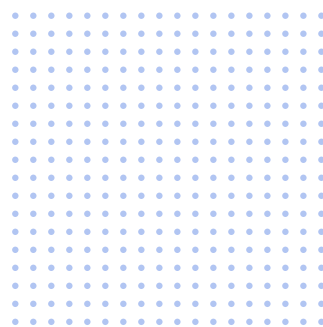




FOR JNU EE EXAM PREPARATION

JNU EE 2022 Question Paper · Ph.D Computational Biology and Bioinformatics - Track 1 Physics

EXAM

JNU EE

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2022

TYPE

Question Paper

SUBJECT

Ph.D Computational Biology and Bioinformatics - Track 1 Physics



Test Date : 10 Dec 2022

Test Slot : Slot 1

Subject : TRAP-Computational Biology & Bioinformatics Track -1 Physics

Sl. No.1

QBID:1082021

Let A be a second rank tensor. If $A^{mn} = A^{nm}$ then A is

1. zero
2. neither symmetric nor antisymmetric
3. symmetric
4. antisymmetric

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16881]

2[Option ID=16882]

3[Option ID=16883]

4[Option ID=16884]

Sl. No.2

QBID:1082022

The value of $\vec{\nabla} \times [f(r)\hat{r}]$ is

1. 1
2. $\hat{r}$
3. 0
4. r^2

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16885]

2[Option ID=16886]

3[Option ID=16887]

4[Option ID=16888]

Sl. No.3

QBID:1082023

If A is an orthogonal matrix, then

1. $\det(A)=\pm 1$
2. $\det(A)>1$
3. $\det(A)<1$
4. $\det(A)=0$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16889]

2[Option ID=16890]

3[Option ID=16891]

4[Option ID=16892]

Sl. No.4

QBID:1082024

The solution of differential equation $x \frac{dy}{dx} + y \sin x = 1$ is

1. $y \sin x = \cot x + C$

2. $y \cos x = \tan x + C$

3. $y \sec x = \tan x + C$

4. $y \sec x = \cot x + C$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16893]

2[Option ID=16894]

3[Option ID=16895]

4[Option ID=16896]

Sl. No.5

QBID:1082025

The value of $\oint_c \frac{e^z dz}{(z-1)(z+3)^2}$ where c is given by $|z| = \frac{3}{2}$ is

1. $\frac{ie}{8}$

2. $\frac{i\pi}{8}$

3. $\frac{\pi e}{8}$

4. $\frac{i\pi e}{8}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16897]

2[Option ID=16898]

3[Option ID=16899]

4[Option ID=16900]

Sl. No.6

QBID:1082026

Let $W = x^2y^2 + xyz$ is three-dimensional scalar field. The $\text{grad}(W)$ at $(2, -1, 0)$ is

1. $4\hat{i} - 8\hat{j} - 2\hat{k}$

2. $2\hat{i} - 8\hat{j} - 2\hat{k}$

3. $4\hat{i} - 8\hat{j} - \hat{k}$

4. $2\hat{i} - 4\hat{j} - \hat{k}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16901]

2[Option ID=16902]

3[Option ID=16903]

4[Option ID=16904]

Sl. No.7

QBID:1082027

The Laplace transform of $\cos \omega t$ is

1. $\frac{s}{s+\omega}$

2. $\frac{s}{s^2+\omega^2}$

3. $\frac{s^2}{s^2+\omega^2}$

4. $\frac{s}{\omega^2}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16905]

2[Option ID=16906]

3[Option ID=16907]

4[Option ID=16908]

Sl. No.8

QBID:1082028

If $\phi(x) = f(x) \cdot e^{i\omega_0 x}$ and F is a Fourier transform of $f(x)$ then $F.T[\phi(x)]$ is

1. $F(\omega)$

2. $F(\omega_0)$

3. $F(\omega - \omega_0)$

4. $F(\omega_0 - \omega)$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16909]

2[Option ID=16910]

3[Option ID=16911]

4[Option ID=16912]

Sl. No.9

QBID:1082029

The value of $\beta = u/c$ for which the relativistic mass of a particle exceed its rest mass by a given fraction of f is

1. $\frac{\sqrt{f(1+f)}}{2+f}$
2. $\frac{\sqrt{f(2+f)}}{f}$
3. $\frac{\sqrt{f(2+f)}}{1+f}$
4. $\frac{\sqrt{f(1+f)}}{2+f}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16913]

2[Option ID=16914]

3[Option ID=16915]

4[Option ID=16916]

Sl. No.10

QBID:1082030

If the law of central force is defined by $f(r) = -\frac{k}{r^2}$, $k > 0$ then the path of the particle is

1. Constant
2. Brownian path
3. Straight line
4. Conic

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16917]

2[Option ID=16918]

3[Option ID=16919]

4[Option ID=16920]

Sl. No.11

QBID:1082031

Consider H is the Hamiltonian of the system. If f is any function depending on position, momenta and time, then

1. $\frac{df}{dt} = \frac{\partial f}{\partial t} + [H, 2f]$
2. $\frac{df}{dt} = \frac{\partial f}{\partial t} + [H, f]$
3. $\frac{df}{dt} = [H, f]$
4. $\frac{df}{dt} = \frac{\partial f}{\partial t} + \{H, f\}$

(1) 1

(2) 2

(3) 3

(4) 4

- 1[Option ID=16921]
 2[Option ID=16922]
 3[Option ID=16923]
 4[Option ID=16924]

Sl. No.12

QBID:1082032

A particle of mass m moves under the influence of gravity on the inner surface of the paraboloid of revolution $x^2 + y^2 = az$ which is assumed frictionless. The Lagrangian and equation of motion are

1. $L = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + \dot{z}^2) - mz$; $2\rho\dot{\rho} - a\dot{z} = 0$
2. $L = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2 + \dot{z}^2) - mz$; $\rho\dot{\rho} - a\dot{z} = 0$
3. $L = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2) - mz$; $\rho\dot{\rho} - a\dot{z} = 0$
4. $L = \frac{1}{2}m(\dot{\rho}^2 + \rho^2\dot{\phi}^2) - mz$; $2\rho\dot{\rho} - a\dot{z} = 0$

(1) 1

(2) 2

(3) 3

(4) 4

- 1[Option ID=16925]
 2[Option ID=16926]
 3[Option ID=16927]
 4[Option ID=16928]

Sl. No.13

QBID:1082033

The moment of inertia of a solid right circular cone of height h , and base radius R (the vertex is at origin and axis of the cone is along x, y and z axis) is

1. $I_x = \frac{3}{5}M\left(\frac{1}{4}R^2 + h^2\right)$; $I_y = I_x$; $I_z = \frac{3}{10}MR^2$
2. $I_x = \frac{3}{5}M\left(\frac{1}{4}R^2 + h^2\right)$; $I_y = \frac{3}{10}MR^2$; $I_z = I_y$
3. $I_x = \frac{5}{3}M\left(\frac{1}{4}R^2 + h^2\right)$; $I_y = \frac{3}{10}MR^2$; $I_z = I_y$
4. $I_x = \frac{5}{3}M\left(\frac{1}{4}R^2 + h^2\right)$; $I_y = I_x$; $I_z = \frac{3}{10}MR^2$

(1) 1

(2) 2

(3) 3

(4) 4

- 1[Option ID=16929]
 2[Option ID=16930]
 3[Option ID=16931]
 4[Option ID=16932]

Sl. No.14

QBID:1082034

A spacecraft is moving relative to the earth. An observer on the earth finds that, between 1 P.M. and 2 P.M. according to her clock, 3601 second elapse on the spacecraft's clock. The speed of spacecraft relative to the earth is

1. $7.1 \times 10^6 m/s$
2. $7.1 \times 10^5 m/s$
3. $7.1 \times 10^4 m/s$
4. $7.1 \times 10^3 m/s$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16933]

2[Option ID=16934]

3[Option ID=16935]

4[Option ID=16936]

Sl. No.15

QBID:1082035

A solenoid of length l and radius a consists of N turns of wire carrying current I . The magnetic field at a point P along its axis is given by ($n = \frac{N}{l}$; θ_1 and θ_2 are angles subtended at P by the end turns)

1. $I(\cos \theta_2 - \cos \theta_1)$
2. $nI(\cos \theta_2 - \cos \theta_1)$
3. $\frac{I}{2}(\cos \theta_2 - \cos \theta_1)\hat{k}$
4. $\frac{nI}{2}(\cos \theta_2 - \cos \theta_1)\hat{k}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16937]

2[Option ID=16938]

3[Option ID=16939]

4[Option ID=16940]

Sl. No.16

QBID:1082036

The differential form of Ampere's law is

1. $\vec{\nabla} \times \vec{H} = \vec{S}$ (Poynting's vector)
2. $\vec{\nabla} \times \vec{H} = 0$
3. $\vec{\nabla} \times \vec{H} = \vec{j}$
4. $\vec{\nabla} \cdot \vec{H} = J$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16941]

2[Option ID=16942]
 3[Option ID=16943]
 4[Option ID=16944]

Sl. No.17
 QBID:1082037

The electric field component of a plane monochromatic electromagnetic wave, propagating through free space, along the z-direction is given by $\vec{E} = E_0 \sin(kz - \omega t)\hat{i}$. The Poynting's vector is

1. $c\epsilon_0 E_0 \sin^2(kz - \omega t)\hat{k}$
2. $c\epsilon_0 E_0^2 \sin^2(kz - \omega t)\hat{k}$
3. $\epsilon_0 E_0^2 \sin^2(kz - \omega t)\hat{k}$
4. $cE_0^2 \sin^2(kz - \omega t)\hat{k}$

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=16945]
 2[Option ID=16946]
 3[Option ID=16947]
 4[Option ID=16948]

Sl. No.18
 QBID:1082038

A parallel plate capacitor with plate area of 5 cm^2 and plate separation of 3 mm has a voltage of $50 \sin 10^3 t\text{ V}$ applied to its plates. The displacement current assuming $\epsilon = 2\epsilon_0$ is

1. $1.474 \sin 10^3 t\text{ nA}$
2. $1.474 \cos 10^3 t\text{ nA}$
3. $14.74 \cos 10^3 t\text{ nA}$
4. $147.4 \cos 10^3 t\text{ nA}$

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=16949]
 2[Option ID=16950]
 3[Option ID=16951]
 4[Option ID=16952]

Sl. No.19
 QBID:1082039

If two operators A and B commute, then they are

1. measurable quantities independent of each other
2. simultaneously measurable
3. can't be measured simultaneously
4. measurable quantities dependent on each other

- (1) 1
 (2) 2
 (3) 3
 (4) 4

- 1[Option ID=16953]
 2[Option ID=16954]
 3[Option ID=16955]
 4[Option ID=16956]

Sl. No.20
 QBID:1082040

If P_i is the projection operator of i^{th} eigen state, then $\sum_i P_i$ is

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

- (1) 1
 (2) 2
 (3) 3
 (4) 4

- 1[Option ID=16957]
 2[Option ID=16958]
 3[Option ID=16959]
 4[Option ID=16960]

Sl. No.21
 QBID:1082041

Uncertainty principle deny the possibility of certain definite pairs of variables known as canonical conjugate variables. The statement is

1. true
2. false
3. incomplete without additional information
4. not verifiable

- (1) 1
 (2) 2
 (3) 3
 (4) 4

- 1[Option ID=16961]
 2[Option ID=16962]
 3[Option ID=16963]
 4[Option ID=16964]

Sl. No.22
 QBID:1082042

The expectation value $\langle x \rangle$ of the position of a particle trapped in a box L wide is

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

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=16965]
 2[Option ID=16966]
 3[Option ID=16967]
 4[Option ID=16968]

Sl. No.23
 QBID:1082043

The wave function of a $1s$ electron of the hydrogen atom is $= \frac{e^{-\frac{r}{a_0}}}{\sqrt{\pi}a_0^{3/2}}$, where symbols have their usual meaning. Then $\langle \frac{1}{r} \rangle$ is

1. 1
2. $\frac{1}{a_0^2}$
3. $\frac{1}{a_0}$
4. a_0

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=16969]
 2[Option ID=16970]
 3[Option ID=16971]
 4[Option ID=16972]

Sl. No.24
 QBID:1082044

The eigenfunction of the operator $\frac{d^2}{dx^2}$ is $\psi = e^{\alpha x}$. The corresponding eigenvalue is

1. α
2. α^2
3. α^3
4. α^4

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=16973]
 2[Option ID=16974]
 3[Option ID=16975]
 4[Option ID=16976]

Sl. No.25
 QBID:1082045

Operators $A, A^\dagger$ satisfy $[A, A^\dagger] = 1$ and a Hamiltonian is given by

$$H = A^\dagger A + g(A + A^\dagger), \text{ where } g = \text{real number}$$

The eigenvalues of H are

1. $-g^2$
2. $N + g^2$
3. $N - g^2$
4. g^2

- (1) 1
(2) 2
(3) 3
(4) 4

1[Option ID=16977]
2[Option ID=16978]
3[Option ID=16979]
4[Option ID=16980]

Sl. No.26
QBID:1082046

The wavefunction of a particle in a state is

$$\psi = N \exp\left(-\frac{x^2}{2\alpha}\right); \text{ where } N = \left(\frac{1}{\pi\alpha}\right)^{\frac{1}{4}}$$

then $(\Delta x)(\Delta p)$ is

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

- (1) 1
(2) 2
(3) 3
(4) 4

1[Option ID=16981]
2[Option ID=16982]
3[Option ID=16983]
4[Option ID=16984]

Sl. No.27
QBID:1082047

The selection rule for transition between singlet and triplet states is

1. $\Delta s = 1$
2. $\Delta s = 0$
3. $\Delta s = -1$
4. $\Delta s = 2$

- (1) 1
(2) 2
(3) 3
(4) 4

1[Option ID=16985]
2[Option ID=16986]
3[Option ID=16987]
4[Option ID=16988]

Sl. No.28
QBID:1082048

The force constant of HCl molecule is 516 N/m. The energy difference between $v = 0$ and $v = 1$ vibrational states in eV is (given $\mu_{HCl} = 1.63 \times 10^{-27} \text{ kg}$)

1. 0.037 eV
2. 0.37 eV
3. 1.37 eV
4. 13.7 eV

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16989]

2[Option ID=16990]

3[Option ID=16991]

4[Option ID=16992]

Sl. No.29

QBID:1082049

The velocity of electron in second order orbit of hydrogen is

1. $11.1 \times 10^6 \text{ m/s}$
2. $0.11 \times 10^6 \text{ m/s}$
3. $1.1 \times 10^6 \text{ m/s}$
4. $11 \times 10^6 \text{ m/s}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16993]

2[Option ID=16994]

3[Option ID=16995]

4[Option ID=16996]

Sl. No.30

QBID:1082050

The possible orientations of $\vec{J}$ for the $J = \frac{3}{2}$ and $J = \frac{1}{2}$ states that correspond to $l = 1$ are

1. $J = \frac{3}{2}$; $m_j = -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$ and $J = \frac{1}{2}$; $m_j = -\frac{1}{2}, \frac{1}{2}$
2. $J = \frac{3}{2}$; $m_j = -\frac{1}{2}, \frac{1}{2}$ and $J = \frac{1}{2}$; $m_j = -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$
3. $J = \frac{3}{2}$; $m_j = -\frac{1}{2}, \frac{1}{2}$ and $J = \frac{1}{2}$; $m_j = -\frac{1}{2}, \frac{1}{2}$
4. $J = \frac{3}{2}$; $m_j = 0$ and $J = \frac{1}{2}$; $m_j = -\frac{3}{2}, -\frac{1}{2}, \frac{1}{2}, \frac{3}{2}$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=16997]

2[Option ID=16998]
 3[Option ID=16999]
 4[Option ID=17000]

Sl. No.31
 QBID:1082051

If the angular momentum of individual electron is specified, the total angular momentum can be

1. exactly known
2. can't be known
3. zero
4. constant and non-zero

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=17001]
 2[Option ID=17002]
 3[Option ID=17003]
 4[Option ID=17004]

Sl. No.32
 QBID:1082052

The Entropy S of a system has the property that as $T \rightarrow 0_+$

1. $S \rightarrow S_1$ (S_1 depends on the structure of the system)
2. $S \rightarrow S_0$ (S_0 is independent of structure of the system)
3. $S \rightarrow S_2$ (S_2 is momentum dependent)
4. $S \rightarrow S_3$ (S_3 is energy dependent)

- (1) 1
 (2) 2
 (3) 3
 (4) 4

1[Option ID=17005]
 2[Option ID=17006]
 3[Option ID=17007]
 4[Option ID=17008]

Sl. No.33
 QBID:1082053

Quantum statistics changes into classical statistics if

1. $\frac{g_i}{n_i} = 1$
2. $\frac{g_i}{n_i} \gg 1$
3. $\frac{g_i}{n_i} \ll 1$
4. $\frac{g_i}{n_i} = 0$

- (1) 1
 (2) 2
 (3) 3

(4) 4

- 1[Option ID=17009]
 2[Option ID=17010]
 3[Option ID=17011]
 4[Option ID=17012]

Sl. No.34

QBID:1082054

The equipartition theorem says that the average energy per degree of freedom of any classical object is

1. kT^2
2. kT
3. $\frac{1}{2}kT$
4. $\frac{3}{2}kT$

(1) 1

(2) 2

(3) 3

(4) 4

- 1[Option ID=17013]
 2[Option ID=17014]
 3[Option ID=17015]
 4[Option ID=17016]

Sl. No.35

QBID:1082055

The wavelength at which a black body emits maximum amount of radiation is proportional to

1. T
2. T^4
3. T^5
4. $\frac{1}{T}$

(1) 1

(2) 2

(3) 3

(4) 4

- 1[Option ID=17017]
 2[Option ID=17018]
 3[Option ID=17019]
 4[Option ID=17020]

Sl. No.36

QBID:1082056

Two Carnot engines A and B are operated in series. First engine A absorbs heat at 1100 K and rejects it to the sink at $T\text{ K}$. Second engine B absorbs half amount of heat rejected by first engine and rejects heat to the sink at 200 K . If the work performed by both the engines are equal, then the temperature T is

1. 400 K
2. 600 K
3. 800 K
4. 1000 K

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=17021]

2[Option ID=17022]

3[Option ID=17023]

4[Option ID=17024]

Sl. No.37

QBID:1082057

Degree of degeneracy will be large when

1. temperature is high, particle density is large
2. temperature is high, particle density is small
3. temperature is low, particle density is small
4. temperature is low, particle density is large

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=17025]

2[Option ID=17026]

3[Option ID=17027]

4[Option ID=17028]

Sl. No.38

QBID:1082058

The average energy at 0 K is related with Fermi energy (ϵ_F) as

1. $\frac{5}{3}\epsilon_F$
2. $\frac{3}{5}\epsilon_F$
3. $\frac{3}{2}\epsilon_F$
4. $\frac{2}{3}\epsilon_F$

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=17029]

2[Option ID=17030]

3[Option ID=17031]

4[Option ID=17032]

Sl. No.39

QBID:1082059

1 kg of water is heated from 0°C to 100°C and converted into steam at the same temperature. The increase in entropy is given by (take specific heat capacity = $4.18 \times 10^3 \text{ Jkg}^{-1}\text{K}^{-1}$, latent heat of vaporization = $2.26 \times 10^6 \text{ Jkg}^{-1}$)

1. 1.305 JK^{-1}
2. 13.05 JK^{-1}
3. 130.5 JK^{-1}
4. 1305 JK^{-1}

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=17033]

2[Option ID=17034]

3[Option ID=17035]

4[Option ID=17036]

Sl. No.40

QBID:1082060

Two ideal black bodies A and B at temperatures 227°C and 327°C respectively are placed in an evacuated enclosure whose walls are blackened and kept at 27°C . The ratio of their rates of loss of heat is

1. 544:1215
2. 444:1215
3. 344:515
4. 244:515

(1) 1

(2) 2

(3) 3

(4) 4

1[Option ID=17037]

2[Option ID=17038]

3[Option ID=17039]

4[Option ID=17040]