PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

CSIR NET Physics - June 2018 - Full Paper

Complete question paper with answer key

75 questions . Answer key included

www.physicsbyaaryan.com . www.csirnetphysics.com
Contact: 9501976811

Q1. [June 2018] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2018 June	2M

In a $100m$ race A beats B by $10m$. B beats C by $5m$. By how many meters does A beat C ?

1. 15.0 m
2. 5.5 m
3. 10.5 m
4. 14.5 m

Q2. [June 2018] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2018 June	2M

Suppose

(i) " $A*B$ " means " A is the father of B ",

(ii) " $A\Delta B$ " means " A is the husband of B ",

(iii) " $A\nabla B$ " means " A is the wife of B ",

(iv) " $A\square B$ " means " A is the sister of B ".

Which of the following represents "C is the father-in-law of the sister of D"

1. $C\nabla E * F \square D$
2. $C * E\nabla F \square D$
3. $C\Delta E^{*} F \square D$
4. $C * E\Delta F \square D$

Q3. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

In a group of 11 persons, each shakes hand with every other once and only once. What is the total number of such handshakes?

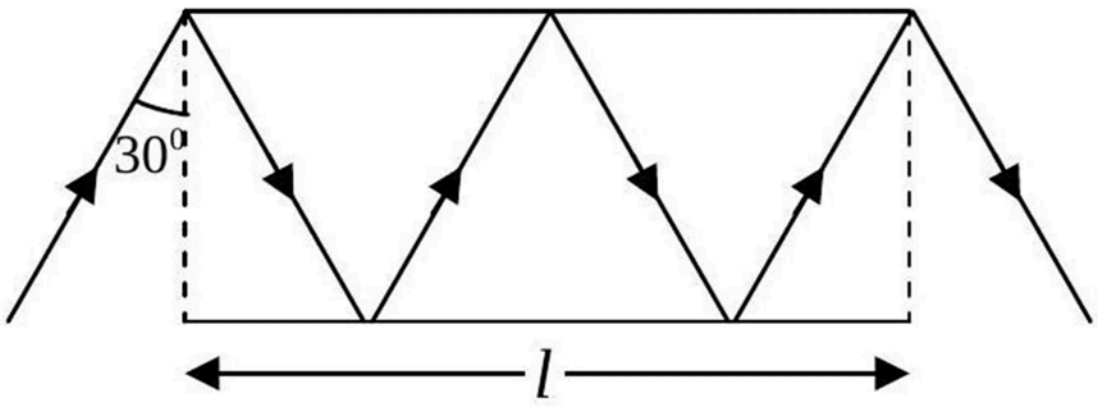
1. 110
2. 121
3. 55
4. 66

Q4. [June 2018] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2018 June	2M

Path of a ray of light between two mirrors is shown in the diagram. If the length of each mirror is ' l ', what is the total path length of the ray between the mirrors?



1. $\frac{3}{4}l$
2. $\frac{4}{3}l$
3. $\frac{3}{2}l$
4. $2l$

Q5. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

What is the value of

$$(1 + 3 + 5 + 7 + \cdots + 4033) + 7983 \times 2017?$$

1. 20170000
2. 20172017
3. 20171720
4. 20172020

Q6. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

What is the last digit of $(2017)^{2017}$?

1. 1
2. 3
3. 7
4. 9

Q7. [June 2018] . 2.0 marks

General Aptitude > General Knowledge

CSIR NET	2018 June	2M

Pick the correct statement:

1. The sky is blue because Sir C.V. Raman gave the correct explanation.
2. Copernicus believed that the Sun, and not the Earth, was at the centre of the Solar system.
3. The sky appears blue when seen from the Moon..
4. No solar eclipse is visible for an astronaut standing on the Moon.

Q8. [June 2018] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2018 June	2M

A librarian is arranging a thirteen-volume encyclopedia on the shelf from left to right in the following order of volume numbers: 8,11,5,4,9,1,7,6,10,3,12,2. In this pattern, where should the volume 13 be placed?

1. Leftmost
2. Rightmost
3. Between 10 and 3
4. Between 9 and 1

Q9. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

Nine eleventh of the members of a parliamentary committee are men. Of the men, two-thirds are from the Rajya Sabha. Further, 7/11 of the total committee members are from the Rajya Sabha. What fraction of the total number are women from the Lok Sabha?

1. 1/11
2. 6/11
3. 2/11
4. 3/11

Q10. [June 2018] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2018 June	2M

When a farmer was asked as to how many animals he had, he replied that all but two were cows, all but two were horses and all but two were pigs. How many animals did he have?

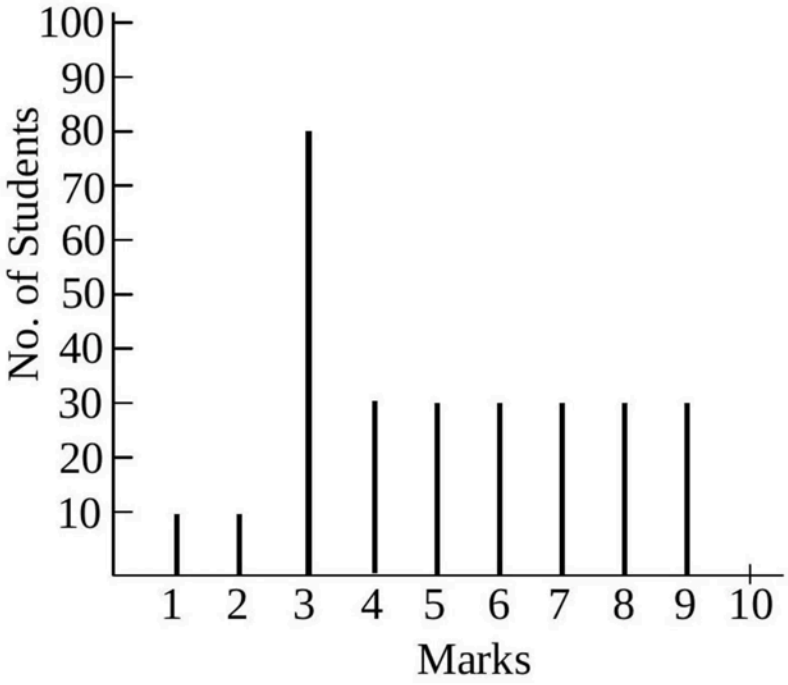
1. 3
2. 6
3. 8
4. 12

Q11. [June 2018] . 2.0 marks

General Aptitude > Data Analysis

CSIR NET	2018 June	2M

The distribution of marks of students in a class is given by the following chart:



If 3.30 marks is the passing score in a 10-mark question paper, which of the following is false?

1. Majority of the students have scored above the pass mark
2. mode of the distribution is 3
3. Average marks of passing students is above 55%
4. Average marks of students who have failed is below 20%

Q12. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

Mohan lent Geeta as much money as she already had, she then spent Rs. 10. Next day, he again lent as much money as Geeta now had, and she spent Rs. 10 again. On the third day, Mohan again lent as much money as Geeta now had, and she again spent Rs. 10.If Geeta was left with no money at the end of third day, how much money did she have initially?

1. Rs. 11.25
2. Rs. 10
3. Rs. 7.75
4. Rs. 8.75

Q13. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

In a sequence of 24 positive integers, the product of any two consecutive integer is 24 . If the 17^{th} member of the sequence is 6 , the 7^{th} member is

1. 24
2. 4
3. 6
4. 17

Q14. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

The prices of diamonds having a particular color and clarity are tabulated below. How many 0.25 carat diamonds can be purchased for the price of a 2-carat diamond?

Weight of diamond (in carats)	Price of diamond (in rupees / carat)
0.25	1 lakh
0.5	2 lakh
1	4 lakh
2	8 lakh

1. 8
2. 16
3. 32
4. 64

Q15. [June 2018] . 2.0 marks

General Aptitude > Reasoning

CSIR NET	2018 June	2M

The university needs to appoint a new Vice Chancellor which will be based on seniority. Ms. West is less senior to Mr. North but more senior to Ms. East. Mr. South is senior to Ms. West but junior to Mr. North. If the senior most declines the assignment, then who will be the new vice Chancellor of the University?

1. Mr. North
2. Mr. East
3. Ms. West
4. Mr. South

Q16. [June 2018] . 2.0 marks

General Aptitude > Geometry

CSIR NET	2018 June	2M

Areas of the three rectangles inside the full rectangle are given in the diagram. What is the area of the full rectangle?

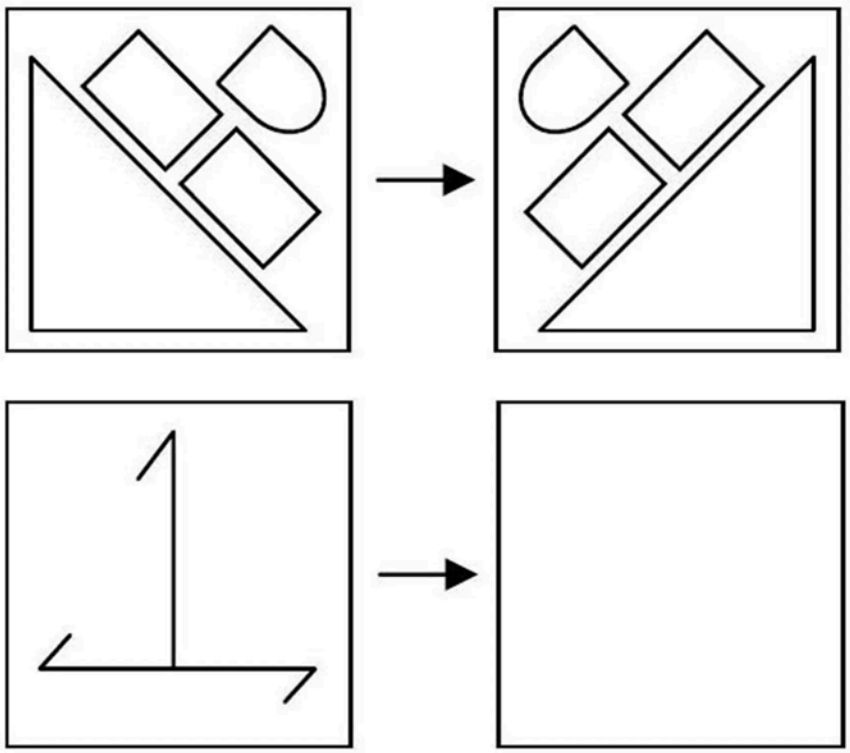
	8
12	4

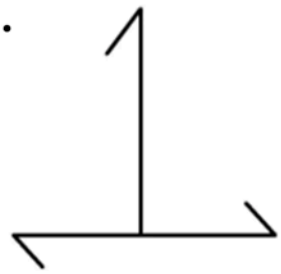
1. 36
2. 48
3. 72
4. 96

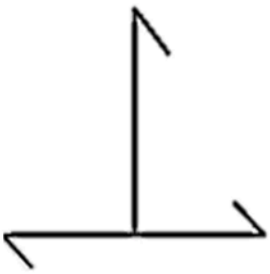
Q17. [June 2018] . 2.0 marks

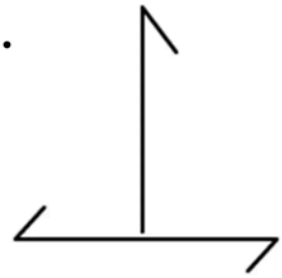
General Aptitude > Reasoning

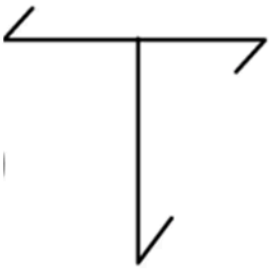
CSIR NET	2018 June	2M



1. 

2. 

3. 

4. 

Q18. [June 2018] . 2.0 marks

General Aptitude > Basic Physics

CSIR NET	2018 June	2M

How much gold and copper (in g), respectively, are required to make a 120g bar of 22 carat gold?

1. 90 and 30
2. 100 and 20
3. 110 and 10
4. 120 and 0

Q19. [June 2018] . 2.0 marks

General Aptitude > Mathematical Analysis

CSIR NET	2018 June	2M

A water tank that is 40% empty holds 40 L more water than when it is 40% full. How much water does it hold when it is full?

1. 100 L
2. 75 L
3. 120 L
4. 200 L

Q20. [June 2018] . 2.0 marks

General Aptitude > Geometry

CSIR NET	2018 June	2M

If all the angles of a triangle are prime numbers, which of the following could be one such angle?

1. 89°
2. 79°
3. 59°
4. 29°

Q21. [June 2018] . 3.5 marks

Mathematical Physics > Vector Algebra and Vector Calculus

CSIR NET	2018 June	3.5M

Consider the three vectors $\vec{v}_1 = 2\hat{i} + 3\hat{k}, \vec{v}_2 = \hat{i} + 2\hat{j} + 2\hat{k}$ and $\vec{v}_3 = 5\hat{i} + \hat{j} + a\hat{k}$ where $\hat{i}, \hat{j}$ and $\hat{k}$ are the standard unit vectors in a three-dimensional Euclidean space. These vectors will be linearly dependent if the value of a is

1. $\frac{31}{4}$
2. $\frac{23}{4}$
3. $\frac{27}{4}$
4. 0

Q22. [June 2018] . 3.5 marks

Mathematical Physics > Fourier Transform

CSIR NET	2018 June	3.5M

The Fourier transform $\int_{-\infty}^{\infty} dx f(x) e^{ikx}$ of the function $f(x) = e^{-|x|}$

1. $-\frac{2}{1+k^2}$
2. $-\frac{1}{2(1+k^2)}$
3. $\frac{2}{1+k^2}$
4. $\frac{2}{(2+k^2)}$

Q23. [June 2018] . 3.5 marks

Mathematical Physics > Dirac Delta Function

CSIR NET	2018 June	3.5M

The value of the integral

$$\int_{-\pi/2}^{\pi/2} dx \int_{-1}^{+1} dy . \delta(\sin 2x)\delta(x-y) \text{ is}$$

1. 0
2. $\frac{1}{2}$
3. $\frac{1}{\sqrt{2}}$
4. 1

Q24. [June 2018] . 3.5 marks

Mathematical Physics > Ordinary Differential Equations

CSIR NET	2018 June	3.5M

Consider the following ordinary differential equation

$$\frac{d^2x}{dt^2} + \frac{1}{x}\left(\frac{dx}{dt}\right)^2 - \frac{dx}{dt} = 0$$

with the boundary conditions $x(t=0)=0$ and $x(t=1)=1$. The value of $x(t)$ at $t=2$ is

1. $\sqrt{e-1}$
2. $\sqrt{e^2+1}$
3. $\sqrt{e+1}$
4. $\sqrt{e^2-1}$

Q25. [June 2018] . 3.5 marks

Mathematical Physics > Complex analysis

CSIR NET	2018 June	3.5M

What is the value of a for which $f(x,y) = 2x + 3(x^2 - y^2) + 2i(3xy + ay)$ is an analytic function of complex variable $z = x + iy$

1. 1
2. 0
3. 3
4. 2

Q26. [June 2018] . 3.5 marks

Classical Mechanics > Oscillations

CSIR NET	2018 June	3.5M

A particle moves in the one-dimensional potential $V(x) = \alpha x^6$, where $a > 0$ is a constant. If the total energy of the particle is E, its time period in a periodic motion is proportional to

1. $E^{-1/3}$
2. $E^{-1/2}$
3. $E^{1/3}$
4. $E^{1/2}$

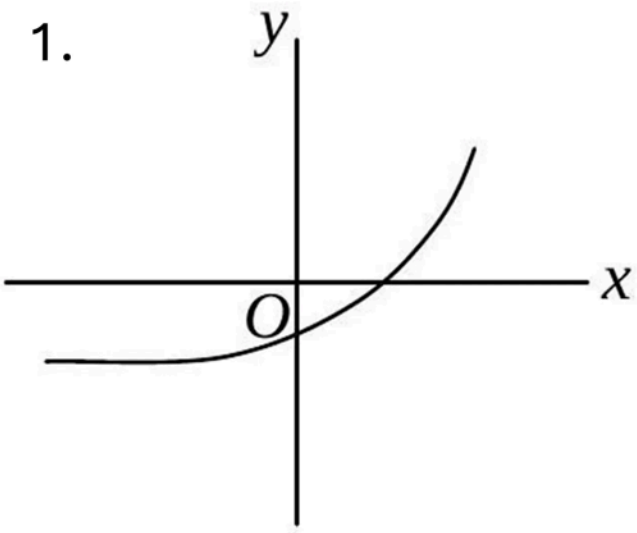
Q27. [June 2018] . 3.5 marks

Classical Mechanics > Central forces

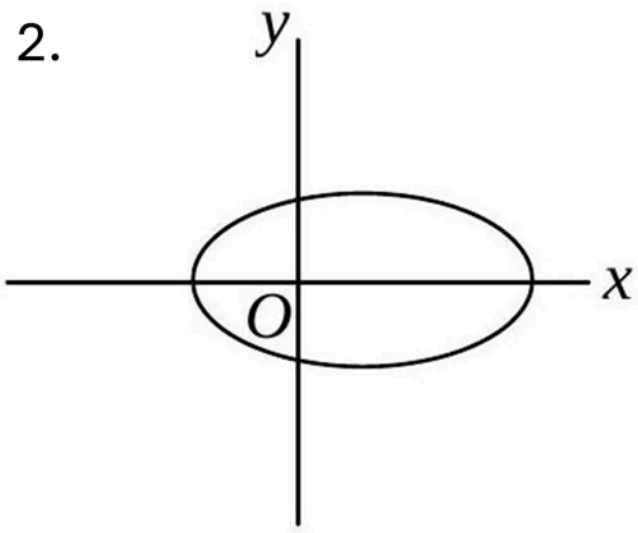
CSIR NET	2018 June	3.5M

Which of the following figures best describes the trajectory of a particle moving in a repulsive central potential $V(r) = \frac{a}{r}$ ($a > 0$ is a constant)?

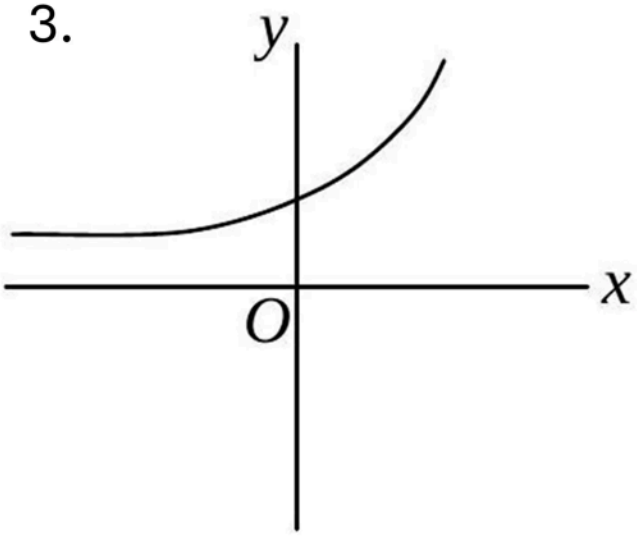
1.



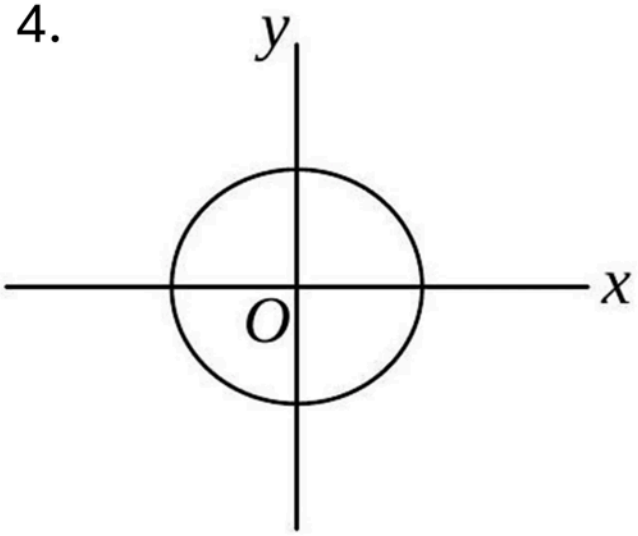
2.



3.



4.



Q28. [June 2018] . 3.5 marks

Classical Mechanics > Special theory of relativity

CSIR NET	2018 June	3.5M

Two particles A and B move with relativistic velocities of equal magnitude v, but in opposite directions, along the x-axis of an inertial frame of reference. The magnitude of the velocity of A, as seen from the rest frame of B, is

1. $\frac{2v}{\left(1-\frac{v^2}{c^2}\right)}$

2. $\frac{2v}{\left(1+\frac{v^2}{c^2}\right)}$

3. $2v\sqrt{\frac{c-v}{c+v}}$

4. $\frac{2v}{\sqrt{1-\frac{v^2}{c^2}}}$

Q29. [June 2018] . 3.5 marks

Classical Mechanics > Oscillations

CSIR NET	2018 June	3.5M

A particle of mass m, kept in potential $V(x) = -\frac{1}{2}kx^2 + \frac{1}{4}\lambda x^4$ (where k and λ are positive constants), undergoes small oscillations about an equilibrium point. The frequency of oscillations is

1. $\frac{1}{2\pi}\sqrt{\frac{2\lambda}{m}}$
2. $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$
3. $\frac{1}{2\pi}\sqrt{\frac{2k}{m}}$
4. $\frac{1}{2\pi}\sqrt{\frac{\lambda}{m}}$

Q30. [June 2018] . 3.5 marks

Electromagnetism > Electrostatics

CSIR NET	2018 June	3.5M

Two-point charges $+2Q$ and $-Q$ are kept at point with Cartesian coordinates $(1,0,0)$, respectively, in front of an infinite grounded conducting plate at $x = 0$. The potential at $(x, 0,0)$ for $x \gg 1$ depends on x as

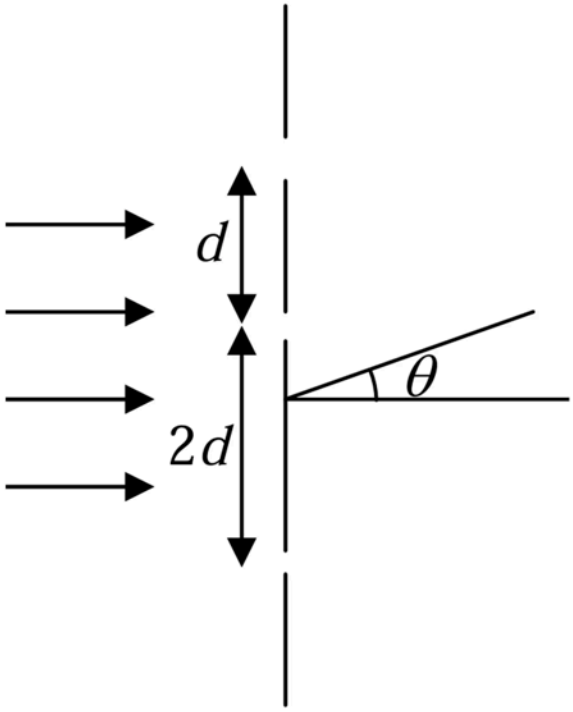
1. x^{-3}
2. x^{-5}
3. x^{-2}
4. x^{-4}

Q31. [June 2018] . 3.5 marks

Optics > Interference and diffraction

CSIR NET	2018 June	3.5M

The following configuration of three identical narrow slits are illuminated by monochromatic light of wavelength λ (as shown in the figure below). The intensity is measured at an angle θ (where θ is the angle with the incident beam) at a large distance from the slits. If $\delta = \frac{2\pi d}{\lambda}\sin\theta$, the intensity is proportional to



1. $2cos\ \delta + 2cos\ 2\delta$
2. $3 + \frac{1}{\delta^2}\sin^2 3\delta$
3. $3 + 2cos\ \delta + 2cos\ 2\delta + 2cos\ 3\delta$
4. $2 + \frac{1}{\delta^2}\sin^2 3\delta$

Q32. [June 2018] . 3.5 marks

Electromagnetism > EM Waves

CSIR NET	2018 June	3.5M

In The electric field of a plane wave in a conducting medium is given by

$$\vec{E}(z,t) = \hat{i}E_0 e^{-z/3a}\cos\left(\frac{z}{\sqrt{3}a} - \omega t\right),$$

where ω is the angular frequency and $a > 0$ is a constant. The phase difference between the magnetic field $\vec{B}$ and the electric field $\vec{E}$ is

1. 30^0 and $\vec{B}$ lags behind $\vec{B}$
2. 30^0 and $\vec{B}$ lags behind $\vec{E}$
3. 60^0 and $\vec{E}$ lags behind $\vec{B}$
4. 60^0 and $\vec{B}$ lags behind $\vec{E}$

Q33. [June 2018] . 3.5 marks

Electromagnetism > Potential Formulation

CSIR NET	2018 June	3.5M

The electric field $\vec{E}$ and the magnetic field $\vec{B}$ corresponding to the scalar and vector potentials, $V(x,y,z,t) = 0$ and $\vec{A}(x,y,z,t) = \frac{1}{2}\hat{k}\mu_0 A_0(ct - x)$, where A_0 is a constant, are

1. $\vec{E} = 0$ and $\vec{B} = \frac{1}{2}\hat{j}\mu_0 A_0$
2. $\vec{E} = -\frac{1}{2}\hat{k}\mu_0 A_0 c$ and $\vec{B} = \frac{1}{2}\hat{j}\mu_0 A_0$
3. $\vec{E} = 0$ and $\vec{B} = -\frac{1}{2}\hat{i}\mu_0 A_0$
4. $\vec{E} = \frac{1}{2}\hat{k}\mu_0 A_0 c$ and $\vec{B} = -\frac{1}{2}\hat{i}\mu_0 A_0$

Q34. [June 2018] . 3.5 marks

Quantum Mechanics > Potential Well

CSIR NET	2018 June	3.5M

In A particle of mass m is confined in a three-dimensional box by the potential

$$V(x,y,z) = \begin{cases} 0, & 0 \leq x,y,z \leq a \\ \infty & \text{otherwise} \end{cases}$$

The number of eigenstates of Hamiltonian with energy $\frac{9\hbar^2\pi^2}{2ma^2}$ is

1. 1
2. 6
3. 3
4. 4

Q35. [June 2018] . 3.5 marks

Quantum Mechanics > Spin Angular momentum

CSIR NET	2018 June	3.5M

The Hamiltonian of a spin $\frac{1}{2}$ particle in a magnetic field $\vec{B}$ is given by $H = -\mu.\vec{B}.\vec{\sigma}$, where μ is a real constant and $\vec{\sigma} = (\sigma_x, \sigma_y, \sigma_z)$ are the Pauli spin matrices. If $\vec{B} = (B_0, B_0, 0)$ and the spin state at time $t = 0$ is an eigenstate of σ_x, then of the expectation values $\langle\sigma_x\rangle, \langle\sigma_y\rangle$ and $\langle\sigma_z\rangle$

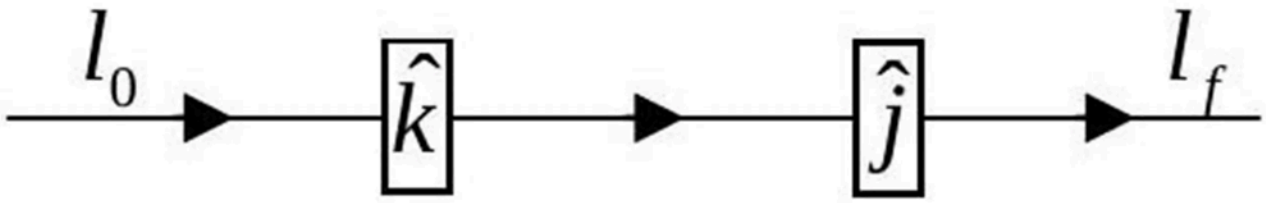
1. only $\langle\sigma_x\rangle$ changes with time
2. only $\langle\sigma_y\rangle$ changes with time
3. only $\langle\sigma_z\rangle$ changes with time
4. all three change with time

Q36. [June 2018] . 3.5 marks

Quantum Mechanics > Spin Angular momentum

CSIR NET	2018 June	3.5M

Two Stern-Gerlach apparatus S_1 and S_2 are kept in a line (x-axis). The directions of their magnetic fields are along the positive z and y-axes, respectively. Each apparatus only transmits particles with spins aligned in the direction of its magnetic field. If an initially unpolarized beam of spin $\frac{1}{2}$ particles passes through this configuration, the ratio of intensities $l_0 : l_f$ of the initial and final beams is



1. 16:1
2. 2:1
3. 4:1
4. 1:0

Q37. [June 2018] . 3.5 marks

Quantum Mechanics > Pertubation theory

CSIR NET	2018 June	3.5M

A particle of mass m is constrained to move in a circular ring of radius R. When a perturbation

$$V' = \frac{a}{R^2}\cos^2\phi$$

(where a is a real constant) is added, the shift in energy of the ground state, to first order in a, is

1. $\frac{a}{R^2}$
2. $\frac{2a}{R^2}$
3. $\frac{a}{2R^2}$
4. $\frac{a}{(\pi R^2)}$

Q38. [June 2018] . 3.5 marks

Thermodynamics > Thermodynamic relations and maxwell equations

CSIR NET	2018 June	3.5M

In Which of the following statements concerning the coefficient of volume expansion α and the isothermal compressibility κ of a solid is true?

1. α and κ are both intensive variables
2. α is an intensive and κ is an extensive variable
3. α is an extensive and κ is an intensive variable
4. α and κ are both extensive variables

Q39. [June 2018] . 3.5 marks

Thermodynamics > Laws of thermodynamics

CSIR NET	2018 June	3.5M

The van der Waals equation for one mole of a gas is $\left(p+\frac{a}{V^2}\right)(V-b)=RT$. The corresponding equation of state for n moles of this gas at pressure P, volume V and temperature T, is

1. $\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$
2. $\left(P+\frac{a}{V^2}\right)(V-nb)=nRT$
3. $\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$
4. $\left(P+\frac{a}{V^2}\right)(V-nb)=nRT$

Q40. [June 2018] . 3.5 marks

Statistical Mechanics > Microstates and Macrostates

CSIR NET	2018 June	3.5M

The number of ways of distributing 11 indistinguishable bosons in 3 different energy levels is

1. 3^{11}
2. 11^3
3. $\frac{(13)!}{2!(11)!}$
4. $\frac{(11)!}{3!8!}$

Q41. [June 2018] . 3.5 marks

Statistical Mechanics > Canonical Ensemble

CSIR NET	2018 June	3.5M

In a system of N distinguishable particles, each particle can be in one of two states with energies 0 and $-E$, respectively. The mean energy of the system at temperature T is

1. $-\frac{1}{2}N\left(1+e^{\varepsilon/k_BT}\right)$
2. $-NE\left(1+e^{\varepsilon/k_BT}\right)$
3. $-\frac{1}{2}NE$
4. $-NE\left(1+e^{-\varepsilon/k_BT}\right)$

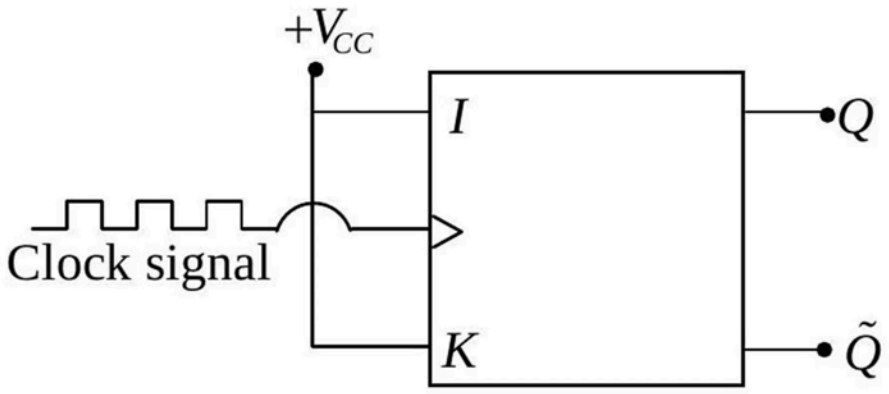
Q42. [June 2018] . 3.5 marks

Electronics > Flip flops/Counters/Registers/microcontroller etc.

CSIR NET	2018 June	3.5M

In the following JK flip-flop circuit, J and K inputs are tied together to $+V_{CC}$. If the input is a clock signal of frequency f, the frequency of the output Q is

1. f
2. $2f$
3. $4f$
4. $\frac{f}{2}$



Q43. [June 2018] . 3.5 marks

Electronics > Digital Electronics

CSIR NET	2018 June	3.5M

Which of the following gates can be used as a parity checker?

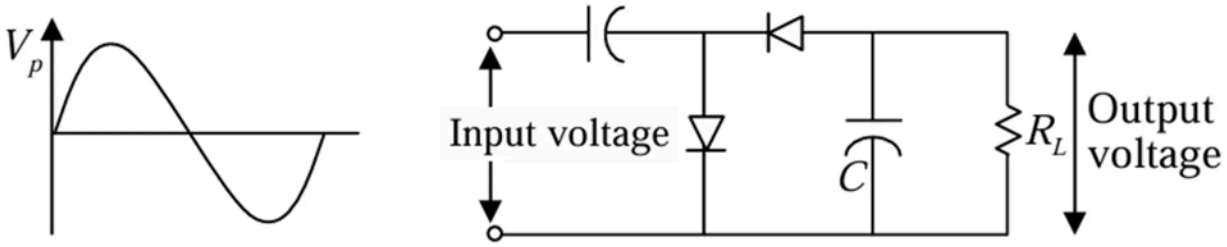
1. an OR gate
2. a NOR gate
3. an exclusive OR (XOR) gate
4. an AND gate

Q44. [June 2018] . 3.5 marks

Electronics > Diodes

CSIR NET	2018 June	3.5M

In A sinusoidal signal with a peak voltage V_p and average value zero, is an input to the following circuit. Assuming ideal diodes, the peak value of the output voltage across the load resistor R_L is



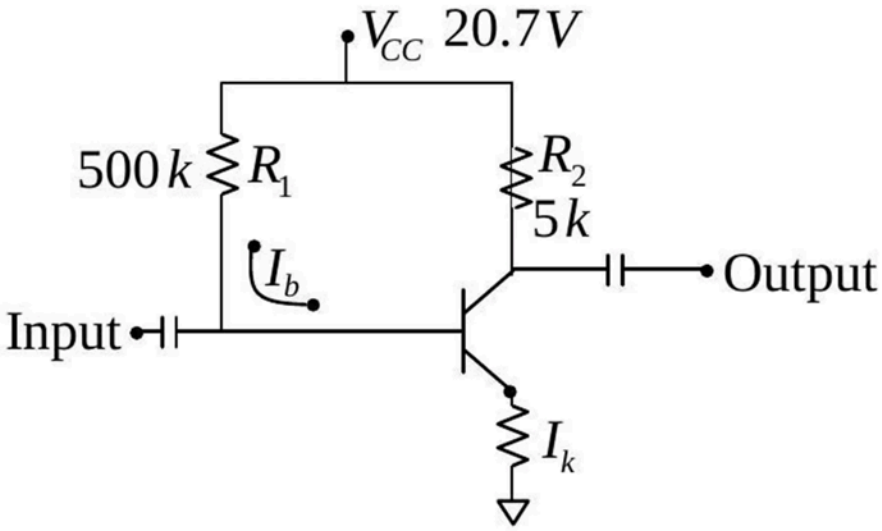
1. V_p
2. $\frac{V_p}{2}$
3. $2V_p$
4. $\sqrt{2}V_p$

Q45. [June 2018] . 3.5 marks

Electronics > Transistors

CSIR NET	2018 June	3.5M

In the following circuit, the value of the common-emitter forward current amplification factor β for the transistor is 100 and V_{BE} is $0.7V$. The base current I_B is



1. $40\mu A$
2. $30\mu A$
3. $44\mu A$
4. $33\mu A$

Q46. [June 2018] . 5.0 marks

Mathematical Physics > Special Functions

CSIR NET	2018 June	5M

In the function $P_n(x)e^{-x^2}$ of a real variable x, $P_n(x)$ is polynomial of degree n. The maximum number of extrema that this function can have is

1. n+2
2. n-1
3. n+1
4. n

Q47. [June 2018] . 5.0 marks

Mathematical Physics > Green Function

CSIR NET	2018 June	5M

The Green's function $G(x,x')$ for the equation $\frac{d^2y(x)}{dx^2}+y(x)=f(x)$, with the boundary values $y(0)=y\left(\frac{\pi}{2}\right)=0$, is

1. $G(x,x') = \begin{cases} x\left(x'-\frac{\pi}{2}\right), & 0<x<x'<\frac{\pi}{2} \\ \left(x-\frac{\pi}{2}\right)x', & 0<x'<x<\frac{\pi}{2} \end{cases}$

2. $G(x,x') = \begin{cases} -\cos x' \sin x, & 0<x<x'<\frac{\pi}{2} \\ -\sin x' \cos x, & 0<x'<x<\frac{\pi}{2} \end{cases}$

3. $G(x,x') = \begin{cases} \cos x' \sin x, & 0<x<x'<\frac{\pi}{2} \\ \sin x' \cos x, & 0<x'<x<\frac{\pi}{2} \end{cases}$

4. $G(x,x') = \begin{cases} x\left(\frac{\pi}{2}-x'\right), & 0<x<x'<\frac{\pi}{2} \\ x'\left(\frac{\pi}{2}-x\right), & 0<x'<x<\frac{\pi}{2} \end{cases}$

Q48. [June 2018] . 5.0 marks

Mathematical Physics > Numerical Methods

CSIR NET	2018 June	5M

The fractional error in estimating the integral $\int_0^1 xdx$ using Simpson's $\frac{1}{3}$ rule, using a step size 0.1, is nearest to

1. 10^{-4}

2. 0

3. 10^{-2}

4. 3×10^{-4}

Q49. [June 2018] . 5.0 marks

Mathematical Physics > Matrices and Linear Algebra

CSIR NET	2018 June	5M

Which of the following statements is true for a 3×3 real orthogonal matrix with determinant +1 ?

1. the modulus of each of its eigenvalues need not be 1 , but their product must be 1
2. at least one of its eigenvalues is +1
3. all of its eigenvalues must be real
4. none of its eigenvalues must be real

Q50. [June 2018] . 5.0 marks

Classical Mechanics > Central forces

CSIR NET	2018 June	5M

A particle of mass m moves in a central potential $V(r) = -\frac{k}{r}$ in an elliptic orbit $r(\theta) = \frac{a(1-e^2)}{1+e\cos\theta}$, where $0 \leq \theta < 2\pi$ and a and e denote the semi-major axis and eccentricity, respectively. If its total energy is $E = -\frac{k}{2a}$, the maximum kinetic energy is

1. $E(1-e^2)$
2. $E\frac{(e+1)}{(e-1)}$
3. $E/(1-e^2)$
4. $E\frac{(e-1)}{(e+1)}$

Q51. [June 2018] . 5.0 marks

Classical Mechanics > Lagrangian and Hamiltonian

CSIR NET	2018 June	5M

The Hamiltonian of a one-dimensional system is $H = \frac{xp^2}{2m} + \frac{1}{2}kx$, where m and k are positive constants. The corresponding Euler-Lagrange equation for the system is

1. $m\ddot{x} + k = 0$
2. $m\ddot{x} + 2\dot{x} + kx^2 = 0$
3. $2mx\ddot{x} - m\dot{x}^2 + kx^2 = 0$
4. $mx\ddot{x} + 2m\dot{x}^2 + kx^2 = 0$

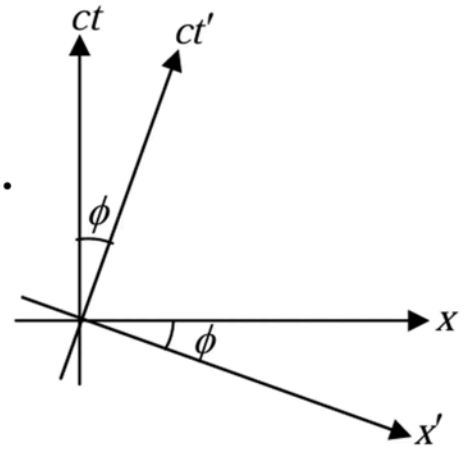
Q52. [June 2018] . 5.0 marks

Classical Mechanics > Special theory of relativity

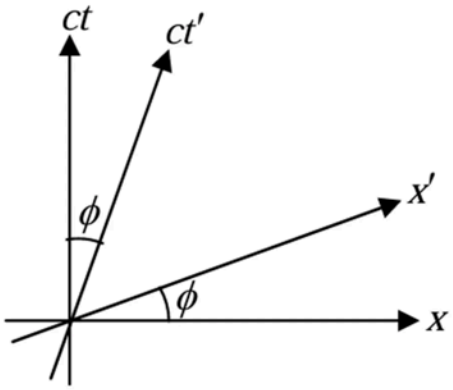
CSIR NET	2018 June	5M

An inertial frame K' moves with a constant speed v with respect to another inertial frame K along their common x-direction. Let (x, ct) and (x', ct') denote the spacetime coordinates in the frames K and K', respectively. Which of the following spacetime diagrams correctly describes the t' - axis ($x' = 0$ line) and the x' - axis ($t' = 0$ line) in the x-ct plane? (In the following figures $\tan\phi = v/c$)

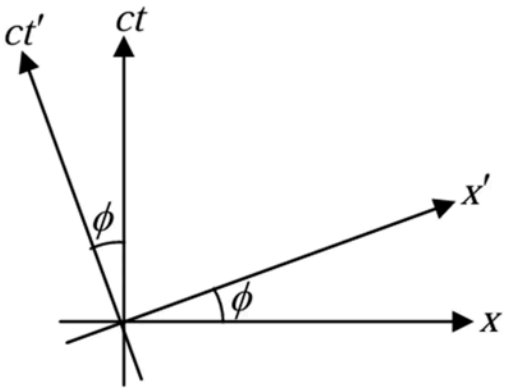
1.



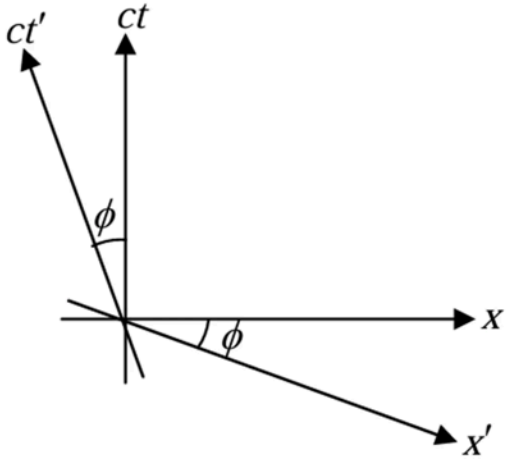
2.



3.



4.

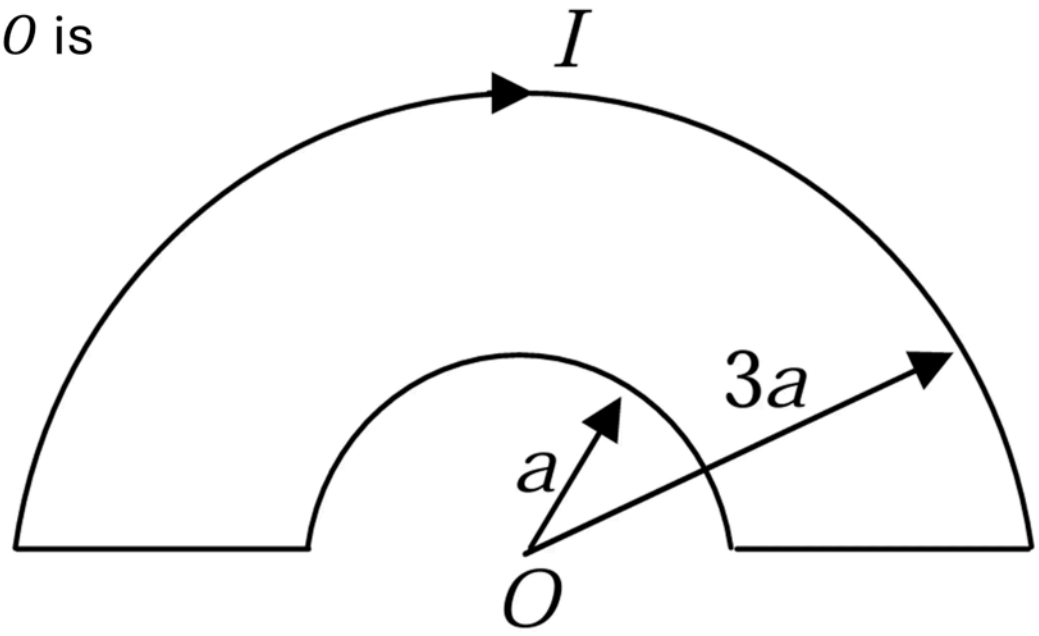


Q53. [June 2018] . 5.0 marks

Electromagnetism > Magetostatics

CSIR NET	2018 June	5M

The loop shown in the figure below carries a steady current I. The magnitude of the magnetic field at the point O is



1. $\frac{\mu_0 I}{2a}$
2. $\frac{\mu_0 I}{6a}$
3. $\frac{\mu_0 I}{4a}$
4. $\frac{\mu_0 I}{3a}$

Q54. [June 2018] . 5.0 marks

Electromagnetism > Radiations

CSIR NET	2018 June	5M

In the region far from a source, the time dependent electric field at a point (r, θ, ϕ) is

$$\vec{E}(r,\theta,\phi) = \hat{\phi} E_0 \omega^2 \left(\frac{\sin\theta}{r}\right) \cos\left[\omega\left(t - \frac{r}{c}\right)\right]$$

where ω is angular frequency of the source. The total power radiated (averaged over a cycle) is

1. $\frac{2\pi}{3}\frac{E_0^2\omega^4}{\mu_0 c}$
2. $\frac{4\pi}{3}\frac{E_0^2\omega^4}{\mu_0 c}$
3. $\frac{4}{3\pi}\frac{E_0^2\omega^4}{\mu_0 c}$
4. $\frac{2}{3}\frac{E_0^2\omega^4}{\mu_0 c}$

Q55. [June 2018] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2018 June	5M

A hollow waveguide supports transverse electric (TE) modes with the dispersion relation $k = \frac{1}{c}\sqrt{\omega^2 - \omega_{mn}^2}$, where ω_{mn} is the mode frequency. The speed of flow of electromagnetic energy at the mode frequency is

1. c
2. ω_{mn}/k
3. 0
4. ∞

Q56. [June 2018] . 5.0 marks

Classical Mechanics > Special theory of relativity

CSIR NET	2018 June	5M

The energy of a free relativistic particle is $E = \sqrt{|\vec{p}|^2c^2 + m^2c^4}$, where m is its rest mass, $\vec{p}$ is its momentum and c is the speed of light in vacuum. The ratio v_g/v_p of the group velocity v_g of a quantum mechanical wave packet (describing this particle) to the phase velocity v_p is

1. $|\vec{p}|c/E$
2. $|\vec{p}|mc^3/E^2$
3. $|\vec{p}|^2c^3/E^2$
4. $|\vec{p}|c/2E$

Q57. [June 2018] . 5.0 marks

Quantum Mechanics > WKB Approximation

CSIR NET	2018 June	5M

The n^{th} energy eigenvalues E_n of a one-dimensional Hamiltonian $H = \frac{p^2}{2m} + \lambda x^4$ (where $\lambda > 0$ is a constant) in the WEB approximation, is proportional to

1. $\left(n + \frac{1}{2}\right)^{4/3} \lambda^{1/3}$
2. $\left(n + \frac{1}{2}\right)^{4/3} \lambda^{2/3}$
3. $\left(n + \frac{1}{2}\right)^{5/3} \lambda^{1/3}$
4. $\left(n + \frac{1}{2}\right)^{5/3} \lambda^{2/3}$

Q58. [June 2018] . 5.0 marks

Quantum Mechanics > Scattering theory

CSIR NET	2018 June	5M

The differential scattering cross-section $\frac{d\sigma}{d\Omega}$ for the central potential $V(r) = \frac{\beta}{r}e^{-\mu r}$, where β and μ are positive constants, is calculated in thee first Born approximation. Its dependence on the scattering angle θ is proportional to (A is a constant below)

1. $\left(A^2 + \sin^2\frac{\theta}{2}\right)$
2. $\left(A^2 + \sin^2\frac{\theta}{2}\right)^{-1}$
3. $\left(A^2 + \sin^2\frac{\theta}{2}\right)^{-2}$
4. $\left(A^2 + \sin^2\frac{\theta}{2}\right)^{2}$

Q59. [June 2018] . 5.0 marks

Quantum Mechanics > Basic Quantum Mechanics

CSIR NET	2018 June	5M

At $t = 0$, the wavefunction of an otherwise free particle confined between two infinite walls at $x = 0$ and $x = L$ is $\psi(x, t = 0) = \sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right)$. Its wave function at a later time $t = \frac{mL^2}{4\pi h}$ is

1. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right)e^{i\pi/6}$

2. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} + \sin\frac{3\pi x}{L}\right)e^{-i\pi/6}$

3. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} - \sin\frac{3\pi x}{L}\right)e^{-i\pi/8}$

4. $\sqrt{\frac{2}{L}}\left(\sin\frac{\pi x}{L} + \sin\frac{3\pi x}{L}\right)e^{-i\pi/6}$

Q60. [June 2018] . 5.0 marks

Thermodynamics > Phase transitions

CSIR NET	2018 June	5M

The pressure P of a system of N particles contained in a volume V at a temperature T is given by $P = nk_BT - \frac{1}{2}an^2 + \frac{1}{6}bn^3$, where n is the number density and a and b are temperature independent constants. If the system exhibits a gas-liquid transition, the critical temperature is

1. $\frac{a}{bk_B}$
2. $\frac{a}{2b^2k_B}$
3. $\frac{a^2}{2bk_B}$
4. $\frac{a^2}{b^2k_B}$

Q61. [June 2018] . 5.0 marks

Statistical Mechanics > Random Walk/Brownian motion/Diffusion

CSIR NET	2018 June	5M

Consider a particle diffusing in a liquid contained in a large box. The diffusion constant of the particle in the liquid is $1.0 \times 10^{-2}\ \mathrm{cm}^2/s$. The minimum time after which the root-mean-squared displacement becomes more than $6cm$ is

1. 10 min
2. 6 min
3. 30 min
4. $\sqrt{6}$ min

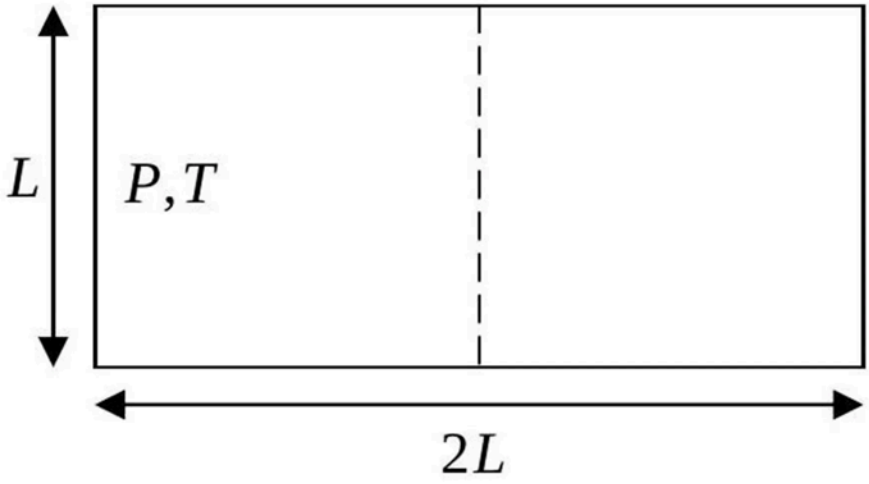
Q62. [June 2018] . 5.0 marks

Thermodynamics > Laws of thermodynamics

CSIR NET	2018 June	5M

A thermally insulated chamber of dimensions ($L, L, 2L$) is partitioned in the middle. One side of the chamber is filled with n moles of an ideal gas at a pressure P and temperature T, while the other side is empty. At $t = 0$, the partition is removed and the gas is allowed to expand freely. The time to reach equilibrium varies as

1. $n^{1/3}L^{-1}T^{1/2}$
2. $n^{2/3}LT^{-1/2}$
3. $n^{0}LT^{-1/2}$
4. $nL^{-1}T^{1/2}$



Q63. [June 2018] . 5.0 marks

Statistical Mechanics > Black Body Radiations

CSIR NET	2018 June	5M

The maximum intensity of solar radiation is at the wavelength of $\lambda_{sun} \sim 5000\text{Å}^{\circ}$ and corresponds to its surface temperature $T_{sun} \sim 10^4\,\text{K}$. If the wavelength of the maximum intensity of an X-ray star is 5Å°, its surface temperature is of the order of

1. $10^{16}\,K$
2. $10^{14}\,K$
3. $10^{10}\,K$
4. $10^{7}\,\text{K}$

Q64. [June 2018] . 5.0 marks

Electronics > AD/DA Conversion

CSIR NET	2018 June	5M

The full scale of a 3 -bit digital-to-analog (DAC) converter is $7V$. Which of the following tables represents the output voltage of this 3 -bit DAC for the given set of input bits?

1.

Input bits	Output voltage
000	0
001	1
010	2
011	3

2.

Input bits	Output voltage
000	0
001	1.25
010	2.5
011	3.75

3.

Input bits	Output voltage
000	1.25
001	2.5
010	3.75
011	5

4.

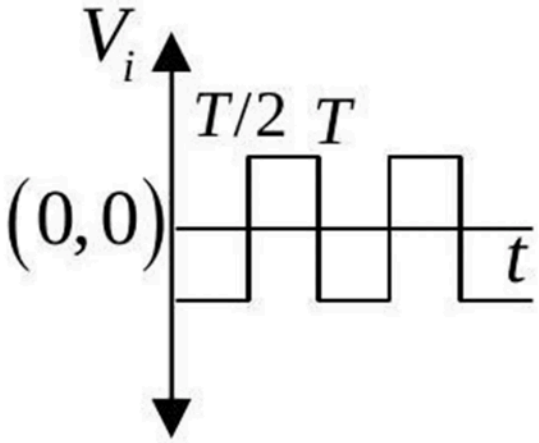
Input bits	Output voltage
000	1
001	2
010	3
011	4

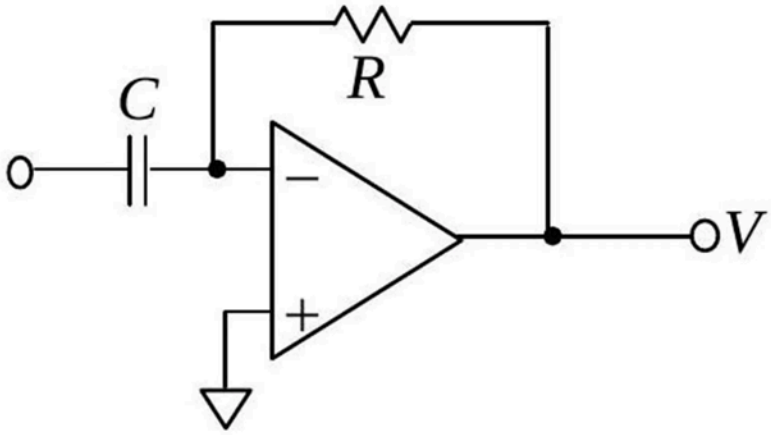
Q65. [June 2018] . 5.0 marks

Electronics > OPAMP

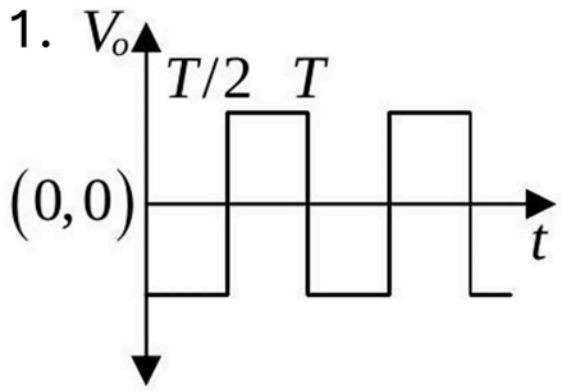
CSIR NET	2018 June	5M

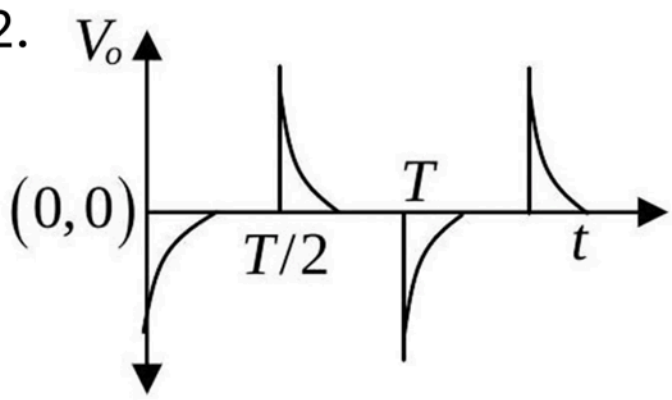
The input V_i to the following circuit is a square wave as shown in the following figure.

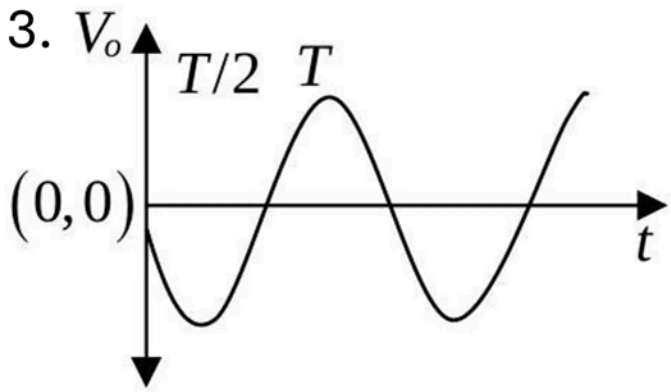


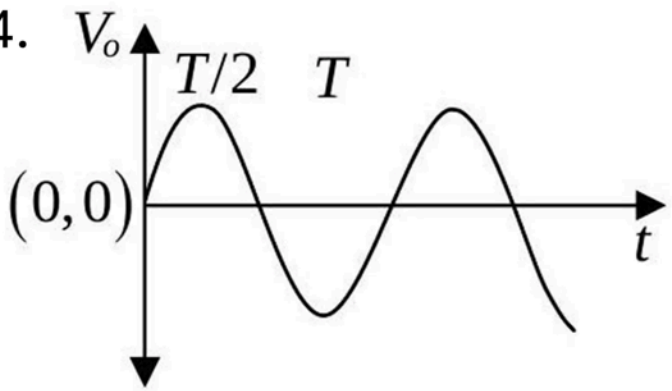


Which of the waveforms V_0 best describes the output?

1. 

2. 

3. 

4. 

Q66. [June 2018] . 5.0 marks

Electronics > Instruments

CSIR NET	2018 June	5M

Two signals $A_1 \sin(\omega t)$ and $A_2 \cos(\omega t)$ are fed into the input and the reference channels, respectively, of a lock-in amplifier. The amplitude of each signal is 1 V . The time constant of the lock-in amplifier is such that any signal of frequency larger than ω is filtered out. The output of the lock-in amplifier is

1. 2V
2. 1V
3. 0.5V
4. 0V

Q67. [June 2018] . 5.0 marks

Atomic and Molecular Physics > Xray and alkali spectra

CSIR NET	2018 June	5M

A photon of energy 115.62 keV ionizes a K-shell electron of a Be atom. One L-shell electron jumps to the K-shell to fill this vacancy and emits a photon of energy 109.2 keV in the process. If the ionization potential for the L-shell is 6.4 keV , the kinetic energy of the ionized electron is

1. 6.42 keV
2. 12.82 keV
3. 20 eV
4. 32 eV

Q68. [June 2018] . 5.0 marks

Atomic and Molecular Physics > Angular momentum in Atomic Physics

CSIR NET	2018 June	5M

The value of the Lande g - factor for a fine-structure level defined by the quantum number $L = 1, J = 2$ and $S = 1$, is

1. $\frac{11}{6}$
2. $\frac{4}{3}$
3. $\frac{8}{3}$
4. $\frac{3}{2}$

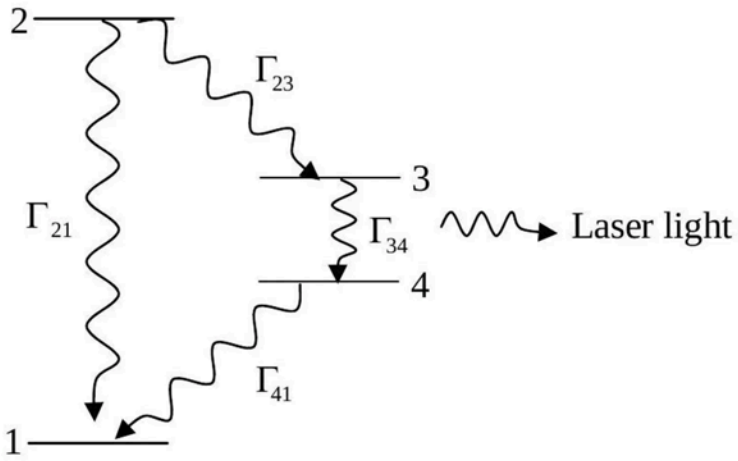
Q69. [June 2018] . 5.0 marks

Atomic and Molecular Physics > Lasers

CSIR NET	2018 June	5M

The electronic energy level diagram of a molecule is shown in the following figure, Let Γ_{ij} denote the decay rate for a transition from the level i to j. The molecules are optically pumped from level 1 to 2 . For the transition from level 3 to level 4 to be a lasing transition, the decay rates have to satisfy

1. $\Gamma_{21} > \Gamma_{23} > \Gamma_{41} > \Gamma_{34}$
2. $\Gamma_{21} > \Gamma_{41} > \Gamma_{23} > \Gamma_{34}$
3. $\Gamma_{41} > \Gamma_{23} > \Gamma_{21} > \Gamma_{34}$
4. $\Gamma_{41} > \Gamma_{21} > \Gamma_{34} > \Gamma_{23}$



Q70. [June 2018] . 5.0 marks

Solid State Physics > Xray diffraction

CSIR NET	2018 June	5M

Sodium Chloride (NaCl) crystal is a face-centered cubic lattice with a basis consisting of Na^+ and Cl^- ions separated by half the body diagonal of a unit cube. Which of the planes corresponding to the Miller indices given below will not give rise to Bragg reflection of X-rays?

1. (220)
2. (242)
3. (221)
4. (311)

Q71. [June 2018] . 5.0 marks

Solid State Physics > Semiconductor Physics

CSIR NET	2018 June	5M

The dispersion relation for the electrons in the conduction band of a semiconductor is given by $E = E_0 + \alpha k^2$ where α and E_0 are constants. If ω_c is the cyclotron resonance frequency of the conduction band electrons in a magnetic field B, the value of α is

1. $\frac{\hbar\omega_c}{4eB}$
2. $\frac{2\hbar^2\omega_c}{eB}$
3. $\frac{\hbar^2\omega_c}{eB}$
4. $\frac{\hbar^2\omega_c}{2eB}$

Q72. [June 2018] . 5.0 marks

Solid State Physics > Crystallography

CSIR NET	2018 June	5M

Hard discs of radius R are arranged in a two-dimensional triangular lattice. What is the fractional area occupied by the discs in the closest possible packing?

1. $\frac{\pi\sqrt{3}}{6}$
2. $\frac{\pi}{3\sqrt{2}}$
3. $\frac{\pi\sqrt{2}}{5}$
4. $\frac{2\pi}{7}$

Q73. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2018 June	5M

Which of the following elementary particle processes does not conserve strangeness?

1. $\pi^0 + p \rightarrow k^+ + \Lambda^0$
2. $\pi^- + p \rightarrow k^0 + \Lambda^0$
3. $\Delta^0 \rightarrow \pi^0 + n$
4. $\mathrm{K}^0 \rightarrow \pi^+ + \pi^-$

Q74. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Particle physics

CSIR NET	2018 June	5M

A deuteron d captures a charged pion π^- in the $l = 1$ state, and subsequently decays into a pair of neutrons (n) via strong interaction. Given that the intrinsic parities of π^-, d and n are $-1, +1$ and +1 respectively, the spin wavefunction of the final state neutrons is.

1. linear combination of a singlet and a triplet
2. Singlet
3. Triplet
4. doublet

Q75. [June 2018] . 5.0 marks

Nuclear and Particle Physics > Radioactivity

CSIR NET	2018 June	5M

The reaction ${}^{63}\mathrm{Cu}_{29} + p \rightarrow {}^{63}\mathrm{Zn}_{30} + n$ is followed by a prompt β-decay of zinc ${}^{63}\mathrm{Zn}_{30} \rightarrow {}^{63}\mathrm{Cu}_{29} + e^{+} + \nu_e$. If the maximum energy of the position is 2.4 MeV , the Q value of the original reaction in MeV is nearest to [Take the masses of electron, proton and neutron to be $0.5MeV/c^2, 938MeV/c^2$ and $939.5\mathrm{MeV}/c^2$, respectively.]

1. -4.4
2. -2.4
3. -4.8
4. -3.4

Answer Key

75 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	General Aptitude	Basic Physics	**4**
Q2	General Aptitude	Reasoning	**4**
Q3	General Aptitude	Mathematical Analysis	**3**
Q4	General Aptitude	Basic Physics	**4**
Q5	General Aptitude	Mathematical Analysis	**1**
Q6	General Aptitude	Mathematical Analysis	**3**
Q7	General Aptitude	General Knowledge	**None**
Q8	General Aptitude	Reasoning	**3**
Q9	General Aptitude	Mathematical Analysis	**1**
Q10	General Aptitude	Reasoning	**1**
Q11	General Aptitude	Data Analysis	**4**
Q12	General Aptitude	Mathematical Analysis	**4**
Q13	General Aptitude	Mathematical Analysis	**3**
Q14	General Aptitude	Mathematical Analysis	**4**
Q15	General Aptitude	Reasoning	**4**
Q16	General Aptitude	Geometry	**2**
Q17	General Aptitude	Reasoning	**3**
Q18	General Aptitude	Basic Physics	**3**
Q19	General Aptitude	Mathematical Analysis	**4**
Q20	General Aptitude	Geometry	**1 or 4**
Q21	Mathematical Physics	Vector Algebra and Vector Calculus	**1**
Q22	Mathematical Physics	Fourier Transform	**3**
Q23	Mathematical Physics	Dirac Delta Function	**2**
Q24	Mathematical Physics	Ordinary Differential Equations	**3**
Q25	Mathematical Physics	Complex analysis	**1**
Q26	Classical Mechanics	Oscillations	**1**
Q27	Classical Mechanics	Central forces	**3**
Q28	Classical Mechanics	Special theory of relativity	**2**
Q29	Classical Mechanics	Oscillations	**3**
Q30	Electromagnetism	Electrostatics	**4**
Q31	Optics	Interference and diffraction	**3**
Q32	Electromagnetism	EM Waves	**None**
Q33	Electromagnetism	Potential Formulation	**2**
Q34	Quantum Mechanics	Potential Well	**3**
Q35	Quantum Mechanics	Spin Angular momentum	**4**
Q36	Quantum Mechanics	Spin Angular momentum	**3**
Q37	Quantum Mechanics	Pertubation theory	**3**
Q38	Thermodynamics	Thermodynamic relations and maxwell equations	**1**
Q39	Thermodynamics	Laws of thermodynamics	**1**
Q40	Statistical Mechanics	Microstates and Macrostates	**3**

Answer Key (cont.)

Q. No	Subject	Topic	Answer
Q41	Statistical Mechanics	Canonical Ensemble	**4**
Q42	Electronics	Flip flops/Counters/Registers/microcontroller etc.	**4**
Q43	Electronics	Digital Electronics	**3**
Q44	Electronics	Diodes	**3**
Q45	Electronics	Transistors	*****
Q46	Mathematical Physics	Special Functions	**3**
Q47	Mathematical Physics	Green Function	**2**
Q48	Mathematical Physics	Numerical Methods	**2**
Q49	Mathematical Physics	Matrices and Linear Algebra	**2**
Q50	Classical Mechanics	Central forces	**2**
Q51	Classical Mechanics	Lagrangian and Hamiltonian	**3**
Q52	Classical Mechanics	Special theory of relativity	**2**
Q53	Electromagnetism	Magetostatics	**2**
Q54	Electromagnetism	Radiations	**2**
Q55	Electromagnetism	Waveguides	**3**
Q56	Classical Mechanics	Special theory of relativity	**3**
Q57	Quantum Mechanics	WKB Approximation	**1**
Q58	Quantum Mechanics	Scattering theory	**3**
Q59	Quantum Mechanics	Basic Quantum Mechanics	**4**
Q60	Thermodynamics	Phase transitions	**3**
Q61	Statistical Mechanics	Random Walk/Brownian motion/Diffusion	**1 or 3**
Q62	Thermodynamics	Laws of thermodynamics	**3**
Q63	Statistical Mechanics	Black Body Radiations	**4**
Q64	Electronics	AD/DA Conversion	**1**
Q65	Electronics	OPAMP	**None**
Q66	Electronics	Instruments	**4**
Q67	Atomic and Molecular Physics	Xray and alkali spectra	**3**
Q68	Atomic and Molecular Physics	Angular momentum in Atomic Physics	**4**
Q69	Atomic and Molecular Physics	Lasers	**None**
Q70	Solid State Physics	Xray diffraction	**3**
Q71	Solid State Physics	Semiconductor Physics	**4**
Q72	Solid State Physics	Crystallography	**1**
Q73	Nuclear and Particle Physics	Particle physics	**4**
Q74	Nuclear and Particle Physics	Particle physics	**2**
Q75	Nuclear and Particle Physics	Radioactivity	**1**

Study with PhysicsByAaryan

Full CSIR NET / GATE / JEST / BARC Physics live batch by Aaryan Mehra Sir.
Concept-first teaching, complete PYQ coverage, daily doubt support.

Use coupon CONSISTENCY for Rs. 500 off

Visit
www.physicsbyaaryan.com
www.csirnetphysics.com

Contact
9501976811