)$ is						
(a)	578	(b)	227	(c)	555	(d)	None of these
68	The expression $\sqrt{20 - \sqrt{20 - \sqrt{20 - \sqrt{20 - \dots}}}}$ is equal to						
(a)	20	(b)	5	(c)	4	(d)	None of these
69	The value of $\cos(\tan^{-1}(-1))$ is						
(a)	$\frac{1}{2}$	(b)	$-\frac{1}{\sqrt{2}}$	(c)	$-\pi$	(d)	$\frac{\sqrt{2}}{2}$
70	A pair of chords of a circle subtending two congruent central angles is						
(a)	parallel	(b)	congruent	(c)	overlapping	(d)	incongruent

Part III: Mathematics-Descriptive Questions

[30 Marks]

Question No 1:

Find value of

$$\sqrt{2 - \sqrt{2 - \sqrt{2 - \sqrt{2 - \sqrt{2 \dots}}}}} - \sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{2 + \sqrt{2 \dots}}}}}$$

Question No 2:

Given BE and CF are the altitudes of the triangle ABC. P, Q are on BE and the extension of CF respectively such that BP = AC, CQ = AB. Prove that AP and AQ perpendicular.

-----End of paper-----