# ENTRANCE TEST-2024

## Integrated B Sc-M Sc Physics/Energy Studies Programme

Total Questions    : 60
Time Allowed     : 70 Minutes                Roll No.

1. Write your roll number in the space provided at the top of this page of question booklet and fill up the necessary information in the spaces provided on OMR Answer sheet.

2. OMR Answer sheet has an original copy and a candidate's copy glued beneath it at the top. While making entries in the original copy, candidate should ensure that the two copies are aligned properly so that the entries made in the original copy against each item are exactly copied in the candidate's copy.

3. All entries in the OMR answers sheet including answers to questions are to be recorded in the original/Carbon copy.

4. Use only blue/ black ball point pen to darken the circle of correct / most appropriate response. In no case gel/ ink pen or pencil should be used.

5. **Do not darken more the one circle of option for any question. A question with more than o darkened response shall be considered wrong.**

6. There will be negative marking for wrong answers. Each wrong answer will lead to the deducti of 0.25.

7. Only those candidates who would obtain positive score in entrance test examination shall be eligible for admission.

8. Do not make any stray mark on the OMR sheet.

9. Calculators and mobiles shall not be permitted inside the examination hall.

10. Rough work, if any, should be done on the blank sheets provided with the question booklet.

11. OMR answer sheet must be handled carefully and it should not be folded or mutilated in such case it will not be evaluated.

12. Ensure that your OMR Answer sheet has been signed by the invigilator and the candidate himself/herself.

13. At the end of the examination hand over the OMR answer sheet to the invigilator who will first tear off the original OMR sheet in presence of the candidate and hand over the candidate's copy to the candidate.

14. If any of the information in the response Sheet/Question Paper has been found missing or not mentioned as stated above the candidate is solely responsible for that lapse.

SEAL

Q1. Total Internal reflection

    a. occurs if angle of incidence is less than the critical angle
    b. explains the fiber optical communication
    c. cannot explain mirage formation
    d. all of the above

Q2. Two objects with mass $M$ and $m$ $(M>m)$ are on a frictionless surface. A force $F$ will accelerate the smaller object with an acceleration $a$. If the same force is applied to the larger object then it will

    a. move but with a smaller acceleration
    b. move with a greater acceleration
    c. move with the same acceleration
    d. none of the above

Q3. If a vector $A = i - 2j + k$ and vector $B = 4i -4j+7k$, the projection of $A$ on $B$ is

    a. 19
    b. 9/19
    c. 19/9
    d. 0

Q4. If the period of the pendulum in its rest frame is 3.0 s, the period of the pendulum measured by an observer moving at a speed of $0.95\ c$ with respect to the pendulum is

    a. 3.0 s
    b. 0.93 s
    c. 9.6 s
    d. 17.93 s

Q5. The number of significant figures in x = 3 s and x = 0.003 s, respectively is

    a. 1 and 3
    b. 1 and 2
    c. 1 and 0
    d. 1 and 1

Q6. A particle moving in the xy plane has the x and y coordinates given as : $x(t) = At^3 + Bt$ and $y(t) = Ct^2 + D$, where A= 1.00 (?), B = -32.0 (?), C = 5.0 (?) , and D = 12.0 (?). Each of these must have the units (?)

    a. $m/s^3$, m/s, $m/s^2$, and m
    b. all of these are unit less
    c. all of these have units of m
    d. none of the above

Q7. In the above question the velocity at t = 3 s is

    a.  25 m/s
    b.  (-5 m/s)$\mathbf{i}$ + (30m/s) $\mathbf{j}$
    c.  (5 m/s)$\mathbf{i}$ + (30m/s) $\mathbf{j}$
    d.  0

Q8. If an object is moving south with an increasing speed, it can be concluded that

    a.  there is a single force on the object directed south
    b.  there is a net force on the object directed south
    c.  there may be several forces on the object, but the largest may be directed south
    d.  none of the above

Q9. If the net force on an object is a non zero constant. Which of the following could also be constant?

    a.  position
    b.  velocity
    c.  acceleration
    d.  speed

Q 10. The astronauts in the space shuttle orbiting the earth are weightless because

    a.  they are so far from the earth that gravity is too weak to be notice
    b.  a gravitational field cannot act in the vacuum of space
    c.  they are in state of free fall
    d.  the gravitational force of the moon balances that of the earth

Q11. A triangular shaped space ship having length ($x$) and height ($y$) of 50.0 $m$ and 25.0 $m$ respectively, when at rest with respect to an observer. If the ship now flies along $x$ direction by an observer at the speed of 0.95 $c$, the $y$ distance of the ship in $m$ is

    a.  25.0
    b.  15.6
    c.  7.80
    d.  none of the above

Q12. The kinetic energy of the electron moving at a speed of 0.85 $c$ is

    a.  0.511 $MeV$
    b.  0.970 $MeV$
    c.  0.459 $MeV$
    d.  Data insufficient

Q13. Which of the following is explained using particle nature of light?

    a. photoelectric effect
    b. Compton effect
    c. pair production
    d. all of the above

Q14. The clear sky is blue because

    a. the nitrogen in the air has a blue colour
    b. the oxygen in the air has a blue colour
    c. the sun's light is slightly blue
    d. air molecules scatter more blue light

Q15. A positron and an electron moving towards each other with equal and opposite velocities

    a. can annihilate into one photon, conserving both energy and momentum
    b. cannot annihilate into one photon, because momentum is not conserved
    c. cannot annihilate into one photon, because energy is not conserved
    d. none of the above

Q16. Two light waves having their intensities in the ratio 25:16, interfere to produce interference pattern. The ratio of maximum to minimum intensity is
    a. 81:1
    b. 5:4
    c. 41:9
    d. none of the above

Q17. If the net force $\mathbf{F}$ on an object is a non zero constant. Which of the following could also be constant?

    a. position
    b. speed
    c. acceleration
    d. velocity

Q18. The efficiency of a Carnot engine working between the temperatures of 100 K & 400 K is
    a. 70%
    b. 80%
    c. 40%
    d. 75%

Q19. Which of the following is true?

    a. Magnetic field lines always form closed loops
    b. If the electric field is zero throughout a certain region of space then the potential must also be zero in this region
    c. a superball bouncing on a hard floor is an example of simple harmonic motion
    d. all of the above

Q20. The acceleration of an electron released from rest in a uniform electric field of magnitude $2.0 \times 10^4$ N/C is

    a. $3.2 \times 10^{16}$ m/s
    b. $0.35 \times 10^{16}$ m/s
    c. $3.5 \times 10^{16}$ m/s
    d. $0.35 \times 10^{15}$ m/s.

Q21. The concept of temperature to measure hotness or coldness of a body is a consequence of

    a. Joules's law
    b. First law of thermodynamics
    c. Newton's law of cooling
    d. Zeroth law of thermodynamics

Q22. The special theory of relativity is applicable to

    a. all frames of reference
    b. only inertial frame of reference
    c. only non-inertial frame of reference
    d. only accelerating frame of reference

Q23. The unit $1\ \mathrm{Nm}^{-1}$ is equivalent to

    a. $1\ \mathrm{erg\ cm}^{-1}$
    b. $1\mathrm{erg\ cm}^{-2}$
    c. $1\ \mathrm{Jm}^{-2}$
    d. $1\ \mathrm{Jm}^{-1}$

Q24. The dimensions of Avogadro's number are

    a. $M^1L^0T^0$
    b. $ML^0T^{-1}$
    c. $M^0L^0T^0$
    d. none of the above

Q25. If there is no transmission of energy in the medium, then the propagated wave is a/an

    a. electromagnetic wave
    b. longitudinal wave
    c. transverse wave
    d. stationary wave

Q26. The venturimeter is used to measure

    a. the rate of flow of a liquid through a pipe
    b. viscosity of a liquid
    c. specific gravity of a liquid
    d. the compressibility of a liquid

Q27. Centrifugal force is a

    a. real force
    b. fictious force
    c. central force
    d. all of the above

Q 28. During negative $\beta$ decay, an anti-neutrino is also emitted along with the ejected electron. Then

    a. only linear momentum will be conserved
    b. total linear momentum and total angular momentum but not total energy will be conserved
    c. total linear momentum and total energy but not total angular momentum will be conserved
    d. total linear momentum, total angular momentum and total energy will be conserved

Q 29. Can the law of momentum conservation be violated?

    a. no
    b. yes, if there are more than two particles
    c. yes, when the forces between the particles are varying in time
    d. yes, if the two particles stick together after a collision

Q 30. A long straight wire is carrying current $I_1$ in the $+z$ direction. The x-y plane contains a closed circular loop carrying current $I_2$ and not encircling the straight wire. The force on the loop will be

    a. $\mu_0 I_1 I_2/2\pi$
    b. $\mu_0 I_1 I_2/4\pi$
    c. zero
    d. none of the above

Q31. In a moving coil galvanometer the number of turns $N = 24$, area of the coil $A = 2 \times 10^{-3}$ m$^2$, and the magnetic field strength $B = 0.2$ T. To increase its current sensitivity by 25 % we

    a. increase $N$ to 30
    b. decrease $A$ to $1.5 \times 10^{-3}$ m$^2$
    c. increase $B$ to 0.30 T
    d. none of the above

Q32. Which of the following is true?

    a. Sound waves cannot interfere
    b. The de-Broglie waves associated with moving particles can interfere
    c. Only light waves may interfere
    d. The Bragg formula for crystal structure is an example of the corpuscular nature of electromagnetic radiation

Q33. Which of the following is true?

    a. Thermal neutrons have a very high probability of causing the fission of $^{235}$U nucleus
    b. Thermal neutrons have an energy similar to the surroundings
    c. Neutrons emerging out of the fission have much higher energies
    d. All of the above

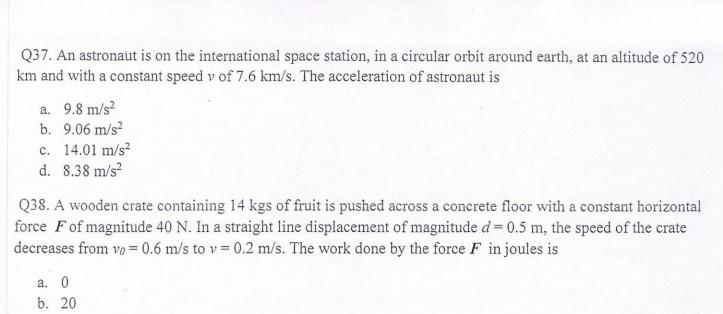Q34. The Balmer series contains wavelengths in the which of the following portion of the hydrogen spectrum

    a. ultraviolet
    b. infrared
    c. visible
    d. all of the above

Q35. In an SHM, $x$ is the displacement and $y$ is the acceleration at time t. The plot of $y$ against $x$ for one complete oscillation will be a/an

    a. ellipse
    b. circle
    c. straight line
    d. sinusoidal curve

Q36. The rock salt crystal has a spacing 2.12 A$^0$. The largest wavelength of X-rays that can be detected with this crystal using Bragg diffraction is ( in A$^0$)

    a. 4.24
    b. 2.12
    c. 1.06
    d. none of the above

Q37. An astronaut is on the international space station, in a circular orbit around earth, at an altitude of 520 km and with a constant speed $v$ of 7.6 km/s. The acceleration of astronaut is

a. 9.8 m/s$^2$
b. 9.06 m/s$^2$
c. 14.01 m/s$^2$
d. 8.38 m/s$^2$

Q38. A wooden crate containing 14 kgs of fruit is pushed across a concrete floor with a constant horizontal force $F$ of magnitude 40 N. In a straight line displacement of magnitude $d = 0.5$ m, the speed of the crate decreases from $v_0 = 0.6$ m/s to $v = 0.2$ m/s. The work done by the force $F$ in joules is

a. 0
b. 20
c. 22
d. none of the above

Q39. In the above question what system does the force $F$ work on?

a. crate
b. floor
c. crate-floor
d. data insufficient

Q40. An explosive shell initially lying stationary on a frictionless floor explodes into two pieces, which then slide across the floor. One piece slides in the $+x$ direction, the direction of the momentum of the second piece is

a. $+x$
b. $-x$
c. at an angle to $+x$ direction
d. it will have zero momentum

Q41. A diver doing a forward somersault dive pulls his arms and legs into a closed tuck position to

a. reduce his rotational inertia
b. increase his angular momentum
c. decrease his angular speed
d. protect himself from the injury

Q42. A living room having floor dimensions of 3.5 m and 4.2 m and a height of 2.4 m. The weight of air in the room at the air pressure of 1.0 atm is (Take the density of air $= 1.21$ kg/m$^3$)

a. 42.68 kg
b. 418 kg
c. 42.68 N
d. 418 N

Q43. $y(x,t) = 0.00327 \sin(72.1x - 2.72t)$ is a wave travelling along a string ( numerical constants are in SI units). The wavelength, period, and frequency of this wave is

   a. 8.71 m, 2 s, 4.33 Hz
   b. 0.8 m, 2 s, 433 Hz
   c. 0.0871 m, 2 s, 0.433 Hz
   d. 0.871 m, 2 s, 4.33 Hz

Q44. One mole of oxygen (assume it to be an ideal gas) expands at a constant temperature $T$ of $310\ K$ from an initial volume $V_i$ of 10 L to a final volume $V_f$ of 20 L. The work done by the gas is

   a. 775 J
   b. 1785 J
   c. 5152 J
   d. none of the above

Q45. $(nRT/V)\ V^\gamma$ = a constant is a/an

   a. adiabatic process
   b. isothermal process
   c. isobaric process
   d. isochoric process

Q46. Water is heated on stove. The entropy change is maximum when its temperature rises

   a. from $30^0C$ to $35^0C$
   b. from $50^0C$ to $55^0C$
   c. from $80^0C$ to $85^0C$
   d. from $20^0C$ to $30^0C$

Q 47. Sphere A has a charge of -50 $e$ and sphere B has a charge of +20 $e$ initially. Both the spheres are made of conducting material and are identical in size. If the spheres then touch, the resulting charge on sphere A is

   a. -30 $e$
   b. 35 $e$
   c. -15 $e$
   d. -35 $e$

Q48. The ink jet printer works on

   a. $F = qE$
   b. $q = ne$
   c. $q = cv$
   d. none of the above

Q49. The path of a charged particle in an electric field is a

    a. straight line
    b. parabola
    c. circle
    d. ellipse

Q50. There is certain net flux $\Phi_i$ through a Guassian sphere of radius $r$ enclosing an isolated charged particle. Suppose the enclosing Guassian surface is changed to a larger Guassian sphere. The net flux through this new Guassian surface is

    a. greater than $\Phi_i$
    b. less than $\Phi_i$
    c. equal to $\Phi_i$
    d. cannot be determined

Q51. If an object $B$ has twice the density and half of the mass of an object $A$. The ratio of the volume of $A$ to volume $B$ is

    a. 2
    b. 1
    c. ½
    d. 4

Q52. An incompressible fluid flows through a horizontal pipe. At one point in the pipe the pressure in the fluid is $p_1$. Further down the pipe the pressure is $p_2 > p_1$. The cross sectional area of the pipe $A_1$ at point 1 and $A_2$ at point 2 are related as

    a. $A_1 > A_2$
    b. $A_1 < A_2$
    c. $A_1 = A_2$
    d. Nothing can be concluded about the relationship between $A_1$ and $A_2$.

Q53. If $\nabla.A = 0$, then vector field $A$ is

    a. solenoidal
    b. irrotational
    c. rotational
    d. none of the above

Q54. A solenoid of length $L = 1.23$ m and inner diameter $d = 3.55$ cm, carries a current of 5.57 $A$. It consists of five close packed layers, each with 850 turns along length $L$. Magnetic field $B$ at its center is

    a. 2.42 T
    b. 242 T
    c. 24.2 mT
    d. 242 mT

Q55. In Faraday's law of electromagnetic induction

    a.  changing magnetic field induces an electric field
    b.  relative motion between circuit and magnet is key for flux change
    c.  $\nabla \times E = -\partial B/\partial t$
    d.  all of the above

Q56. A coil has an inductance of 53 mH and a resistance of 0.35 ohms. If a 12 $V$ emf is applied across the coil, the energy stored in the magnetic field after the current has built up to its equilibrium value is

    a.  31 kJ
    b.  31 J
    c.  13 J
    d.  33 J

Q57. The behaviour of superconductor is

    a.  diamagnetic
    b.  ferromagnetic
    c.  paramagnetic
    d.  anti-ferromagnetic

Q58. Photon

    a.  is charge less particle
    b.  has zero rest mass
    c.  has spin 1
    d.  all of the above

Q59. The radioactive emissions which produce an isotope of the original nucleus are

    a.  one alpha and four beta
    b.  one alpha and one beta
    c.  two alpha and one beta
    d.  one alpha and two beta

Q60. Newton's rings are formed because of

    a.  diffraction
    b.  interference by division of wave front
    c.  interference by division of amplitude
    d.  all of the above