



Adama Science and Technology University

College of Applied Sciences

Department of Applied Physics

The Third round Exit Model Exam for Fourth-Year Physics Students

1. According to Coulomb's law, the force between two point charges is proportional to
A. The product of the charges B. The square of the distance between them
C. The sum of the charges D. The electric field strength
2. If the distance between two point charges is doubled, the electrostatic force between them becomes.
A. Four times larger B. Two times larger
C. One-half as large D. One-fourth as large
3. The electric potential due to a positive point charge is
A. Zero everywhere B. Negative everywhere
C. Positive everywhere D. Alternating positive and negative
4. When a dielectric is inserted between the plates of a capacitor connected to a battery, the capacitance
A. Decreases B. Remains unchanged C. Increases D. Becomes zero
5. The drift velocity of electrons in a conductor is
A. Greater than thermal velocity B. Zero
C. Much smaller than thermal velocity D. Equal to speed of light
6. Kirchhoff's current law is based on the conservation of
A. Energy B. Charge C. Momentum D. Power
7. A charged particle moving perpendicular to a uniform magnetic field follows a
A. Straight line B. Parabolic path C. Circular path D. Helical path

8. The magnetic field inside a long solenoid is independent of
A. Current B. Number of turns per unit length
C. Length of solenoid D. Magnetic permeability
9. The magnetic field at the center of a circular loop is maximum when
A. Radius is maximum B. Radius is minimum C. Current is zero D. Loop is broken
10. Self-inductance depends on
A. Geometry of the circuit B. Current magnitude
C. External magnetic field D. Charge density
11. The quality factor (Q) of a series RLC circuit is best described as
A) Ratio of energy dissipated to energy stored per cycle
B) Measure of sharpness of resonance
C) Ratio of capacitive reactance to inductive reactance
D) Independent of resistance
12. The kind of process during which the pressure remains constant is called
A) Isometric process
B) Isothermal process
C) Isochoric process
D) Isobaric process
13. In which of the following system neither mass nor energy can transfer?
A) System in thermal contact with a heat reservoir.
B) System in thermal contact with both heat and particle reservoir.
C) Isolated system.
D) Close system.
14. All substances have minimum internal energy at
A) absolute zero
B) 0°C
C) -32°F
D) 100 K
15. Suppose an isolated system with given constraints was initially in one of its equilibrium states.
If some of the constraints are now removed, which one of the following statement is correct?
A) The number of states accessible to the system never increases.
B) The number of states accessible to the system never decreases.
C) The number of states accessible to the system remains unchanged.
D) All
16. In the limit of high temperature, the particles are distributed over a large range of energy values, therefore the occupancy on each state is
A. very small B. Very large C. Same D. Zero
17. If there is reversible flow of heat into system, then entropy will
A. Increases B. decreases C. Remain the same D. none

18. In which of the following system neither mass nor energy can transfer?
 A. close system B. open system C. **isolated system** D. none
19. Suppose 6 white and 6 red balls are placed in a box. In the process of randomly drawing one ball at a time, what is the probability of drawing two white balls successively?
 A. $\frac{1}{2}$ B. $\frac{1}{6}$ C. $\frac{1}{12}$ D. **$\frac{5}{11}$**
20. The branch of science that deals with the geometric description of crystals and their internal arrangement.
 A. Physics B. Solid state physics
 C. **Crystallography** D. Condensed matter physics
21. Bravais Lattice consists of _____ space lattices.
 A. Eleven B. Twelve
 C. Thirteen D. **Fourteen**
22. The crystal lattice has a _____ arrangement.
 A. One-dimensional B. Two-dimensional
 C. **Three-dimensional** D. Four-dimensional
23. A fundamental building block of a crystal
 A. **unit cell** B. lattice
 C. simple cubic D. bravais lattice
24. A parallelepiped specified by the primitive translation vectors and minimum volume cell which has one lattice point per primitive cell is called
 A. Unit cell B. **Primitive cell**
 C. Basis D. Simple cubic
25. Crystal structure gives the details of
 A. Phases B. Grains
 C. **Arrangement of atoms** D. Porosity
26. In which pair most efficient packing is present?
 A. hcp and bcc B. **hcp and ccp (fcc)**
 C. bcc and ccp D. bcc and simple cubic cell
27. The percentage of empty space in a body centered cubic arrangement is _____.
 A. hcp and bcc B. **hcp and ccp (fcc)**
 C. bcc and ccp D. bcc and simple cubic cell
28. The atomic diameter of an BCC crystal (if a is lattice parameter) is
 A. a B. $a/2$ C. **$a/(4/\sqrt{3})$** D. $a/(4/\sqrt{2})$
29. The area under a velocity–time graph gives
 A) Acceleration B) Distance C) **Displacement** D) Speed
30. A 50.0-g sample of copper is at 25.0°C. If 1200 J of energy is added to it by heat, what is the final temperature of the copper?
 A) 7.3 °C B) 8.3 °C C) 870.3 °C D) **87.3 °C**
31. Velocity at highest point of projectile is
 A) Zero B) Maximum C) **Horizontal** D) Vertical

32. Action and reaction forces act
A) On same body **B) On different bodies** C) In same direction D) Unequal
33. Friction always acts
A) Along motion **B) Opposite motion** C) Perpendicular D) Random
34. In elastic collision, conserved quantity is
A) Momentum only B) Energy only **C) Both KE and momentum** D) Force
35. A mass-spring system oscillates with a spring constant $k = 150\text{ N/m}$ and amplitude $A = 0.05\text{ m}$. What is the total mechanical energy of the system?
A) 7.5 J **B) 0.1875 J** C) 75 J D) 0.25 J
36. A plane lands with a speed of 100 m/s and slows down at a rate of 5 m/s^2 as it comes to rest. What is the time interval needed by the jet to come to rest?
A) 2 s **B) 20 s** C) 10 s D) 5 s
37. A mass of 0.5 kg is attached to a spring with spring constant $k = 200\text{ N/m}$. Find the period of oscillation?
A) 0.66 s **B) 0.314 s** C) 1.33 s D) 0.033 s
38. A mass of 2 kg is attached to a spring with spring constant 50 N/m . The mass is pulled 0.1 m from equilibrium and released. Find Work done to stretch the spring.
A) 0.25 J B) 2.5 J C) 5 J D) 0.5 J
39. A 2.0 kg stone moving at 4.0 m/s collides head-on with a 3.0 kg stationary wagon. After the collision, the two stones stick together. Find their final velocity?
A) 1.6 m/s B) 6 m/s C) 16 m/s D) 4 m/s
40. Which of the following statements best explains why Gauss's law is always true?
A. Gauss's law is valid only for highly symmetric charge distributions such as spherical or cylindrical systems.
B. Gauss's law is an experimental approximation that fails for non-uniform electric fields.
C. Gauss's law is a fundamental law that follows directly from Coulomb's law and the principle of superposition, and is therefore valid for all charge distributions.
D. Gauss's law is true only in electrostatic situations and breaks down in the presence of time-varying fields.
41. Gauss's law is most useful for calculating the electric field when:
A. The charge distribution is arbitrary
B. The electric field varies randomly in space
C. The charge distribution has high symmetry
D. The observation point is very far from the charges

42. A dielectric medium is said to be linear if:
- A. The polarization is independent of the applied electric field
 - B. The polarization is directly proportional to the applied electric field
 - C. The electric field inside the medium is zero
 - D. The permittivity depends on frequency only
43. Magnetostatics applies to situations where:
- A. Charges are at rest
 - B. Charges move with constant velocity
 - C. Currents are steady (time-independent)
 - D. Electric fields are time-varying
44. Which of the following best explains why Maxwell found it necessary to modify Ampere's law by introducing the displacement current term?
- A. Ampere's law fails to describe magnetic fields produced by permanent magnets.
 - B. The original Ampere's law violates charge conservation when electric fields vary with time, as revealed by the charging capacitor problem.
 - C. Ampere's law cannot be derived from Gauss's law for magnetism.
 - D. The original law predicts magnetic monopoles in conducting media.
45. A charged particle with positive charge q moves with velocity $\vec{V}$ in a region of uniform magnetic field $\vec{B}$. The magnetic Lorentz force acting on the particle is given by $\vec{F} = q\vec{V} \times \vec{B}$. Which of the following statements is always true?
- A. The force is parallel to the velocity of the particle
 - B. The force is parallel to the magnetic field
 - C. The force is perpendicular to both $\vec{V}$ and $\vec{B}$
 - D. The force increases the speed of the particle
46. A charged particle with charge q enters a uniform magnetic field with speed v such that its velocity is perpendicular to the magnetic field. The radius r of the circular (cyclotron) orbit is given by $r = mv/qB$. Which of the following changes will **increase the radius** of the orbit?
- A. Increasing the magnetic field strength
 - B. Decreasing the speed of the particle
 - C. Increasing the mass of the particle
 - D. Increasing the charge of the particle
47. The electric displacement field D in a linear dielectric is related to E by:
- A. $D = \epsilon_0 E$
 - B. $D = \chi_e E$
 - C. $D = \epsilon E$
 - D. $D = E / \epsilon$

48. The decay constant λ of a radioactive nucleus is best interpreted as:
- A. The fraction of nuclei decaying per second
 - B. The inverse of the half-life
 - C. The average lifetime of the nucleus
 - D. The probability per unit time that a nucleus decays
49. If Rutherford's model were entirely correct and complete, electrons would orbit the nucleus indefinitely without losing energy. Why did this later prove incorrect according to classical physics?
- A. Accelerating charges (like orbiting electrons) should continuously radiate energy and spiral into the nucleus.
 - B. The electron's negative charge cancels nuclear attraction exactly.
 - C. The nucleus emits radiation that balances the electron's energy loss.
 - D. The positive nucleus prevents electrons from radiating.
50. Two radioactive samples have the same activity but different half-lives. Which statement is correct?
- A. They contain the same number of nuclei
 - B. The sample with shorter half-life has fewer nuclei
 - C. The sample with longer half-life has fewer nuclei
 - D. Activity is independent of half-life
51. The binding energy of a nucleus is the energy required to:
- A. Hold the electrons in orbit around the nucleus
 - B. Separate the nucleus into its constituent nucleons
 - C. Bind atoms into a molecule
 - D. Create a nucleus from nucleons
52. The curve of binding energy per nucleon versus mass number shows that:
- A. Fusion of light nuclei and fission of heavy nuclei both release energy.
 - B. Only fission releases energy.
 - C. Only fusion releases energy.
 - D. Both fusion and fission absorb energy.
53. A nuclear reaction proceeds even when the projectile energy is lower than the Coulomb barrier because of:
- A) Resonance scattering
 - B) Quantum tunneling
 - C) Neutron moderation
 - D) Compound nucleus instability

54. The primary function of a moderator in a nuclear reactor is to:
- A) Absorb excess neutrons
 - B) Increase neutron energy
 - C) Control reactor temperature
 - D) Slow down fast neutrons**
55. Delayed neutrons are crucial in nuclear reactors because they:
- A) Increase reactor power
 - B) Cause reactor instability
 - C) Allow time control of the chain reaction**
 - D) Reduce radiation damage
56. Any two eigenfunctions belonging to unequal eigen values of a self adjoint operator are...
- A) nonorthogonal
 - B) orthogonal**
 - C) parallel
 - D) imaginary
57. Which of the following is allowed in quantum mechanics
- A). when an operator stands on right of a ket vector
 - B). when an operator stands on the left of bra vector
 - C). when an operator stands on the right of bra vector**
 - D). All
58. If δ_{mn} , is Kronecker delta function then $\delta_{mn} = 1$ when.....
- A) $m=n$**
 - B) $m > n$
 - C) $m < n$
 - D) $m \neq n$
59. The potential of free particle is
- A) maximum
 - B) minimum
 - C) zero**
 - D) infinite
60. Scrodinger wave equation can be used to calculate which of the following for a subatomic particle
- A) wavefunction**
 - B) energy
 - C) probability
 - D) all above
61. The state vector is time-dependent, while the operators are time-independent. This statement is considered as
- A). Heisenberg Picture
 - B). Schrodinger Picture**
 - C). Interaction Picture
 - D). Dirac Picture
62. How is information extracted from a wavefunction?
- A) Expectation value**
 - B) Operators
 - C) Differential
 - D) Partial differential
63. Which of the following is correct statement about reflection and transmission coefficients
- A). Reflection coefficient represents the ratio of the reflected to the incident beams**
 - B). Reflection coefficient represents the ratio of the transmitted to the incident beams
 - C). Transmission coefficient represents the ratio of the reflected to the incident beams
 - D). Transmission coefficient represents the ratio of the reflected to the transmitted beams

64. Laser beam is made of:

- A) Highly coherent electrons
- B) Highly coherent photons
- C) Highly coherent phonons
- D) The answer is not given

65. In laser light, population inversion occurred when

- A) The number of electrons in higher energy state is more than the ground state
- B) The number of electrons in lower energy state is more than higher energy state
- C) The number of electrons in higher and lower energy state is same
- D) The number of electron in the ground and higher energy is equal

66. An optical resonator plays a major role in

- A) Stimulating more and more atoms from excited state to ground state
- B) Generation of intense laser output
- C) Generation of unidirectional beam of photons
- D) All of them are correct

67. The wavelength of the laser light depends primarily on

- A) The type of lasing medium
- B) The temperature of the medium
- C) The size of the cavity
- D) The external electric field applied

68. A three-level laser system has an upper energy level at 3.0 eV and a lower energy level at 0 eV. Determine the wavelength of the light emits when the electron move from the upper level to lower

- A) 550 nm
- B) 234 nm
- C) 413 nm
- D) 600 nm

69. A laser emits at 1550 nm with a spectral linewidth of 1 MHz. Calculate the coherence length of the laser.

- A) 300 m
- B) 1550 m
- C) 250 m
- D) The answer is not given

70. Which laser type is most suitable for medical applications such as laser surgery and dermatology?

- A) CO₂ Laser
- B) Ruby Laser
- C) He-Ne Laser
- D) Dye Laser

71. A particle is observed to have a total relativistic energy equal to three times its rest energy; using relativistic energy relations, determine the speed of the particle relative to the speed of light.

A. 0.75c

B. 0.80c

C. 0.94c

D. 0.99c

72. The respective velocities of particles A and B are given by: $v_a(t) = a\hat{i} + bt\hat{j}$, $v_b(t) = (a + bt)\hat{j}$, where a, b and c are constants. Which is correct about the motion of the two particle?

A. Particle A is accelerating and particle B is not

B. Particle A is moving along parabola and particle B is moving along a line

C. Both particles are accelerating equally

D. Both particles have equal initial velocity

73. Two objects A and B are projected in space in such a way that object A attained positive mechanical energy and object B attained negative mechanical energy relative to a central force point. Which one is true about the motion of these two objects?

A) Object A falls to a central point and object B escapes away

B) Object A escapes away and object B revolves around the central point

C) Object A falls to a central point and object B revolves around the central point

D) Both object A and B revolve around the central point

74. As the speed of a particle approaches the speed of light, the relativistic momentum of the particle behaves in which of the following ways?

A) It approaches zero B) It remains finite C) It increases linearly D) It increases without bound

75. In special relativity, which physical quantity remains invariant for all inertial observers regardless of their relative motion?

A) Time interval B) Length C) Momentum D) Speed of light in vacuum

76. According to de Broglie's hypothesis, the wave nature of matter becomes prominent when the momentum of the particle is

A) Very large B) Constant C) Very small D) Independent of mass

77. The experimental verification of matter waves through electron diffraction was first provided by which experiment?

A) Rutherford scattering B) Millikan oil drop C) Davisson–Germer D) Franck–Hertz

78. Which one of the following is true about the mass of a solid gold rectangular bar with density of $19.3 \times 10^3 \text{ kg/m}^3$ that has dimensions of $4.50 \text{ cm} \times 11.0 \text{ cm} \times 26.0 \text{ cm}$?

A) 24.8 kg

B) 42.8 kg

C) 25.2 kg

D) 32.5 kg

79. How much energy is required to raise the temperature of 5.00 kg of lead from 20.0°C to its melting point of 327°C ? The specific heat of lead is $128 \text{ J/kg} \cdot ^\circ\text{C}$.

A) $4.04 \times 10^5 \text{ J}$

B) $1.07 \times 10^5 \text{ J}$

C) $8.15 \times 10^4 \text{ J}$

D) $1.96 \times 10^5 \text{ J}$

80. A beach ball filled with air is pushed about 1 m below the surface of a swimming pool and released from rest. Which of the following statements are valid, assuming the size of the ball remains the same?
- A) As the ball rises in the pool, the buoyant force on it increases.
 - B) When the ball is released, the buoyant force exceeds the gravitational force, and the ball accelerates upward.
 - C) The buoyant force on the ball decreases as the ball approaches the surface of the pool.
 - D) The buoyant force on the ball equals its weight and remains constant as the ball rises
81. Which one of the following statements is **not** true about heat and heat transfer
- A) The transfer of energy due to temperature difference
 - B) Heat can be transferred through conduction, convection and radiation
 - C) The unit of measurement of heat is calorie
 - D). Non-spontaneous transfer energy due to a force acting through a displacement.
82. Which one of the following statement is true about in fluid statics and fluid dynamics
- A) The pressure varies with depth of static fluid
 - B) When fluid is in motion the flow rate is constant
 - C) When fluid is in motion the flow rate is varies
 - D) Bernoulli's equation is result of the sum of work done by the pipe and the potential energy of the fluid.
83. Which one of the following statements is wrong about buoyant force?
- A) Buoyant force equals to the weight of the fluid displaced by the object if the object is completely submerged.
 - B) In Buoyant force, the volume of the fluid displaced by the object equals to the volume of the object if the object is partially submerged.
 - C) The magnitude of buoyant force acting on an object is influenced by the density of the object.
 - D) The buoyant force acting on an object is always directed vertically upward
84. According to first law of thermodynamics, which one of the following statement is not true.
- A) The conservation of energy principle in relation to heat and work
 - B) Energy can be converted from heat to work and vice versa. But, the total energy remains constant
 - C) Heat and work are the same processes and related forms of energy transfer
 - D) Heat and work are different processes but related forms of energy transfer Classical Mechanics

85. Kirchhoff's Current Law (KCL) states that:

- A) Resistance in parallel adds directly
- B) Voltage around a loop is zero
- C) The sum of currents entering a node equals the sum leaving
- D) Power supplied equals power absorbed

86. Norton's theorem represents a circuit as:

- A) A dependent source
- B) A current source in parallel with resistance
- C) An ideal capacitor
- D) A voltage source in series with resistance

87. Delta-to-Y conversion is used to:

- A) Convert AC to DC
- B) Simplify three-terminal networks
- C) Analyze diodes
- D) Bias transistors

88. P-type semiconductors are formed by:

- A) Adding donor impurities
- B) Applying voltage
- C) Heating the crystal
- D) Adding acceptor impurities

89. Zener breakdown occurs due to:

- A. Thermal vibrations
- B. Magnetic field
- C. High forward bias
- D. Strong electric field in reverse bias

90. Thevenin's equivalent circuit consists of:

- A. Voltage source + series resistance
- B. Current source + parallel resistance
- C. Capacitor + resistor
- D. Inductor + resistor

91. A full-wave bridge rectifier requires:

- A. Six diodes
- B. Two diodes
- C. One diode
- D. Four diodes

92. Boolean algebra is used to:

- A. Simplify logic circuits
- B. Calculate voltages
- C. Design amplifiers
- D. Analyze diodes

93. Which of the following products of two vector **A** and **B** is different from zero?
- A) $(\mathbf{A} \times \mathbf{B}) \cdot \mathbf{A}$
 - B) $(\mathbf{B} \times \mathbf{A}) \cdot \mathbf{B}$
 - C) $[(\mathbf{A} \cdot \mathbf{B})\mathbf{A}] \cdot \mathbf{B}$
 - D) $[(\mathbf{A} \times \mathbf{B}) \times \mathbf{A}] \cdot \mathbf{A}$
94. A particle is moving from point $(x\hat{i} - y\hat{j} + z\hat{k})$ to the second point $(-x\hat{i} + y\hat{j})$, where x, y and z are in meters. The exact description of the displacement of this object is:
- A) $2x\hat{i} - 2y\hat{j} + z\hat{k}$
 - B) $2(y\hat{i} - z\hat{k})$
 - C) $-2x\hat{i} + 2y\hat{j} - z\hat{k}$
 - D) $2(-x\hat{i} + z\hat{k})$
95. Which one of the following is **not** correct according to Newton's 3rd law of motion?
- A) Force is the result of the interaction of two bodies
 - B) Force is always produced in pair
 - C) The bigger object exert more force on the smaller object
 - D) Both action and reaction forces act on different bodies
96. Mechanical power is defined as
- A) the rate at which mechanical energy is transferred per unit time to other forms
 - B) the rate at which other energies are transferred per unit time to mechanical energy
 - C) the rate at which mechanical energy is transferred per unit time to work done
 - D) the rate at which energy is transferred per unit time from one form to another
97. Displacement of a moving object can be defined as:
- A) the final position of an object relative to its initial position
 - B) the final position of an object relative to the reference frame
 - C) a line joining any two points on the path of the object
 - D) the speed of the object times the time taken for the motion
98. According to Newton's 1st law of motion
- A) No motion without force
 - B) No change of motion without force
 - C) The greater the inertia the larger change of motion
 - D) Force is needed to keep an object in motion
99. Angular momentum conserved when? Work done $F = 2x$ from 0 to 3m
- A. $F = 0$
 - B. torque = 0
 - C. Velocity constant
 - D. $E = 0$

100. The position of an object in simple harmonic motion along the x-axis is given as function of time, t as $x(t) = A \sin \omega t$, where A is its amplitude and ω is its angular frequency. The ratio of its potential energy to its kinetic energy is:

A) $\sec^2 \omega t$.

B) $\tan^2 \omega t$.

C) $\cot^2 \omega t$.

D) $\csc^2 \omega t$.