Kerala Engineering Entrance Examination 2006
Physics & Chemistry

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1. A boat travels 50 km East, then 120 km North and finally it comes back to the starting point through the shortest distance. The total time of journey is 3 hours. What is the average velocity, in km h^{-1}, over the entire trip?

    (A) 0   (B) 100   (C) 17   (D) 33.33   (E) 86.7

2. The instantaneous displacement of a simple harmonic oscillator is given by $y = A \cos\left(\omega t + \dfrac{\pi}{4}\right)$. Its speed will be maximum at the time

    (A) $\dfrac{2\pi}{\omega}$ (B) $\dfrac{\omega}{2\pi}$ (C) $\dfrac{\omega}{\pi}$ (D) $\dfrac{\pi}{4\omega}$ (E) $\dfrac{\pi}{\omega}$

3. Calculate the surface temperature of the planet, if the energy radiated by unit area in unit time is 5.67×10^4 watt

    (A) 1273°C   (B) 1000°C   (C) 727°C   (D) 727 K   (E) 1273 K

4. If the potential energy of a gas molecule is $U = M/r^6 - N/r^{12}$, M and N being positive constants, then the potential energy at equilibrium must be

    (A) Zero   (B) $M^2/4N$ (C) $N^2/4M$ (D) $MN^2/4$ (E) $NM^2/4$

5. A toy cyclist completes one round of a square track of side 2 m in 40 seconds. What will be the displacement at the end of 3 minutes?

    (A) 52 m   (B) zero   (C) 16 m   (D) 2√2 m   (E) 4√2 m

6. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. If the escape velocity from the earth is v, then the escape velocity from the planet is

    (A) $\sqrt{3}\,v$ (B) $\sqrt{2}\,v$ (C) v (D) $\sqrt{5}\,v$ (E) $\sqrt{12}\,v$

7. A particle of mass 5 g is executing simple harmonic motion with an amplitude 0.3 m and time period $(\pi/5)$ s. The maximum value of the force acting on the particle is

(A) 5 N   (B) 4 N   (C) 0.5 N   (D) 0.3 N   (E) 0.15 N

8. The inputs and outputs for different time intervals are given below for NAND gate

TIME INTERVAL	INPUT A	INPUT B	OUTPUT Y
t_1 to t_2	0	1	P
t_2 to t_3	0	0	Q
t_3 to t_4	1	0	R
t_4 to t_5	1	1	S

The values taken by P,Q,R,S are respectively

(A) 1,1,1,0   (B) 0,1,0,1   (C) 0,1,0,0   (D) 1,0,1,1   (E) 1,0,1,0

9. A solenoid of 0.4 m length with 500 turns carries a current of 3 A. A coil of 10 turns and of radius 0.01 m carries a current of 0.4 A. The torque required to hold the coil with its axis at right angles to that of solenoid in the middle point of it is

(A) $6\pi^2 \times 10^{-7}$ Nm   (B) $3\pi^2 \times 10^{-7}$ Nm   (C) $9\pi^2 \times 10^{-7}$ Nm

(D) $12\pi^2 \times 10^{-7}$ Nm   (E) $15\pi^2 \times 10^{-7}$ Nm

10. Two particles P and Q get 6 m closer each second while travelling in opposite directions. They get 2.4 m closer every second while travelling in the same direction. The speeds of P and Q are respectively

(A) 4.2 ms^{-1} and 2.4 ms^{-1} (B) 6 ms^{-1} and 2.4 ms^{-1}

(C) 8.4 ms^{-1} and 3.6 ms^{-1} (D) 4.2 ms^{-1} and 3.6 ms^{-1}

(E) 4.2 ms^{-1} and 1.8 ms^{-1}

11. An electric dipole is placed at an angle of 30° with an electric field of intensity 2×10^5 NC^{-1}. It experiences a torque equal to 4 Nm. Calculate the charge on the dipole if the dipole length is 2 cm

   (A) 8 mC   (B) 4 mC   (C) 8 μC   (D) 4 μC   (E) 2 mC

12. 32 cells each of emf 3 V are connected in series and kept in a box. Externally, the combination shows an emf of 84 V. The number of cells reversed in the connection is

   (A) 0   (B) 2   (C) 4   (D) 8   (E) 16

13. Which of the following statement is incorrect?

   (A) In LCR series ac circuit, as the frequency of the source increases, the impedance of the circuit first decreases and then increases

   (B) If the net reactance of an LCR series ac circuit is same as its resistance, then the current lags behind the voltage by 45°

   (C) At resonance, the impedance of an ac circuit becomes purely resistive

   (D) At resonance in LCR series ac circuit, the potential drops across inductor and capacitor are equal in magnitude but opposite in sign

   (E) Below resonance, voltage leads the current while above it, current leads the voltage

14. A ray of light incident in a medium of refractive index μ_1, is partially reflected and refracted at the boundary of another medium of refractive index μ_2. If the reflected and refracted rays are perpendicular to each other, then the angle of incidence must be

   (A) $\sin^{-1}(\mu_2/\mu_1)$ (B) $\cos^{-1}(\mu_2/\mu_1)$ (C) $\sin^{-1}(\mu_1/\mu_2)$

   (D) $\tan^{-1}(\mu_2/\mu_1)$ (E) $\cos^{-1}(\mu_1/\mu_2)$

**15.** The plot represents the flow of current through a wire at three different times.
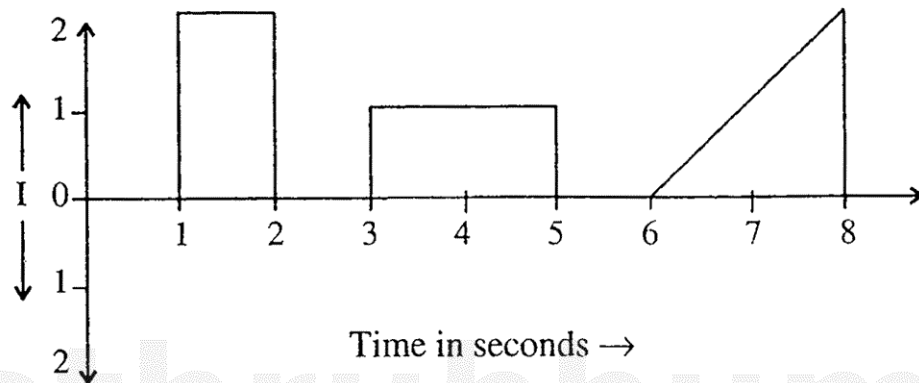
The ratio of charges flowing through the wire at different times is

(A) $2:1:2$ (B) $1:3:3$ (C) $1:1:1$ (D) $2:3:4$ (E) $2:3:3$

16. In a gas, two waves of wavelengths 1 m and 1.01 m are superposed and produce 10 beats in 3 seconds. The velocity of sound in the medium is

(A) 300 m/s   (B) 336.7 m/s   (C) 360.2 m/s

(D) 270 m/s   (E) 390 m/s

17. Two blocks of masses 8 kg and 4 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of 12 ms^{-1} to the heavier block in the direction of the lighter block. The velocity of the centre of mass is

(A) 12 ms^{-1} (B) 10 ms^{-1} (C) 8 ms^{-1} (D) 6 ms^{-1} (E) 4 ms^{-1}

18. The pressure inside two soap bubbles is 1.01 and 1.02 atmosphere respectively. The ratio of their respective volumes is

(A) 2   (B) 4   (C) 6   (D) 8   (E) 16

19. If α and β are the current gain in the CB and CE configurations respectively of the transistor circuit, then $\dfrac{\beta - \alpha}{\alpha\beta} =$

(A) ∞ (B) 1   (C) 2   (D) 0.5   (E) zero

20. Which of the following sets of quantities have same dimensional formulae?

    (A) Frequency, angular frequency and angular momentum

    (B) Surface tension, stress and spring constant

    (C) Acceleration, momentum and retardation

    (D) Thermal capacity, specific heat and entropy

    (E) Work, energy and torque

21. A varying manetic flux linking a coil is given by $\Phi = Xt^2$. If at time $t=3s$, the emf induced is 9 V, then the value of X is

    (A) 0.66 Wb.s^{-2} (B) 1.5 Wb.s^{-2} (C) –0.66 Wb.s^{-2}

    (D) –1.5 Wb.s^{-2} (E) –0.33 Wb.s^{-2}

22. The apparent frequency of the whistle of an engine changes in the ratio 9:8 as the engine passes a stationary observer. If the velocity of the sound is 340 ms^{-1}, then the velocity of the engine is

    (A) 40 ms^{-1} (B) 20 ms^{-1} (C) 340 ms^{-1} (D) 180 ms^{-1} (E) 50 ms^{-1}

23. The width of a single slit if the first minimum is observed at an angle 2° with a light of wavelength 6980 Å

    (A) 0.2 mm   (B) 2×10^{-5}mm   (C) 2×10^{5}mm   (D) 2 mm   (E) 0.02 mm

24. The number densities of electrons and holes in a pure germanium at room temperature are equal and its value is 3×10^{16} per m^3. On doping with aluminium the hole density increases to 4.5×10^{22} per m^3. Then the electron density in doped germanium is

    (A) 2×10^{10} m^{-3} (B) 5×10^{9} m^{-3} (C) 4.5×10^{9} m^{-3}

    (D) 3×10^{9} m^{-3} (E) 4×10^{10} m^{-3}

25. A metallic surface is irradiated by a monochromatic light of frequency v_1 and stopping potential is found to be V_1. If the light of frequency v_2 irradiates the surface, the stopping potential will be

(A) $V_1 + (h/e)(v_1 + v_2)$ (B) $V_1 + (h/e)(v_2 - v_1)$
(C) $V_1 + (e/h)(v_2 - v_1)$ (D) $V_1 - (h/e)(v_1 + v_2)$
(E) $V_1 - (e/h)(v_2 - v_1)$

26. A 20 kg ball moving with a velocity 6 m/s collides with a 30 kg ball initially at rest. If both of them coalesce, then the final velocity of the combined mass is

(A) 6 m/s   (B) 5 m/s   (C) 3.6 m/s   (D) 2.4 m/s   (E) 1.2 m/s

27. A monkey climbs up and another monkey climbs down a rope hanging from a tree with same uniform acceleration separately. If the respective masses of monkeys are in the ratio 2:3, the common acceleration must be

(A) $g/5$ (B) $6g$ (C) $g/2$ (D) g (E) $g/3$

28. A running man has the same kinetic energy as that of a boy of half his mass. The man speeds up by 2 ms^{-1} and the boy changes his speed by 'x' ms^{-1} so that the kinetic energies of the boy and the man are again equal. Then 'x' in ms^{-1} is

(A) $-2\sqrt{2}$ (B) $+2\sqrt{2}$ (C) $\sqrt{2}$ (D) 2   (E) $1/\sqrt{2}$

29. In artificial radioactivity, 1.414×10^6 nuclei are disintegrated into 10^6 nuclei in 10 minutes. The half life in minutes must be

(A) 5   (B) 20   (C) 15   (D) 30   (E) 25

30. Given is the graph between $\dfrac{PV}{T}$ and P for 1 gram of oxygen gas at two different temperatures T_1 and T_2.
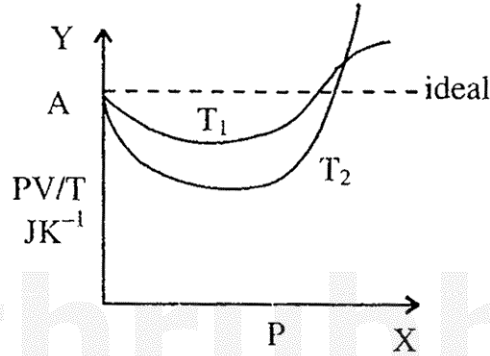
Given: density of oxygen = 1.429 kgm^{-3}. The value of $\dfrac{PV}{T}$ at the point A and the relation between T_1 and T_2 are .... and .... respectively

(A) 0.256 JK^{-1} and $T_1 < T_2$

(B) 8.314 J $mole^{-1}$ K^{-1} and $T_1 > T_2$

(C) 0.256 JK^{-1} and $T_1 > T_2$

(D) 4.28 JK^{-1} and $T_1 < T_2$

(E) 8314 J $mole^{-1}$ K^{-1} and $T_1 < T_2$

31. A network of six identical capacitors, each of value C, is made as shown in the figure.
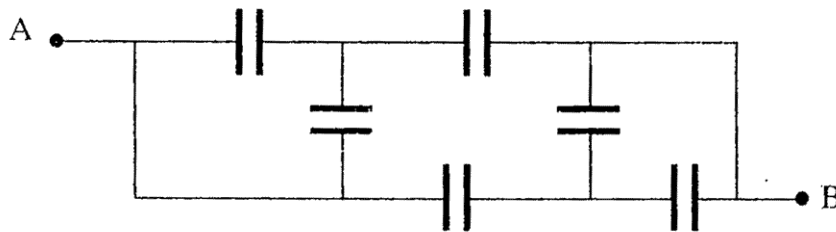
The equivalent capacitance between the points A and B is

(A) C/4   (B) 3C/4   (C) 3C/2   (D) 3C   (E) 4C/3

32. A body travelling along a straight line traversed one-third of the total distance with a velocity V_1. The remaining part of the distance was covered with a velocity V_2 for half the time and with velocity V_3 for the other half of time. The mean velocity averaged over the whole time of motion is

(A) $\dfrac{3V_1(V_2+V_3)}{2V_1+V_2+V_3}$

(B) $\dfrac{3V_1(V_2+V_3)}{4V_1+V_2+V_3}$

(C) $\dfrac{V_1(V_2+V_3)}{4V_1+V_2+V_3}$

(D) $\dfrac{V_1(V_2+V_3)}{V_1+V_2+V_3}$

(E) $\dfrac{3V_1(V_2+V_3)}{V_1+V_2+V_3}$

33. A simple pendulum has a time period T_1 when on the earth's surface and T_2 when taken to a height 2R above the earth's surface where R is the radius of the earth. The value of (T_1 / T_2) is

(A) $\dfrac{1}{9}$ (B) $\dfrac{1}{3}$ (C) $\sqrt{3}$ (D) 9 (E) 3

34. Two electrons (each of charge = e and mass = m) are attached one at each end of light rigid rod of length $2r$. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of angular momentum about the axis of rotation to the magnetic dipole moment of the system is

(A) $\dfrac{2me}{3}$

(B) $\dfrac{e^2}{2m}$

(C) $2 \times$ specific charge of electron

(D) $\dfrac{5m}{2e}$

(E) $\dfrac{2m}{e}$

35. In a thermocouple, the temperature of the cold junction and the neutral temperature are $-40°C$ and $275°C$ respectively. If the cold junction temperature is increased by $60°C$, the neutral temperature and temperature of inversion respectively become

(A) 275°C and 530°C

(B) 355°C and 530°C

(C) 275°C and 590°C

(D) 355°C and 590°C

(E) 275°C and 450°C

36. The amplitude of the sinusoidally oscillating electric field of a plane wave is 60 V/m. Then the amplitude of magnetic field is

(A) 2×10^7 T

(B) 6×10^7 T

(C) 6×10^{-7} T

(D) 2×10^{-7} T

(E) 3×10^8 T

37. A car of mass 1000 kg moves on a circular track of radius 20 m. If the coefficient of friction is 0.64, then the maximum velocity with which the car can move is

(A) 15 m/s

(B) 11.2 m/s

(C) 20 m/s

(D) 18 m/s

(E) 22.4 m/s

38. The speed of electromagnetic wave in a medium of dielectric constant 2.25 and relative permeability 4 is

(A) 1×10^8 m/s

(B) 2.5×10^8 m/s

(C) 2×10^8 m/s

(D) 3×10^8 m/s

(E) 1.5×10^8 m/s

39. Two planets have radii r_1 and r_2 and densities d_1 and d_2 respectively. Then the ratio of acceleration due to gravity on them will be

(A) $r_1 d_1 : r_2 d_2$

(B) $r_1 d_2 : r_2 d_1$

(C) $r_1^2 d_1 : r_2^2 d_2$

(D) $r_1 : r_2$

(E) $r_1 / \sqrt{d_1} : r_2 / \sqrt{d_2}$

40. A physical quantity $P = \dfrac{(\sqrt{abc^2})}{d^3 e^{\frac{1}{3}}}$ is determined by measuring a, b, c, d and e separately with the percentage error of 2%, 3%, 2%, 1% and 6% respectively. Minimum amount of error is contributed by the measurement of

(A) b

(B) a

(C) d

(D) e

(E) c

41. The ratio of the resistance of conductor at temperature 15°C to its resistance at temperature 37.5°C is 4:5. The temperature coefficient of resistance of the conductor is

(A) $\dfrac{1}{25}$ °C^{-1} (B) $\dfrac{1}{50}$ °C^{-1} (C) $\dfrac{1}{80}$ °C^{-1} (D) $\dfrac{1}{75}$ °C^{-1} (E) $\dfrac{1}{40}$ °C^{-1}

42. A mixture of blue and green light of respective wavelengths 4000 Å and 5400 Å falls normally on an air film of 0.3 μm thickness. The film looks

(A) Blue   (B) Violet   (C) Yellow

(D) Green   (E) Bluish Green

43. The momentum of a body is increased by 25%. The kinetic energy is increased by about

(A) 25%   (B) 5%   (C) 56%   (D) 38%   (E) 65%

44. Find the potential difference between the points E and F in the figure given below. Assume E and F are the mid-points of AB and DC respectively
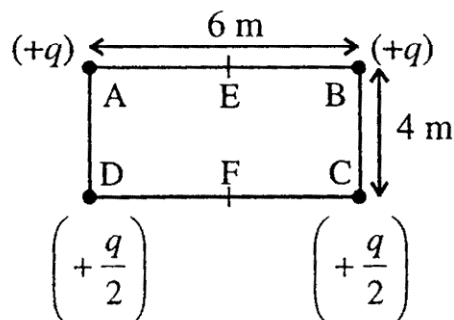

(A) $(1.2 \times 10^9 q)$ Volts   (B) $(1.8 \times 10^9 q)$ Volts

(C) $(10^9 q)$ Volts   (D) $(1.5 \times 10^9 q)$ Volts   (E) $(3 \times 10^9 q)$ Volts

45. Two radioactive materials X_1 and X_2 contain same number of nuclei. If 6λ s^{-1} and 4λ s^{-1} are the decay constants of X_1 and X_2 respectively, the ratio of number of nuclei undecayed of X_1 to that of X_2 after an interval of time $(1/e)$ will be

(A) $\dfrac{1}{2\lambda}$ s (B) $\dfrac{1}{10\lambda}$ s (C) $\dfrac{1}{5\lambda}$ s (D) $\dfrac{1}{\lambda}$ s (E) $\dfrac{1}{8\lambda}$ s

46. A methane molecule CH_4 may be fitted in a cube of side $2a$ such that the C atom lies at the body centre and four H-atoms at non-adjacent corners of the cube as shown in figure. The angle between any two C–H bonds is
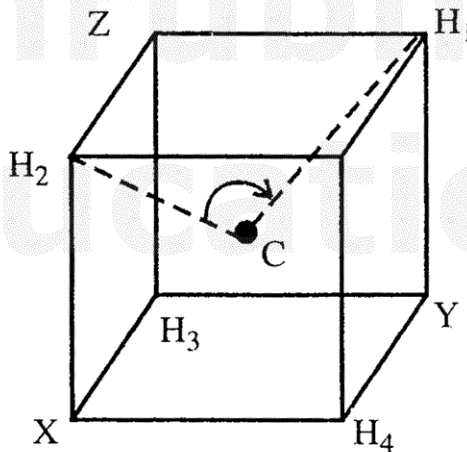
(A) 120° (B) $\cos^{-1}(-1/3)$ (C) 150°

(D) $\sin^{-1}(1/3)$ (E) $\cos^{-1}(1/3)$

47. A 2 kg copper block is heated to 500°C and then it is placed on a large block of ice at 0°C. If the specific heat capacity of copper is 400 J kg^{-1} °C^{-1} and latent heat of fusion of water is 3.5×10^5 J kg^{-1}, the amount of ice that can melt is

(A) 7/8 kg (B) 7/5 kg (C) 8/7 kg (D) 5/7 kg (E) 7/3 kg

**48.** The input resistance of a CE amplifier is 333 Ω and the load resistance is 5 kΩ. A change of base current by 15 μA results in the change of collector current by 1 mA. The voltage gain of the amplifier is

(A) 550 (B) 51 (C) 101 (D) 501 (E) 1001

49. Two identical springs, each of spring constant K, are connected first in series and then in parallel. A mass M is suspended from them. The ratio of the frequencies of vertical oscillations will be

(A) 2:1   (B) 1:1   (C) 1:4   (D) 4:1   (E) 1:2

50. A thin wire of length l and uniform linear mass density ρ is bent into a circular loop with centre at O and radius r as shown below.
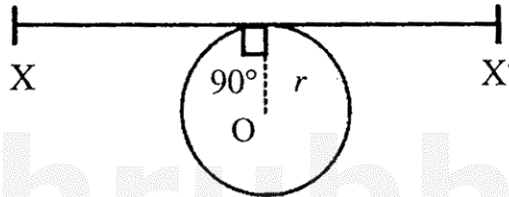
The moment of inertia of the loop about the axis X X′ is

(A) $\dfrac{3\rho l^3}{8\pi^2}$ (B) $\dfrac{\rho l^3}{16\pi^2}$ (C) $\dfrac{3\rho l^3}{8\pi^2 r}$ (D) $\dfrac{\rho l^3}{8\pi^2 r}$ (E) $\dfrac{3\rho l^3}{16\pi^2}$

51. The plane faces of two identical plano-convex lenses each having a focal length of 50 cm are placed against each other to form a usual biconvex lens. The distance from this lens combination at which an object must be placed to obtain a real, inverted image which has the same size as the object is

(A) 50 cm   (B) 25 cm   (C) 100 cm   (D) 40 cm   (E) 125 cm

52. A solid sphere of volume V and density ρ floats at the interface of two immiscible liquids of densities ρ_1 and ρ_2 respectively. If $\rho_1 < \rho < \rho_2$, then the ratio of volume of the parts of the sphere in upper and lower liquids is

(A) $\dfrac{\rho - \rho_1}{\rho_2 - \rho}$ (B) $\dfrac{\rho_2 - \rho}{\rho - \rho_1}$ (C) $\dfrac{\rho + \rho_1}{\rho + \rho_2}$ (D) $\dfrac{\rho + \rho_2}{\rho + \rho_1}$ (E) $\dfrac{\sqrt{\rho_1 \rho_2}}{\rho}$

53. A solenoid of length 30 cm with 10 turns per centimetre and area of cross-section 40 cm^2 completely surrounds another co-axial solenoid of same length, area of cross-section 20 cm^2 with 40 turns per centimetre. The mutual inductance of the system is

(A) 10 H   (B) 8 H   (C) 30 mH   (D) 30 μH   (E) 0.301mH

54. In Young's double slit experiment, white light is used to illuminate two slits, separated by a distance d apart. On the screen in front of one of the slits, certain wavelength is missing. If the distance between the slit and screen is D, the missing wavelength must be

(A) D^2/d (B) $d^2/2D$ (C) d^2/D (D) $D^2/3d$ (E) $2d^2/3D$

55. At a temperature of 30°C, the susceptibility of a ferromagnetic material is found to be χ. Its susceptibility at 333°C is

(A) χ (B) 0.5 χ (C) 2 χ (D) 11.1 χ (E) 0.09 χ

56. To cover a population of 20 lakh, a transmission tower should have a height… (Radius of earth = 6400 km, population per square km = 1000)

(A) 25 m (B) 50 m (C) 75 m (D) 100 m (E) 39 m

57. Two identical air core capacitors are connected in series to a voltage source of 15 V. If one of the capacitors is filled with a medium of dielectric constant 4, the new potential across this capacitor is

(A) 5 V (B) 8 V (C) 10 V (D) 12 V (E) 3 V

58. The range of frequencies allotted for FM radio is

(A) 88 to 108 kHz (B) 88 to 108 MHz (C) 47 to 230 kHz

(D) 47 to 230 MHz (E) 470 to 960 MHz

59. A string of density 7.5 g cm^{-3} and area of cross-section 0.2 mm^2 is stretched under a tension of 20 N. When it is plucked at the mid-point, the speed of the transverse wave on the wire is

(A) 116 ms^{-1} (B) 40 ms^{-1} (C) 200 ms^{-1} (D) 80 ms^{-1} (E) 5900 ms^{-1}

60. In co-axial cable the material used as spacer is

(A) teflon (or) polyethylene   (B) glass or mica

(C) a gaseous medium   (D) glass   (E) mica

61. A work of 2×10^{-2} J is done on a wire of length 50 cm and area of cross-section 0.5 mm^2. If the Young's modulus of the material of the wire is 2×10^{10} Nm^{-2}, then the wire must be

(A)   elongated to 50.1414 cm

(B)   contracted by 2.0 mm

(C)   stretched by 0.707 mm

(D)   of length changed to 49.293 cm

(E)   of length changed to 50.2 cm

62. Refer to the figure. All the surfaces are frictionless. The strings are massless and inextensible.
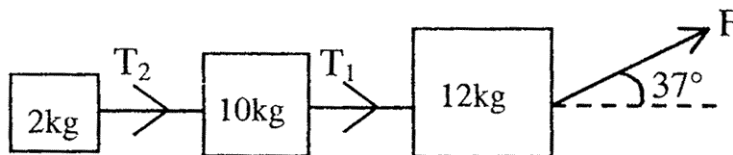

The ratio of tensions T_1 and T_2 is

(A) 1:5   (B) 5:1   (C) 1:1   (D) 6:1   (E) 1:6

63. Two identical cells whether connected in parallel or in series gives the same current when connected to an external resistance 1.5 Ω. Find the value of internal resistance of each cell

(A) 1 Ω   (B) 0.5 Ω   (C) zero   (D) 2 Ω   (E) 1.5 Ω

64. The binding energy per nucleon for deuteron and helium are 1.1 MeV and 7.0 MeV. The energy released when two deuterons fuse to form a helium nucleus is

(A) 23.6 MeV   (B) 2.2 MeV   (C) 30.2 MeV

(D) 3.6 MeV   (E) 28.0 MeV

65. If the two vectors $A = 2i + 3j + 4k$ and $B = i + 2j - nk$ are perpendicular then the value of n is

(A) 1   (B) 2   (C) 3   (D) 4   (E) 5

66. Force between two identical charges placed at a distance of r in vacuum is F. Now a slab of dielectric of dielectric constant 4 is inserted between these two charges. If the thickness of the slab is $r/2$, then the force between the charges will become

(A) F   (B) $\dfrac{3}{5}F$ (C) $\dfrac{4}{9}F$ (D) $\dfrac{F}{4}$ (E) $\dfrac{F}{2}$

67. A stone of mass m tied to a string of length l is rotating along a circular path with constant speed v. The torque on the stone is

(A) mlv (B) $\dfrac{mv}{l}$ (C) $\dfrac{mv^2}{l}$ (D) mv^2l (E) zero

68. A copper disc of radius 0.1 m is rotated about its centre with 20 revolutions per second in a uniform magnetic field of 0.1 T with its plane perpendicular to the field. The emf induced across the radius of the disc is

(A) $\dfrac{\pi}{20}$ volt   (B) $\dfrac{\pi}{10}$ volt   (C) 20π milli volt

(D) 10π milli volt   (E) 2π milli volt

69. Water rises in a capillary tube to a height h. Choose FALSE statement regarding capillary rise from the following

    (A) On the surface of Jupiter, height will be less than h.

    (B) In a lift moving up with constant accelaration, height is less than h.

    (C) On the surface of moon, the height is more than h.

    (D) In a lift moving down with constant acceleration, height is less than h.

    (E) At the poles, height is less than that at equator.

70. A magnetised wire of magnetic moment M and length L is bent in the form of a semi circle of radius r. The new magnetic moment is

    (A) M (B) $\dfrac{M}{2\pi}$ (C) $\dfrac{M}{\pi}$ (D) $\dfrac{2M}{\pi}$ (E) zero

71. A proton, a deuteron and an alpha particle with the same kinetic energy enter a region of uniform magnetic field B at right angles to the field. The ratio of the radii of their circular paths is

    (A) $1:1:1$ (B) $1:\sqrt{2}:\sqrt{2}$ (C) $\sqrt{2}:1:1$

    (D) $\sqrt{2}:\sqrt{2}:1$ (E) $1:\sqrt{2}:1$

72. LANDSAT series of satellites move in near polar orbits at an altitude of

    (A) 3600 km (B) 3000 km (C) 918 km

    (D) 512 km (E) 9200 km

73. The addition of Br_2 to (E)-but-2-ene gives

(A) (R,R)-2,3-Dibromobutane

(B) (S,S)-2,3-Dibromobutane

(C) (R,S)-2,3-Dibromobutane

(D) A mixture of (R,R) and (S,S) -2,3-Dibromobutane

(E) (R,S)-2,3-Dibromocyclobutane

74. The following homogeneous gaseous reactions were experimentally found to be second order overall

1. $2NO \rightarrow N_2 + O_2$

2. $3O_2 \rightarrow 2O_3$

3. $N_2O_3 \rightarrow NO + NO_2$

4. $H_2 + I_2 \rightarrow 2HI$
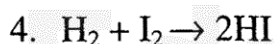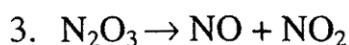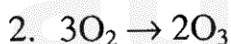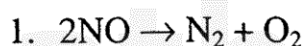
Which of these are most likely to be elementary reactions that occur in one step?

(A) 3 only   (B) 1 and 3   (C) 1 and 4   (D) 3 and 4   (E) 1, 2 and 3

75. The successive ionization energy values for an element 'X' are given below.

(a) 1st Ionisation energy   = 410 kJ mol^{-1}

(b) 2nd Ionisation energy   = 820 kJ mol^{-1}

(c) 3rd Ionisation energy   = 1100 kJ mol^{-1}

(d) 4th Ionisation energy   = 1500 kJ mol^{-1}

(e) 5th Ionisation energy   = 3200 kJ mol^{-1}

Find out the number of valence electron for the atom, 'X'

(A) 4   (B) 3   (C) 5   (D) 2   (E) 1

76. Two gas bulbs A & B are connected by a tube having a stopcock. Bulb A has a volume of 100 mL and contains hydrogen. After opening the gas from A to the evacuated bulb B the pressure falls down by 40%. The volume (mL) of B must be

(A) 75   (B) 150   (C) 125   (D) 200   (E) 250

77. Match list I with list II and select the correct answer using the codes given below the lists

List I : Metal ions	List II : Magnetic moment (B.M.)
1. Cr^{3+}	a. $\sqrt{35}$
2. Fe^{2+}	b. $\sqrt{30}$
3. Ni^{2+}	c. $\sqrt{24}$
4. Mn^{2+}	d. $\sqrt{15}$
	e. $\sqrt{8}$

Codes:
(A) 1 – a, 2 – c, 3 – e, 4 – d   (B) 1 – b, 2 – c, 3 – e, 4 – a
(C) 1 – d, 2 – c, 3 – e, 4 – a   (D) 1 – d, 2 – e, 3 – c, 4 – a
(E) 1 – e, 2 – a, 3 – b, 4 – c

78. The number of optical isomers of $CH_3CH(OH)CH(OH)CHO$ is

(A) Zero   (B) 2   (C) 3   (D) 4   (E) 6

79. For which of the following sparingly soluble salt, the solubility (S) and solubility product (K_{sp}) are related by the expression $S = (K_{sp}/4)^{1/3}$

(A) $BaSO_4$ (B) $Ca_3(PO_4)_2$

(C) Hg_2Cl_2 (D) Ag_3PO_4 (E) CuS

80. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$, ΔH and ΔS are –283 kJ and –87 JK^{-1}, respectively. It was intended to carry out this reaction at 1000, 1500, 3000 and 3500 K. At which of these temperatures would this reaction be thermodynamically spontaneous?

(A) 1500 and 3500 K   (B) 3000 and 3500 K
(C) 1000, 1500 and 3000 K   (D) 1500, 3000 and 3500 K
(E) At all these temperatures

81. At certain temperature a 5.12% solution of cane sugar is isotonic with a 0.9% solution of an unknown solute. The molar mass of solute is

(A) 60   (B) 46.17   (C) 120   (D) 90   (E) 92.34

82. Which of the following is true in respect of adsorption?

(A) $\Delta G < 0$; $\Delta S > 0$; $\Delta H < 0$

(B) $\Delta G < 0$; $\Delta S < 0$; $\Delta H < 0$

(C) $\Delta G > 0$; $\Delta S > 0$; $\Delta H < 0$

(D) $\Delta G < 0$; $\Delta S < 0$; $\Delta H > 0$

(E) $\Delta G > 0$; $\Delta S > 0$; $\Delta H > 0$

83. Lead is the final product formed by a series of changes in which the rate determining stage is the radioactive decay of Uranium-238. This radioactive decay is first order reaction with a half life of 4.5×10^9 years. What would be the age of a rock sample originally lead free, in which the molar proportion of uranium to lead is now 1:3?

(A) 1.5×10^9 years (B) 2.25×10^9 years (C) 4.5×10^9 years

(D) 9.0×10^9 years (E) 13.5×10^9 years

84. If (x/m) is the mass of adsorbate adsorbed per unit mass of adsorbent, p is the pressure of the adsorbate gas and "a" and "b" are constants, which of the following represents "Langmuir adsorption isotherm"?

(A) $\log\left(\dfrac{x}{m}\right) = \log\left(\dfrac{a}{b}\right) + \dfrac{1}{a}\log p$ (B) $\dfrac{x}{m} = \dfrac{b}{a} + \dfrac{1}{ap}$

(C) $\dfrac{x}{m} = \dfrac{1+bp}{ap}$ (D) $\dfrac{1}{(x/m)} = \dfrac{a}{b} + \dfrac{p}{a}$

(E) $\dfrac{1}{(x/m)} = \dfrac{b}{a} + \dfrac{1}{ap}$

85. The amine which will not liberate nitrogen on reaction with nitrous acid is

(A) trimethyl amine (B) ethyl amine

(C) sec-butyl amine (D) t-butyl amine (E) iso-propyl amine

86. 5.6 g of an organic compound on burning with excess of oxygen gave 17.6 g of CO_2 and 7.2 g of H_2O. The organic compound is

(A) C_6H_6 (B) C_4H_8 (C) C_3H_8 (D) CH_3COOH (E) CH_3CHO

87. One mole of acidified $K_2Cr_2O_7$ on reaction with excess KI will liberate ----- mole(s) of I_2

   (A) 6   (B) 1   (C) 7   (D) 2   (E) 3

88. Which of the following exists as zwitter ion?

   (A) p-Aminophenol   (B) Salicyclic acid

   (C) Sulphanilic acid   (D) Ethanolamine

   (E) p-Amino acetophenone

89. Match the lists I and II and pick the correct matching from the codes given below

List I	List II
a. Thymine	1. Pyrimidine base
b. Thiamine	2. Enzyme
c. Insulin	3. Cell wall component
d. Pepsin	4. Hormone
e. Phospholipids	5. Vit B_1

   (A) a – 4 ; b – 3 ; c – 1 ; d – 5 ; e – 2

   (B) a – 5 ; b – 3 ; c – 4 ; d – 1 ; e – 2

   (C) a – 3 ; b – 2 ; c – 1 ; d – 5 ; e – 4

   (D) a – 2 ; b – 4 ; c – 1 ; d – 3 ; e – 5

   (E) a – 1 ; b – 5 ; c – 4 ; d – 2 ; e – 3

90. The halogen compound which most readily undergoes nucleophilic substitution is

   (A) $CH_2=CHCl$ (B) $CH_3CH=CHCl$

   (C) $CH_2=CHC(Cl)=CH_2$ (D) $CH_2=CHCH_2Cl$ (E) C_6H_5Cl

91. Given the standard reduction potentials $Zn^{2+}/Zn = -0.74$ V, $Cl_2/Cl^- = 1.36$ V, $H^+/\frac{1}{2}H_2 = 0$ V and $Fe^{2+}/Fe^{3+} = 0.77$ V. The order of increasing strength as reducing agent is

   (A) Zn, H_2, Fe^{2+}, Cl^- (B) H_2, Zn, Fe^{2+}, Cl^-

   (C) $Cl^- Fe^{2+}, Zn, H_2$ (D) H_2, Fe^{2+}, Cl^-, Zn

   (E) Cl^-, Fe^{2+}, H_2, Zn

92. An exothermic chemical reaction proceeds by two stages

$$\text{reactants} \xrightarrow{\text{stage 1}} \text{intermediate} \xrightarrow{\text{stage 2}} \text{products}$$
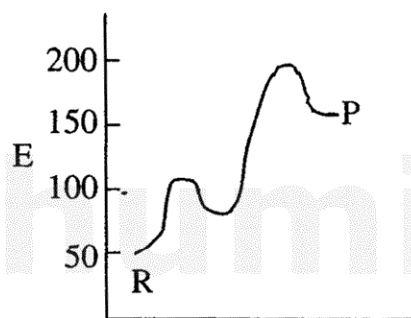
The activation energy of stage 1 is 50 kJ mol^{-1}. The overall enthalpy change of the reaction is -100 kJ mol^{-1}. Which diagram could represent the energy level diagram for the reaction?
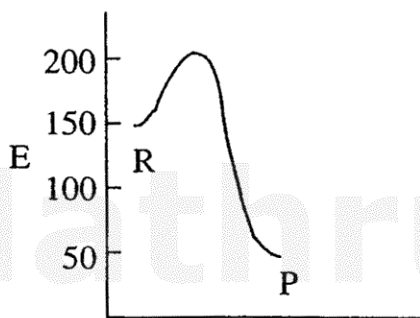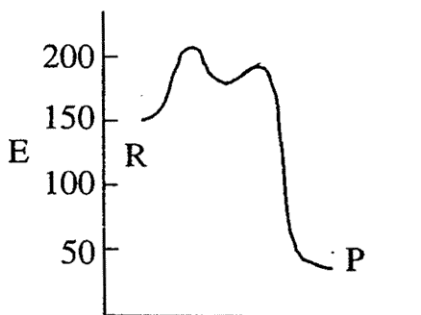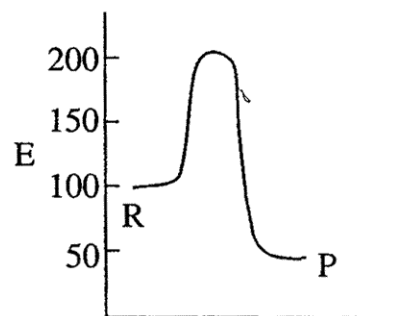

(A)

(B)

(C)

(D)
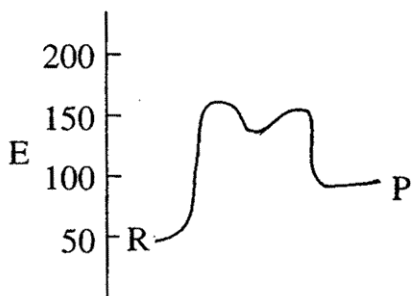
(E)

93. Match list I with list II and select the correct answer using the codes given below the lists

List I: Type of Ore	List II: Example
1. Oxide ore	a. Feldspar
2. Sulphide ore	b. Barytes
3. Sulphate ore	c. Fluorspar
4. Halide ore	d. Galena
	e. Corundum

Codes:

(A) 1–a, 2–e, 3–b, 4–c   (B) 1–b, 2–d, 3–c, 4–a

(C) 1–b, 2–d, 3–e, 4–a   (D) 1–e, 2–b, 3–d, 4–c

(E) 1–e, 2–d, 3–b, 4–c

94. Consider the following halogen containing compounds

a. $CHCl_3$ b. CCl_4 c. CH_2Cl_2 d. CH_3Cl e. $Cl-\langle O \rangle-Cl$
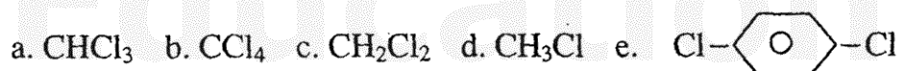
The compounds with a net zero dipole moment are

(A) b and e only   (B) c only   (C) c and d only   (D) a and d only   (E) b only

95. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta H = -93.6$ kJ mol^{-1}, the concentration of H_2 at equilibrium can be increased by

(1) lowering the temperature

(2) increasing the volume of the system

(3) adding N_2 at constant volume

(4) adding H_2 at constant volume

(A) (2) and (4) are correct   (B) (2) only is correct

(C) (1), (2) and (3) are correct   (D) (3) and (4) are correct

(E) (4) only is correct

96. Which of the following is bacteriostatic?

(A) Penicillin   (B) Erythromycin   (C) Amino glycodine

(D) Ofloxacin   (E) Bithional

97. Which one of the following set of quantum numbers is NOT possible for an electron in the ground state of an atom with atomic number 19?

(A) $n = 2, l = 0, m = 0$

(B) $n = 2, l = 1, m = 0$

(C) $n = 3, l = 1, m = -1$

(D) $n = 3, l = 2, m = +2$

(E) $n = 4, l = 0, m = 0$

98. Match list I and list II and pick out correct matching codes from the given choices

List I : Compound	List II : Structure
(a) ClF_3	1. Square planar
(b) PCl_5	2. Tetrahedral
(c) IF_5	3. Trigonal bipyramidal
(d) CCl_4	4. Square pyramidal
(e) XeF_4	5. T-shaped

(A) (a)–5, (b)–4, (c)–3, (d)–2, (e)–1   (B) (a)–5, (b)–3, (c)–4, (d)–2, (e)–1

(C) (a)–5, (b)–3, (c)–4, (d)–1, (e)–2   (D) (a)–4, (b)–3, (c)–5, (d)–2, (e)–1

(E) (a)–3, (b)–4, (c)–1, (d)–5, (e)–2

99. The sequence that **correctly** describes the relative bond strength pertaining to oxygen molecule and its cation or anions is

(A) $O_2^{2-} > O_2^- > O_2 > O_2^+$ (B) $O_2 > O_2^+ > O_2^- > O_2^{2-}$

(C) $O_2^+ > O_2 > O_2^{2-} > O_2^-$ (D) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(E) $O_2 > O_2^- > O_2^{2-} > O_2^+$

100. The hybrid rocket propellant consists of
(A) acrylic rubber and liquid nitrogen tetroxide
(B) polyurethane and ammonium perchlorate
(C) nitroglycerine and nitrocellulose
(D) liquid hydrogen and liquid oxygen
(E) hydrogen peroxide

101. The orbital angular momentum of an electron revolving in a p-orbital is

(A) zero (B) $\dfrac{h}{\sqrt{2}\pi}$ (C) $\dfrac{h}{2\pi}$ (D) $\dfrac{1}{2}\dfrac{h}{2\pi}$ (E) $\dfrac{h}{2\sqrt{2}\pi}$

102. Boric acid is used in carom boards for smooth gliding of pawns because

(A) H_3BO_3 molecules are loosely chemically bonded and hence soft

(B)   Its low density makes it fluffy

(C)   It can be powdered to a very small grain size

(D)   It is chemically inert with the plywood

(E)   H-bonding in H_3BO_3 gives it a layered structure

103. Consider the following molecules or ions

(a) CH_2Cl_2

(b) NH_4^+

(c) SO_4^{2-}

(d) ClO_4^-

(e) NH_3

sp^3 hybridization is involved in the formation of

(A) (a) (b) (e) only (B) (a) (b) only (C) (b) only

(D) (a) (b) (c) (d) only (E) (a) (b) (c) (d) & (e)

104. Gases X,Y, Z, P and Q have the van der Waals' constants a and b (in CGS units) as shown below

	X	Y	Z	P	Q
a	6	6	20	0.05	30
b	0.025	0.15	0.1	0.02	0.2

The gas with the highest critical temperature is

(A) P (B) Q (C) Y (D) Z (E) X

105. How many optically active stereoisomers are possible for butane-2, 3-diol?

    (A) 0   (B) 1   (C) 2   (D) 3   (E) 4

106. We can drive any thermodynamically forbidden reaction in the desired direction by coupling with

    (A) Highly exothermic reaction

    (B) Highly endothermic reaction

    (C) Highly exergonic reaction

    (D) Highly endoergonic reaction

    (E) Reaction with large positive ΔS values

107. Which of the following statements regarding the S_N1 reaction shown by alkyl halide is not correct?

    (A) The added nucleophile plays no kinetic role in S_N1 reaction

    (B) The S_N1 reaction involves the inversion of configuration of the optically active substrate

    (C) The S_N1 reaction on the chiral starting material ends up with racemization of the product

    (D) The more stable the carbocation intermediate the faster the S_N1 reaction

    (E) Polar protic solvent increases the rate of S_N1 reaction

108. Pick out the statement(s) which is(are) not true about the diagonal relationship of Li and Mg

    (a) Polarising powers of Li^+ and Mg^{+2} are almost same

    (b) Like Li, Mg decomposes water very fast

    (c) LiCl and $MgCl_2$ are deliquescent

    (d) Like Li, Mg readily reacts with liquid bromine at ordinary temperature

    (A) (a) and (d)   (B) (b) and (c)   (C) only (b)

    (D) only (a)   (E) (b) and (d)

109. Which of the following concentration terms is / are independent of temperature?

(A) molarity

(B) molarity and mole fraction

(C) mole fraction and molality

(D) molality and normality

(E) only molality

110. Which one of the following has the highest molar conductivity?

(A) Diamminedichloroplatinum(II)

(B) Tetraamminedichlorocobalt(III) chloride

(C) Potassium hexacyanoferrate(II)

(D) Hexaaquochromium(III) bromide

(E) Pentacarbonyliron(0)

111. One mole of magnesium in the vapour state absorbed 1200 kJ mol^{-1} of energy. If the first and second ionization energies of Mg are 750 and 1450 kJ mol^{-1} respectively, the final composition of the mixture is

(A) 31% Mg^+ + 69% Mg^{2+}

(B) 69% Mg^+ + 31% Mg^{2+}

(C) 86% Mg^+ + 14% Mg^{2+}

(D) 14% Mg^+ + 86% Mg^{2+}

(E) 13% Mg^+ + 87% Mg^{2+}

112. Which one of the following equations does NOT correctly represent the first law of thermodynamics for the given processes?

(A) Isothermal process : $q = -w$

(B) Cyclic process : $q = -w$

(C) Isochoric process : $\Delta E = q$

(D) Adiabatic process : $\Delta E = -w$

(E) Expansion of a gas into vacuum : $\Delta E = q$

113. Which of the following complexes are NOT correctly matched with the hybridization of their central metal ion?

    1. $[Ni(CO)_4]$ sp^3

    2. $[Ni(CN)_4]^{2-}$ sp^3

    3. $[COF_6]^{3-}$ d^2sp^3

    4. $[Fe(CN)_6]^{3-}$ sp^3d^2

Select the correct answer using the codes given below

(A) 1 and 2   (B) 1 and 3   (C) 2 and 4   (D) 1, 3 and 4   (E) 2, 3 and 4

114. During the transformation of $^bX_a \rightarrow {}^dY_c$ the number of β-particles emitted is

(A) $(b-d)/4$ (B) $(c-a) + ½(b-d)$

(C) $(a-c) - ½(b-d)$ (D) $(b-d) + 2(c-a)$

(E) $(b-d) + ½(c-a)$

115. The Markovnikov's rule is best applicable to the reaction between

(A) $C_2H_4 + HCl$ (B) $C_3H_6 + Br_2$ (C) $C_3H_6 + HBr$

(D) $C_3H_8 + Cl_2$ (E) $C_2H_4 + I_2$

116. Phenol can be distinguished from ethanol by the following reagents except

(A) Sodium   (B) $NaOH/I_2$

(C) Neutral $FeCl_3$ (D) Br_2/H_2O

(E) Phthalic anhydride / conc. H_2SO_4 and NaOH

117. The enol form of acetone after treatment with D_2O, gives

    (A)   (B)   (C)

    (D)   (E)

118. Consider the following compounds

    a. chloroethene

    b. benzene

    c. 1,3-butadiene

    d. 1,3,5-hexatriene

All the carbon atoms are sp^2 hybridised in

(A) a,c,d only   (B) a, b only   (C) b, c, d only

(D) c, d only   (E) a, b, c & d

119. An alkene on reductive ozonolysis gives 2-molecules of $CH_2(CHO)_2$. The alkene is

(A) 2, 4-Hexadiene   (B) 1, 3-Cyclohexadiene

(C) 1, 4-Cyclohexadiene   (D) 1-Methyl-1, 3-Cyclopentadiene

(E) 1, 2-Dimethyl cyclopropene

120. Which of the following statements are correct concerning redox properties?

1. A metal M for which E^0 for the half reaction $M^{n+}+ne^- \rightleftharpoons M$ is very negative will be a good reducing agent.

2. The oxidizing power of the halogens decreases from chlorine to iodine.

3. The reducing power of hydrogen halides increases from hydrogen chloride to hydrogen iodide.

(A) 1, 2 and 3   (B) 1 and 2   (C) 1 only

(D) 2 and 3 only   (E) 3 only