

GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject : **Physics**
Paper name : **Thermodynamics and Mathematical Physics-I**
Paper No : **Phy/II/EC/03**
Semester : **II**

A. Multiple choice questions [25 (5 from each unit)]

- The mean kinetic energy of a molecule is
 - directly proportional to \sqrt{T}
 - inversely proportional to \sqrt{T}
 - directly proportional to T
 - inversely proportional to T
- Pressure remaining constant, the temperature at which the rms velocity of nitrogen will be double of its value at NTP is
 - 815°C
 - 818°Cx
 - 915°C
 - 918°C
- Energy associated with 1 gram molecule of a triatomic gas having 6 degrees of freedom is
 - $U = 2RT$
 - $U = 3RT$
 - $U = 6RT$
 - $U = 7RT$
- In VanderWaal's equation of real gas, correction for pressure,
 - $p \propto V$
 - $p \propto V^2$
 - $p \propto P$
 - $p \propto P^2$
- In thermal conductivity, the amount of heat flowing from the hotter to the colder surface is proportional
 - inversely to time of flow
 - inversely to surface area
 - directly to surface area
 - directly to the separation of surface
- The first law of thermodynamics is based on the principal of conservation
 - momentum
 - energy
 - mass
 - none of these
- The efficiency of a heat engine can never be

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- a) zero
 - b) 30.5%
 - c) 50%
 - d) 100%
8. The physical concept of entropy is that entropy may be taken as
- a) thermal length
 - b) thermal height
 - c) thermal inertia
 - d) none of these
9. In an adiabatic process, change in entropy is
- a) maximum
 - b) half
 - c) two-third
 - d) zero
10. Third law of thermodynamics states that "at absolute zero, the entropy tends to be
- a) infinite
 - b) maximum
 - c) zero
 - d) negative
11. In cylindrical coordinate system, the intersection of the coordinate surfaces $\rho = c_1$ and $\phi = c_2$ is
- a) a circle
 - b) a semi-circle
 - c) an ellipse
 - d) a straight line
12. Identify the correct statement in regards to the nature of the tensors as stated below
- a) Gradient is covariant, velocity is contravariant
 - b) Velocity is covariant, gradient is contravariant
 - c) Velocity is contravariant, acceleration is covariant
 - d) Acceleration is covariant, gradient is contravariant
13. If \vec{r} is a position vector in 3D Cartesian coordinate system, then $\nabla^2 \frac{1}{|\vec{r}|}$ equals
- a) infinity
 - b) one
 - c) zero
 - d) three
14. In cylindrical system, time derivative of unit vector $\frac{d\hat{e}_\phi}{dt}$ equals

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- a) $-\dot{\phi}\hat{e}_\rho$
b) $\dot{\phi}\hat{e}_\theta$
c) $\dot{\phi}\hat{e}_\phi$
d) 0
15. In spherical coordinate system, the scale factor h_θ is
a) $r\sin\theta$
b) r
c) 1
d) 0
16. If A and B be two symmetric matrices of same order, then the product AB is symmetric if
a) $(AB)^T = B^T A^T$
b) $(AB)^T = -B^T A^T$
c) $AB = BA$
d) $AB = -BA$
17. The total number of independent elements in a symmetric matrix of order 4×4 is
a) 8
b) 10
c) 12
d) 16
18. Let A be a matrix such that $A^\theta = A$, then $B^\theta AB$ is a _____ matrix.
a) hermitian
b) skew-hermitian
c) may be hermitian or skew-hermitian
d) none of these.
19. If A be a real symmetric matrix and P its diagonalizing matrix, then P is _____ matrix.
a) a symmetric
b) a skew-symmetric
c) a unitary
d) an orthogonal
20. If A is invertible, then $tr(ACA^{-1})$ is equal to
a) $tr A$
b) $tr C$
c) $tr A^{-1}$

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d) $\text{tr } C^{-1}$

21. The value $\beta(m, 2)$ is

a) $\frac{1}{m}$

b) $\frac{1}{m+1}$

c) $\frac{1}{m(m+1)}$

d) $\frac{m}{m+1}$

22. The value of $\Gamma(2 + m)\Gamma(1 - m)$ is

a) $\frac{\pi}{\sin m\pi}$

b) $\frac{m\pi}{\sin m\pi}$

c) $\frac{(m+1)\pi}{\sin m\pi}$

d) $\frac{m(m+1)\pi}{\sin m\pi}$

23. The value of $\Gamma\left(\frac{1}{4}\right)\Gamma\left(\frac{3}{4}\right)$ is

a) π

b) $\pi\sqrt{2}$

c) $\sqrt{\pi}$

d) $\frac{\sqrt{\pi}}{2}$

24. The value of $\Gamma\left(-\frac{5}{2}\right)$ is

a) $-\frac{8}{15}\sqrt{\pi}$

b) $-\frac{8}{5}\sqrt{\pi}$

c) $-\frac{8}{3}\sqrt{\pi}$

d) $-\frac{3}{8}\sqrt{\pi}$

25. The value of $\Gamma\left(\frac{1}{25}\right)\Gamma\left(\frac{2}{25}\right)\dots\dots\Gamma\left(\frac{24}{25}\right)$ is

a) $\frac{(2\pi)^{12}}{5}$

b) $\frac{(2\pi)^{12}}{25}$

c) $\frac{2\pi^{12}}{5}$

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d) $\frac{2\pi^{12}}{25}$

B. Fill up the blanks [15 (3 from each unit)]

1. In kinetic theory of an ideal gas, molecules move at _____ in all directions.
2. At absolute zero, the molecules are in a perfect state of _____.
3. In _____, heat is transmitted from one body to another body without heating the intervening medium.
4. _____ law of thermodynamics states that, "if two bodies A and B are each separately in thermal equilibrium with a third body C, then A and B are also in thermal equilibrium with each other."
5. Amount of heat is taken to be _____, if heat is supplied to the system.
6. In Carnot's engine, _____ is the working substance.
7. If A^{ij} is an antisymmetric tensor and B_i is a vector, then the product $A^{ij}B_iB_j$ will be
8. Symmetry property of a tensor is under coordinate transformation
9. theorem is valid for an open two sided surface bounded by a closed non-intersecting curve 'C' (simple closed curve)
10. If A be a real symmetric matrix and P its diagonalizing matrix, then P is _____ matrix.
11. If A is a unitary matrix and $B = AP$ where $P \neq O$, then PB^{-1} is _____ matrix.
12. If H is a Hermitian matrix, then e^{iH} is _____ matrix.
13. $\beta(m + 1, n) + \beta(m, n + 1) =$ _____
14. The integral $\int_0^\infty e^{-2x}x^4dx =$ _____.
15. The integral $\int_0^{\pi/2} \sin^7 \theta d\theta =$ _____.

Key Answers

A. Multiple choice questions [replace x]

- | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|
| 1. c | 2. b | 3. b | 4. d | 5. c | 6. b | 7. d |
| 8. c | 9. d | 10. c | 11. d | 12. a | 13. c | 14. a |
| 15. b | 16. c | 17. b | 18. a | 19. d | 20. b | 21. c |
| 22. d | 23. b | 24. a | 25. a | | | |

B. Fill up the blanks [replace x]

1. Random
2. Rest
3. Radiation
4. Zeroth
5. Positive
6. Ideal gas
7. zero

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8. invariant
9. Stokes theorem
10. an orthogonal
11. a unitary
12. a unitary
13. $\beta(m, n)$
14. $\frac{3}{4}$
15. $\frac{16}{35}$