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: Physics
NSTC-22, June 28, 2025

Maximum Marks: 100 Maximum Time: 3 hours

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

i) Paper contains 8 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. In Part I and Part II, there are four choices (a, b, c, d) corresponding to each multiple-choice question. Blacken one of these choices, 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 III 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.

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Name:_____ **Roll No:**_____

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. Which gas is filled in electric bulb?
   a) Argon b) Helium c) Nitrogen d) All of these
2. Cancer is disease of:
   a) Simple cell division b) Uncontrolled cell division c) Controlled cell division d) Accelerated cell division
3. Which of the following is a list of entirely abiotic factors?
   a) Soil, temperature, viral infection, pH of soil, predators b) viral infection, predators, competition for resources c) Sunlight, soil pH, number of species, Plant canopy d) Temperature, soil pH, oxygen, light
4. Malaria is an infectious disease caused by a single-celled eukaryotic organism, carried by female mosquitoes. The mosquito is the:
   a) Pathogen b) Vector c) Agent d) Virus
5. Cellular digestion is associated with which organelle?
   a) Lysosomes b) Mitochondria c) Golgi bodies d) Plastids

OR

COMPUTER

1. When _____ is encountered inside any loop, control automatically passes to the first statement after loop.
   a) Continue b) Goto c) Return d) Break
2. The speed of the laser printer is measured in.
   a) Lines per minute b) Page per minutes c) Characters per sound d) Word per minutes
3. Which unit in the CPU is responsible for fetching instructions from memory?
   a) ALU (Arithmetic Logic Unit) b) Register c) Cache Memory d) Control Unit
4. When a collection of various computers appears as a single coherent system to its clients, what is this called?
   a) mail system b) distributed system c) networking system d) computer network
5. In a hierarchical database model, data is organized in a:
   a) Tree-like structure b) Mesh structure c) Circular structure d) Linear structure

Name:_____ Roll No:_____

CHEMISTRY

6. A mole of any substance is related to
   a) Number of particles b) Volume of gaseous substance c) Mass of a substance d) All of these

7. A drop of liquid acquires a spherical shape because of
   a) its tendency to maximize its surface area b) its tendency to acquire minimum surface area
   c) its viscous nature d) none of these

8. Some people add sodium chloride to water while boiling eggs. This is to
   a) decrease the boiling point of water b) increase the boiling point of water
   c) prevent breaking of eggs d) make egg tasty

9 A variety of water which contains soluble salts of Ca and Mg is known as
   a) Soft water b) Heavy water (c) Conductivity water d) Hard water

10. Milk is a colloid in which
   a) Liquid is dispersed in liquid b) Gas is dispersed in liquid c) Sugar is dispersed in water d) Solid is dispersed in liquid

MATHEMATICS

11. If $x + 1/x = 3$, then the value of $x^2 + 1/x^2$ is:
   a) 5 b) 7 c) 9 d) 3

12. Find the degree of the polynomial $5x^4y^2 + 3xy^5 + 7$?
   a) 4 b) 6 c) 7 d) 5

13. Number of real roots of $x^2 + 4x + 5 = 0$ is:
   a) 2 b) 0 c) 1 d) infinite

14. If $x^2 - 6x + 9 = 0$, the $x =$
   a) 0 b) 3 c) 9 d) ± 3

15. The set of all points, in a plane equidistance from a fix point $A = (x, y)$, forms a
   a) Line b) Circle c) Sphere d) None of these

PHYSICS

16. A 1,200-kilogram car traveling at 10 meters per second hits a tree and is brought to rest in 0.10 second. What is the magnitude of the average force acting on the car to bring it to rest?
   a) 1.2×10^2 N b) 1.2×10^4 N c) 1.2×10^3 N d) 1.2×10^5 N

17. A spring scale reads 20 newtons as it pulls a 5.0-kilogram mass across a table. What is the magnitude of the force exerted by the mass on the spring scale?
   a) 49 N b) 20 N c) 5 N d) 4 N

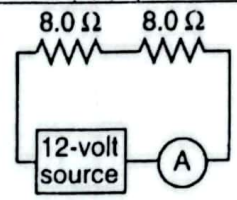
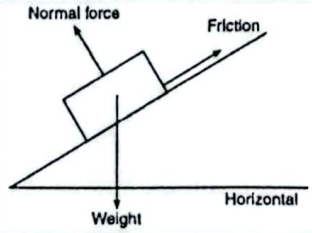
18. When a neutral metal sphere is charged by contact with a positively charged glass rod, the sphere
   a) loses electrons b) gains electrons c) loses protons d) gains protons

19. A motor is used to produce 4.0 waves each second in a string. What is the frequency of the waves?
   a) 0.25 Hz, b) 25 Hz, c) 15 Hz, d) 4 Hz

20. One watt is equivalent to one
   a) N•m b) N/m c) J•s d) J/s

Name:_____ Roll No:_____

PART II – PHYSICS

21	A constant force is used to keep a block sliding at constant velocity along a rough horizontal track. As the block slides, there could be an increase in its						
(a)	gravitational potential energy, only	(b)	internal energy, only	(c)	gravitational potential energy and kinetic energy	(d)	internal energy and kinetic energy
22	The spring of a toy car is wound by pushing the car backward with an average force of 15 newtons through a distance of 0.50 meter. How much elastic potential energy is stored in the car's spring during this process?						
(a)	1.9 J	(b)	7.5 J	(c)	30 J	(d)	56 J
23	The diagram shows a circuit with two resistors. What is the reading on ammeter A? 						
(a)	1.3 A	(b)	1.5 A	(c)	3.0 A	(d)	0.75 A
24	A radar gun can determine the speed of a moving automobile by measuring the difference in frequency between emitted and reflected radar waves. This process illustrates						
(a)	resonance	(b)	diffraction	(c)	the Doppler effect	(d)	refraction
25	A photon of which electromagnetic radiation has the most energy?						
(a)	ultraviolet	(b)	infrared	(c)	x ray	(d)	microwave
26	When a 12-newton horizontal force is applied to a box on a horizontal tabletop, the box remains at rest. The force of static friction acting on the box is						
(a)	0 N	(b)	between 0 and 12 N	(c)	12 N	(d)	greater than 12 N
27	Three forces act on a box on an inclined plane as shown in the diagram. [Vectors are not drawn to scale.] If the box is at rest, the net force acting on it is equal to 						
(a)	the weight	(b)	friction	(c)	the normal force	(d)	zero
28	If 4.8×10^{-17} joule of work is required to move an electron between two points in an electric field, what is the electric potential difference between these points?						
(a)	1.6×10^{-19} V	(b)	4.8×10^{-17} V	(c)	3.0×10^{2} V	(d)	4.8×10^{2} V
29	The speed of light having frequency $f = 5.09\times10^{14}$ Hz, in a transparent material is 0.75 times its speed in air. The absolute index of refraction of the material is						
(a)	0.75	(b)	1.3	(c)	2.3	(d)	4.0
30	If a deuterium nucleus has a mass of 1.53×10^{-3} universal mass units less than its components, this mass represents an energy of						
(a)	1.38 MeV	(b)	1.42 MeV	(c)	1.53 MeV	(d)	3.16 MeV
31	Babar, who has a mass of M = 100 kg, climbs to the roof of a 30 m building and then lowers one end of a massless rope to his friend Rashid. Babar then pulls Rashid, who has a mass of m = 75 kg, up the roof of the building. Approximately how much total work has Babar done after Rashid is on the roof?						
(a)	60 J	(b)	600 J	(c)	7×10^{3} J	(d)	5×10^{4} J

Name:_____ Roll No:_____

32	Luqman (mass 33.1 kg), Hamid (mass 63.7 kg), and Nadeem (mass 24.3 kg) sit on a lightweight seesaw at evenly spaced 2.74 m intervals (in the order in which they are listed; Hamid is between Luqman and Nadeem) so that the seesaw balances. Who exerts the most torque (in terms of magnitude) on the seesaw? Ignore the mass of the seesaw.						
(a)	Luqman	(b)	Hamid	(c)	Nadeem	(d)	All exert same Torque
33	Two identical objects of mass m are placed at either end of a spring of spring constant k and the whole system is placed on a horizontal frictionless surface. At what angular frequency ω does the system oscillate?						
(a)	$\sqrt{k/m}$	(b)	$\sqrt{2k/m}$	(c)	$\sqrt{k/2m}$	(d)	$\sqrt{k/m}/2$
34	A certain football quarterback can throw a football a maximum range of 80 meters on level ground. What is the highest point reached by the football if thrown this maximum range? Ignore air friction.						
(a)	10 m	(b)	20 m	(c)	30 m	(d)	40 m
35	Consider a completely inelastic collision between two lumps of space goo. Lump 1 has mass m and originally moves directly north with a speed v_0. Lump 2 has mass $3m$ and originally moves directly east with speed $\frac{v_0}{2}$. What is the final speed of the masses after the collision? Ignore gravity, and assume the two lumps stick together after the collision.						
(a)	$\frac{7}{16}v_0$	(b)	$\frac{\sqrt{5}}{8}v_0$	(c)	$\frac{\sqrt{13}}{8}v_0$	(d)	$\sqrt{13/8}v_0$
36	Two teams of movers are lowering a piano from the window of a 10 floor apartment building. The rope breaks when the piano is 30 meters above the ground. The movers on the ground, alerted by the shouts of the movers above, first notice the piano when it is 14 meters above the ground. How long do they have to get out of the way before the piano hits the ground?						
(a)	0.66 sec	(b)	0.78 sec	(c)	1.67 sec	(d)	1.79 sec
37	A 5.0 kg block with a speed of 8.0 m/s travels 2.0 m along a horizontal surface where it makes a head-on, perfectly elastic collision with a 15.0 kg block which is at rest. The coefficient of kinetic friction between both blocks and the surface is 0.35. How far does the 15.0 kg block travel before coming to rest?						
(a)	0.76 m	(b)	1.79 m	(c)	2.29 m	(d)	3.04 m
38	Four masses m are arranged at the vertices of a tetrahedron of side length a. What is the gravitational potential energy of this arrangement?						
(a)	$-2\frac{Gm^2}{a}$	(b)	$-3\frac{Gm^2}{a}$	(c)	$-4\frac{Gm^2}{a}$	(d)	$-6\frac{Gm^2}{a}$
39	The gravitational self-potential energy of a solid ball of mass density ρ and radius R is E. What is the gravitational self-potential energy of a ball of mass density ρ and radius $2R$?						
(a)	$4E$	(b)	$8E$	(c)	$16E$	(d)	$32E$
40	A ball with mass m projected horizontally off the end of a table with an initial kinetic energy K. At a time t after it leaves the end of the table it has kinetic energy $3K$. What is t? Neglect air resistance.						
(a)	$(3/g)\sqrt{K/m}$	(b)	$(2/g)\sqrt{K/m}$	(c)	$(1/g)\sqrt{8K/m}$	(d)	$(K/g)\sqrt{6/m}$
41	A block with mass m=3.0 kg slides down one incline and then moves up another. The coefficient of kinetic friction on both ramps is μ_k=0.40. The block starts from rest at a height of h_1=1.0 m above the horizontal. Both ramps are inclined at 30^0 to the horizontal. How high above the horizontal does the block rise on the second ramp?						
(a)	0.52 m	(b)	0.18 m	(c)	0.59 m	(d)	0.71 m
42	A cyclist maintains a steady speed of 22.0 km/h during the ride, except for a 20-minute break. If the overall average speed for the entire journey (including the stop) is 17.5 km/h, determine the total distance the cyclist covered.						
(a)	37.9 km	(b)	31.2 km	(c)	28.5 km	(d)	32.3 km
43	An 80 kg astronaut is seated in a spacecraft that is accelerating upward at five times the acceleration due to gravity, near Earth's surface. What force does the astronaut exert on the spacecraft?						
(a)	4020 N	(b)	800 N	(c)	3208 N	(d)	4720 N
44	A student pulls a 22.0 kg suitcase across a flat airport floor at a steady speed of 1.10 m/s. The suitcase is pulled with a force of 1.00×10^2 N along a handle inclined at 30° above the horizontal. What is the coefficient of kinetic friction between the suitcase and the floor?						
(a)	$\mu_k = 0.013$	(b)	$\mu_k = 0.394$	(c)	$\mu_k = 0.523$	(d)	$\mu_k = 1.055$

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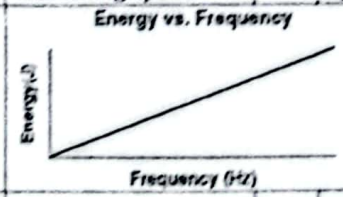
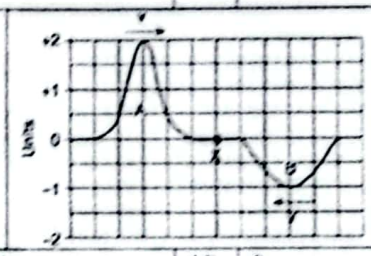
45	The energy of a photon is inversely proportional to its						
(a)	wavelength	(b)	frequency	(c)	speed	(d)	phase
46	The diagram represents an electric circuit consisting of a 12-volt battery, a 3.0-ohm resistor, R_1, and a variable resistor, R_2. At what value must the variable resistor be set to produce a current of 1.0 ampere through R_1? 						
(a)	6.0 Ω	(b)	3.0 Ω	(c)	9.0 Ω	(d)	12 Ω
47	A source of waves and an observer are moving relative to each other. The observer will detect a steadily increasing frequency if						
(a)	he moves toward the source at a constant speed	(b)	the source moves away from him at a constant speed	(c)	he accelerates toward the source	(d)	the source accelerates away from him
48	A 40.-kilogram student runs up a staircase to a floor that is 5.0 meters higher than his starting point in 7.0 seconds. The student's power output is						
(a)	29 W	(b)	280 W	(c)	1.4×10^{3} W	(d)	1.4×10^{4} W
49	Which type of field is present near a moving electric charge?						
(a)	an electric field, only	(b)	a magnetic field, only	(c)	both an electric field and a magnetic field	(d)	neither an electric field nor a magnetic field
50	A person is standing on a weighing machine in an elevator car. If the scale on the weighing machine reads a value greater than the weight of the person at rest, the elevator car could be moving						
(a)	downward at constant speed	(b)	upward at constant speed	(c)	downward at increasing speed	(d)	upward at increasing speed
51	The graph represents the relationship between the energy and the frequency of photons. The slope of the graph would be 						
(a)	$6.63\times10^{-34} J.s$	(b)	6.67×10^{-11} $N.m^2/kg^2$	(c)	$1.60\times10^{-19} J$	(d)	$1.60\times10^{-19} C$
52	Two pulses, A and B, travel toward each other along the same rope, as shown. When the centers of the two pulses meet at point X, the amplitude at the center of the resultant pulse will be 						
(a)	+1 unit	(b)	-1 units	(c)	+2 unit	(d)	0
53	Which wave phenomenon makes it possible for a player to hear the sound from a referee's whistle in an open field even when standing behind the referee?						
(a)	diffraction	(b)	Doppler effect	(c)	reflection	(d)	refraction
54	A high school physics student is sitting in a seat reading this question. The magnitude of the force with which the seat is pushing up on the student to support him is closest to						
(a)	0 N	(b)	60 N	(c)	600 N	(d)	6000 N
55	The microphone is moved to a new fixed location 0.50 meter in front of the speaker. Compared to the sound waves detected at the 1.00-meter position, the sound waves detected at the 0.50-meter position have a different						
(a)	wave speed	(b)	frequency	(c)	wavelength	(d)	amplitude

Name:_____ Roll No:_____

56	An ideal spring is used to fire a 15.0-g pellet horizontally. The spring has a spring constant of 20 N/m and is initially compressed by 7.0 cm. The kinetic energy of the pellet as it leaves the spring is:						
(a)	Zero	(b)	$2.5 \times 10^{-2} J$	(c)	$4.9 \times 10^{-2} J$	(d)	$9.8 \times 10^{-2} J$
57	A vector has a magnitude of 12. When its tail is at the origin it lies between the positive x-axis and the negative y-axis and makes an angle of 30° with the x-axis. Its y-component is:						
(a)	$6/\sqrt{3}$	(b)	$-6/\sqrt{3}$	(c)	6	(d)	-6
58	A very massive object traveling at 10 m/s strikes a very light object, initially at rest, and the light object moves off in the direction of travel of the heavy object. If the collision is elastic, the speed of the lighter object is:						
(a)	5.0 m/s	(b)	10 m/s	(c)	15 m/s	(d)	20 m/s
59	A hypothetical planet has a mass 1.80 times that of Earth, but the same radius. What is g near its surface?						
(a)	13.5 m/s²	(b)	9.8 m/s²	(c)	5.4 m/s²	(d)	17.6 m/s²
60	A rocket of mass 2.75×10^6 kg exerts a vertical thrust of 3.55×10^7 N on the gases it expels. Assuming gravity g=9.8 m/s² is constant and the mass of expelled gas is negligible, how long does the rocket take to reach an altitude of 9500 m?						
(a)	90.1 sec	(b)	46.2 sec	(c)	62.3 sec	(d)	118.4 sec
61	Neglecting air resistance, a baseball player on Earth can throw a baseball a distance of 100 m. If gravity is 5 times weaker on the moon, how far could he throw the ball if he were on the moon?						
(a)	20 m	(b)	100 m	(c)	500 m	(d)	2500 m
62	An object starting from rest can roll without slipping down an incline. Which of the following four objects, each with mass M and radius R, would have the largest acceleration down the incline?						
(a)	A uniform solid sphere	(b)	A uniform solid disk	(c)	A hollow spherical shell	(d)	A hoop
63	An object is thrown directly downward from the top of a 180 meter tall building. It takes 1.0 seconds for the object to fall the last 60 meters. With what initial downward speed was the object thrown from the roof?						
(a)	15 m/s	(b)	25 m/s	(c)	35 m/s	(d)	55 m/s
64	Radio waves and gamma rays traveling in space have the same						
(a)	frequency	(b)	period	(c)	wavelength	(d)	speed
65	What is the gravitational potential energy with respect to the surface of the water of a 75.0- kilogram diver located 3.0 meters above the water?						
(a)	2.17×10^4 J	(b)	2.25×10^2 J	(c)	2.21×10^3 J	(d)	2.29×10^1 J
66	A 60.0-kilogram runner has 1920 joules of kinetic energy. At what speed is he running?						
(a)	5.66 m/s	(b)	32.0 m/s	(c)	8.00 m/s	(d)	64.0 m/s
67	If the direction of a moving car changes and its speed remains constant, which quantity must remain the same?						
(a)	velocity	(b)	displacement	(c)	momentum	(d)	kinetic energy
68	Which form(s) of energy can be transmitted through a vacuum?						
(a)	light, only	(b)	sound, only	(c)	both light and sound	(d)	neither light nor sound
69	If the potential difference applied to a fixed resistance is doubled, the power dissipated by that resistance						
(a)	remains the same	(b)	halves	(c)	doubles	(d)	quadruples
70	According to the Standard Model, a proton is constructed of two up quarks and one down quark (uud) and a neutron is constructed of one up quark and two down quarks (udd). During beta decay, a neutron decays into a proton, an electron, and an electron antineutrino. During this process there is a conversion of a						
(a)	u quark to a d quark	(b)	d quark to a meson	(c)	baryon to another baryon	(d)	lepton to another lepton

Name:_____ Roll No:_____

Part III: Physics-Descriptive Questions
[30 Marks]

Question No 01: (5+5+5)

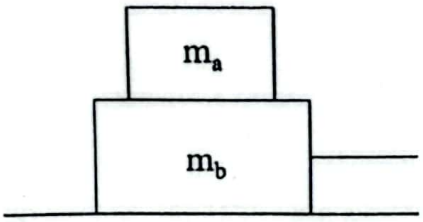
a) A skier of mass m moves from rest down a slope of angle θ to the horizontal. The skier experiences a constant resistive force, F_r. At time t he has travelled a distance d down the slope. Obtain an expression for F_r in terms of the quantities given, and the acceleration due to gravity g.

b) An object falls under gravity. The ratio of the distance fallen by the object in the last second of its fall to the distance covered in the 2nd last second of its fall is 3: 2.
   (i) Find the height from which the object fell, and
   (ii) The speed at which it hits the ground.

c) The resistance of a copper wire 1 m long with a mass of 1 g is 0.15 Ω. Find the length of a wire of the same material with a mass of 1000 kg and a resistance of 6000 Ω.

Question No 2: (2+3+5+5)

A person is pulling two stacked boxes as shown in the figure below.



The string attached to the bottom box is parallel to the ground. The mass of the bottom box is m_b and that of the top box is m_a. The tension in the string is T. The coefficient of static friction between the bottom box and the ground is μ_b and that between the two boxes is μ_a.

a) Draw free body diagram for both the bodies.
b) Write force balance equations in horizontal and vertical directions.

Find the range (all the possible values) of T with sufficient justification and mathematical reasoning when:

c) two boxes are static
d) the bottom box is moving relative to the ground with the box on top resting on it

---End of paper---

Name:_____ Roll No:_____