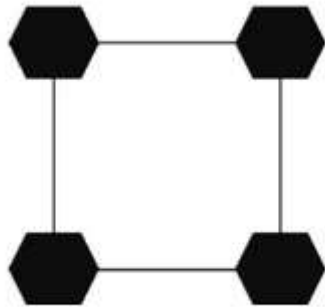
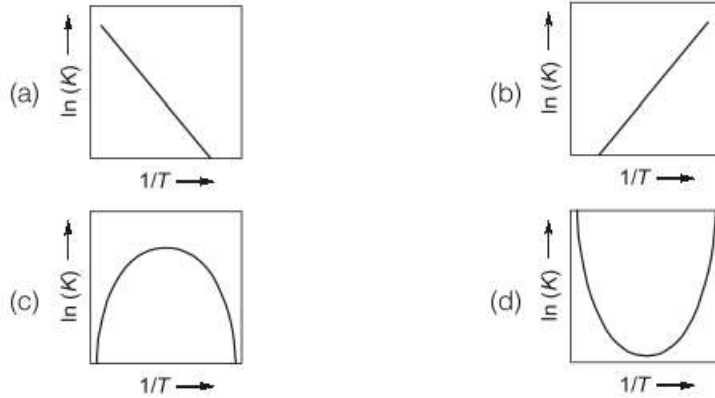


1. Which of the following energy has the greatest potential among all the sources of renewable energy?
 - a) Solar energy
 - b) Wind Energy
 - c) Thermal energy
 - d) Hydro-electrical energy
2. Complete the following reaction.
 $\text{H}_2\text{O} + \text{CO}_2 \rightarrow \underline{\hspace{2cm}}$
 - a) $\text{CH}_2\text{O} + \text{O}_2$
 - b) $\text{CO}_2 + \text{O}_2$
 - c) $\text{H} + \text{CO}_2 + \text{O}_2$
 - d) $\text{CH}_2\text{O} + \text{H}_2\text{O} + \text{O}_2$
3. How many are the number of commonly used fuel injection systems in diesel power stations?
 - a) 2
 - b) 4
 - c) 3
 - d) 5
4. Let x_0, x_1, x_2, \dots be the sequence generated by the Newton-Raphson method applied to the function $f(x) = x^3 - 2x + 2$ with $x_0 = 1$. Then the sequence
 - (a) Converges to 0
 - (b) Becomes unbounded.
 - (c) Converges to a root of $f(x)$.
 - (d) Does not converge.
5. Let A be a 3×3 matrix such that $A^2 = A$. Then it is necessary that
 - (a) A is the identity matrix or the zero matrix.
 - (b) The determinant of A^4 is either 0 or 1.
 - (c) The rank of A is 3.
 - (d) A has one imaginary eigenvalue
6. How many normal modes of vibrations are possible for CO_2 ?
 - (a) 4 (b) 3 (c) 2 (d) 1
7. The rotational Raman spectra follow the selection rule
 - (a) $\Delta J = 0$, (b) $\Delta J = 0, \pm 2$ (c) $\Delta F =$ (d) $\Delta J = 0, \pm 3$

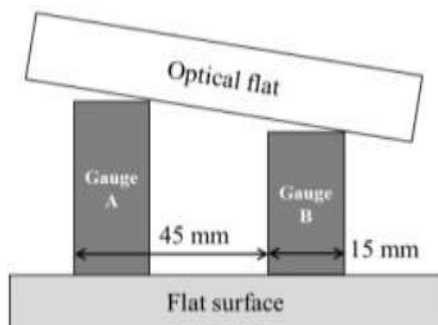
8. The unit cell of Si has an edge 5.43 \AA and contains eight atoms per unit cell. If the dielectric constant of Si is 12, the electronic polarizability of Si atoms is
 (a) $4.5 \times 10^{-40} \text{ Fm}^2$ (b) $1.29 \times 10^{-40} \text{ Fm}^2$ (c) $8.6 \times 10^{-40} \text{ Fm}^2$ (d) $3.3 \times 10^{-40} \text{ Fm}^2$
9. The number of degrees of freedom for a rigid body with one point fixed is
 (a) 3 (b) 5 (c) 6 (d) None of these
10. Following diagram shows a square 2-D lattice with a hexagonal motif (dark colored). The rotational symmetry element that must be present in the system is



- (a) fold rotation
 (b) Two-fold rotation
 (c) Three-fold rotation
 (d) Four-fold rotation
11. The volume flow between any two points not lying on the same streamline in a flow field is equal to
 (a) Change in strain rate between the points
 (b) Change in vorticity between the points
 (c) Change in potential function between the points
 (d) Change in stream function between the points
12. For a reversible endothermic chemical reaction with constant heat of reaction over the operating temperature range, K is the thermodynamic equilibrium constant. Which one of the following figures shows the CORRECT dependence of K on temperature T ?

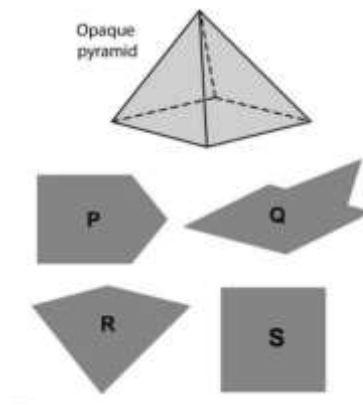


13. For a fully developed turbulent flow of an incompressible Newtonian fluid through a pipe of constant diameter, which of the following statements is/are CORRECT?
- (a) Reynolds stress, averaged over a sufficiently long time, is zero everywhere inside the pipe.
 - (b) Reynolds stress at the pipe wall is zero.
 - (c) Average velocity of the fluid is half of its centerline velocity.
 - (d) Average pressure gradient in the flow direction is constant
14. An optical flat is used to measure the height difference between a reference slip gauge A and a slip gauge B. Upon viewing via the optical flat using a monochromatic light of wavelength $0.5 \mu\text{m}$, 12 fringes were observed over a length of 15 mm of gauge B. If the gauges are placed 45 mm apart, the height difference of the gauges is pm. (Answer in integer)



- (a) 5
 - (b) 9
 - (c) 10
 - (d) 12
15. A differential amplifier has a common-mode gain of 0.2 and a common-mode rejection ratio of 3250. What would be the output voltage if the single-ended input voltage is 7 mV rms?
- (a) 1.4 mV rms (b) 650 mV rms (c) 4.55 V rms (d) 0.455V rms

16. What will be the number of memory chips needed to design a 8K-byte memory if the memory chip size is 1024 X 1
 (a) 128 (b) 64 (c) 16 (d) 3
17. The inter planer spacing for (220) planes of FCC structured lead of atomic radius 1.746 Å is
 (a) 0.1746 nm (b) 0.1278 nm (c) 0.3615 nm (d) 0.2465 nm
18. An opaque pyramid (shown below), with a square base and isosceles faces, is suspended in the path of a parallel beam of light, such that its shadow is cast on a screen oriented perpendicular to the direction of the light beam. The pyramid can be reoriented in any direction within the light beam. Under these conditions, which one of the shadows P, Q, R, and S is NOT possible?



- (a) P
 (b) Q
 (c) R
 (d) S
19. The smallest nucleus whose energy level structure is governed by the nuclear forces is the
 (a) diproton (b) triton (c) deuteron (d) alpha particle
20. The singularity of the function $f(z) = \ln(z)$ is at
 (a) 0 (b) ∞ (c) 1 (d) -1