WARNING :	Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.

PAPER – I CHEMISTRY & PHYSICS

Version Code		Question Booklet Serial Number	
Time : 150 Minutes		Number of Questions : 120	Maximum Marks : 480
Name of Candidate			
Roll Number			
Signature of Candidate			

INSTRUCTIONS TO THE CANDIDATE

1. Please ensure that the **VERSION CODE shown at the top of this Question Booklet is the same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different **VERSION CODE**, please get it replaced with a Question Booklet with the same VERSION CODE as that of the OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**

2. Please fill in the items such as name, signature and roll number of the candidate in the columns given above. Please also write the Question Booklet Sl. No. given at the top of this page against item 4 in the OMR Answer Sheet.

3. Please read the instructions given in the OMR Answer Sheet for marking answers. Candidates are advised to strictly follow the instructions contained in the OMR Answer Sheet.

4. This Question Booklet contains 120 Questions. For each Question, five answers are suggested and given against (A), (B), (C), (D) and (E) of which, only one will be the **Most Appropriate Answer.** Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black ball - point pen only.**

5. Negative Marking: In order to discourage wild guessing, the score will be subject to penalization formula based on the number of right answers actually marked and the number of wrong answers marked. Each correct answer will be awarded FOUR marks. One mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.

IMMEDIATELY AFTER OPENING THIS QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET ISSUED CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO

PLEASE ENSURE THAT THIS BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120 (Printed Pages : 32)

1. Among the following which are ambidentate ligands?
    a. NO_2^- b. NO_3^- c. $EDTA^{4-}$
    d. $C_2O_4^{2-}$ e. SCN^- f. $H_2NCH_2CH_2NH_2$

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

2. In the complex with formula $MCl_3.4H_2O$, the coordination number of the metal M is six and there is no molecule of hydration in it. The volume of 0.1 M $AgNO_3$ solution needed to precipitate the free chloride ions in 200 mL of 0.01 M solution of the complex is
    (A) 40 mL   (B) 20 mL   (C) 60 mL
    (D) 80 mL   (E) 10 mL

3. The enolic form of butanone contains
    (A) 12 σ bonds, 1 π bond and 2 lone pairs of electrons
    (B) 11 σ bonds, 1 π bond and 2 lone pairs of electrons
    (C) 12 σ bonds, 1 π bond and 1 lone pairs of electrons
    (D) 10 σ bonds, 2 π bonds and 2 lone pairs of electrons
    (E) 13 σ bonds, 1 π bond and 2 lone pairs of electrons

4. The Prussian blue colour obtained in the Lassaigne's test for nitrogen is due to the formation of
    (A) iron(II) hexacyanoferrate(III)
    (B) iron(III) hexacyanoferrate(II)
    (C) iron(III) hexacyanoferrate(III)
    (D) iron(II) hexacyanoferrate(II)
    (E) sodium hexacyanoferrate(III)

5. An organic compound whose empirical and molecular formula are same, contains 20% carbon, 6.7% hydrogen, 46.7% nitrogen and the rest oxygen. On heating it yields ammonia, leaving a solid residue. The solid residue gives a violet colour with dilute solution of alkaline copper sulphate. The organic compound is
    (A) NH_2COONH_4 (B) CH_3COONH_4 (C) NH_2NHCHO
   (D) $HCOONH_4$ (E) NH_2CONH_2

Space for Rough Work

6.   Give the IUPAC name of the alkene
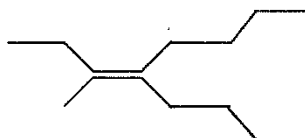
(A)   Z-3-methyl-4-propyl-3-octene
(B)   E-3-methyl-4-propyl-3-octene
(C)   E-4-butyl-3-methyl-3-heptene
(D)   E-2-ethyl-3-propyl-2-heptene
(E)   Z-2-ethyl-3-propyl-2-heptene

7.   Which of the following isomer will have the highest octane number?
(A)   n-octane
(B)   2-methylheptane
(C)   2-methylpentane
(D)   2,2,4-trimethylpentane
(E)   2-methylhexane

8.   From which one of the following, both ethylene and acetylene could be prepared in a single step reaction
(A) CH_3CH_2OH
(B) $Br-CH_2-CH_2-Br$
(C) CH_3CH_2Br
(D) $Br-CH_2-CH_2-OH$
(E) CH_3COOH

9.   The decreasing order of reactivity towards electrophilic substitution reaction of the following compounds is
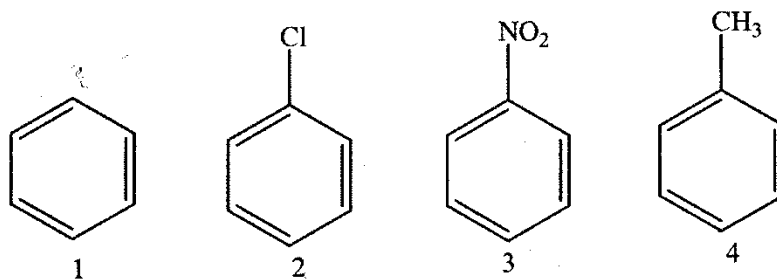

(A) $1 > 3 > 4 > 2$ (B) $4 > 1 > 3 > 2$ (C) $4 > 1 > 2 > 3$
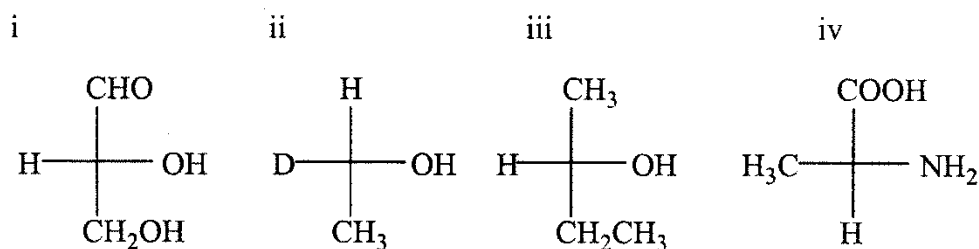(D) $4 > 2 > 1 > 3$ (E) $2 > 4 > 1 > 3$

Space for Rough Work

10. Which among following statements are true with respect to electronic displacement in a covalent bond?
    1) Inductive effect operates through π bond
    2) Resonance effect operates through σ bond
    3) Inductive effect operates through σ bond
    4) Resonance effect operates through π bond
    5) Resonance and inductive effects operate through σ bond
    (A) 3 and 4   (B) 1 and 2   (C) 2 and 4
    (D) 1 and 3   (E) 2 and 3

11. Which of the following is not aromatic?
    (A) Benzene
    (B) Cyclopentadienyl cation
    (C) Cyclopropenyl cation
    (D) Tropylium cation
    (E) Cyclopentadienyl anion

12. Which among the following compound will exhibit optical isomerism?
    (A) tert-butylamine
    (B) sec-butylamine
    (C) Isobutylamine
    (D) n-Butylamine
    (E) Neopentylamine

13. The most stable geometrical isomer among the following is

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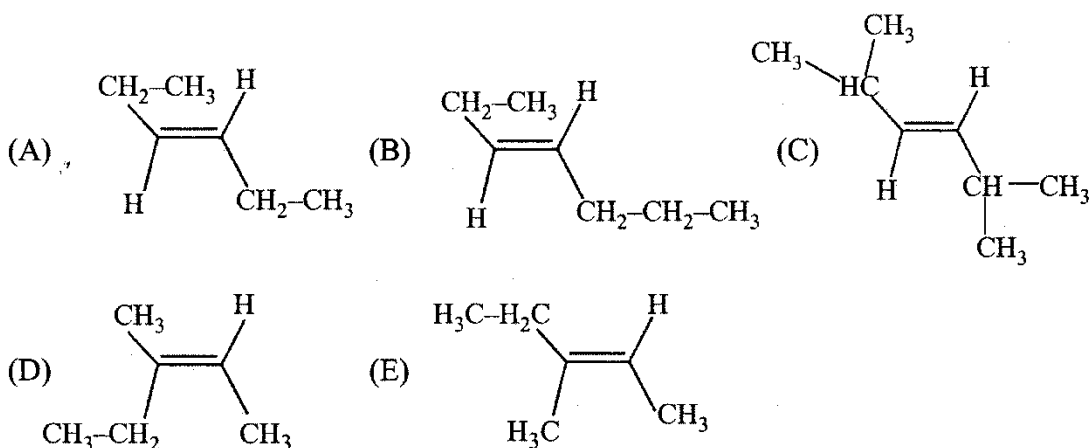
Space for Rough Work

14. The R-isomers among the following are

i	ii	iii	iv

i:
$$CHO$$
$$H—\!\!|\!\!—OH$$
$$CH_2OH$$

ii:
$$H$$
$$D—\!\!|\!\!—OH$$
$$CH_3$$

iii:
$$CH_3$$
$$H—\!\!|\!\!—OH$$
$$CH_2CH_3$$

iv:
$$COOH$$
$$H_3C—\!\!|\!\!—NH_2$$
$$H$$

(A) i and ii only
(B) i and iii only
(C) ii and iii only
(D) iii and iv only
(E) i, ii and iv only

15. CCl_4 is a well known fire extinguisher. However after using it to extinguish fire, the room should be well ventilated. This is because

(A) it is flammable at higher temperatures
(B) it is toxic
(C) it produces phosgene by reaction with water vapour at higher temperatures
(D) it is corrosive
(E) it is anaesthetic

16. Which of the following will be least reactive in nucleophilic substitution?

(A) $CH_3–CH_2–CH_2Cl$
(B) $(CH_3)_3CCl$
(C) $CH_3–CHCl–CH_3$
(D) $CH_2=CH–CH_2Cl$
(E) $CH_2=CHCl$

Space for Rough Work

17. The hydrolysis of 2-bromo-3-methylbutane by S_N1 mechanism gives mainly
    (A) 3-methyl-2-butanol
    (B) 2-methyl-2-butanol
    (C) 2,2-dimethyl-2-propanol
    (D) 2-methyl-1-butanol
    (E) 1-pentanol

18. Which of the following pathways produces 2-hexanone?
    (i) 1-hexyne is treated with H_2SO_4, $HgSO_4$ and water
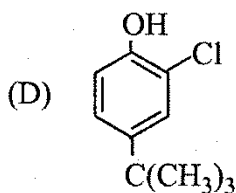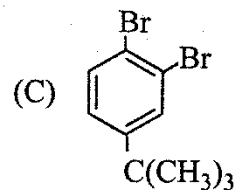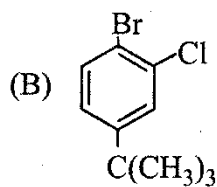   (ii) 3-methyl-2-heptene is treated with O_3 followed by hydrolysis
    (iii) n-butyl magnesium bromide reacts with acetaldehyde followed by hydrolysis and then chromic acid oxidation
    (iv) hydroboration-oxidation of 1-hexyne
    (A) (i) , (ii) and (iii)
    (B) (i) and (ii) only
    (C) (i), (ii) and (iv)
    (D) (i) and (iii) only
    (E) all the four methods

19. When 2-chloro-2-methyl butane is heated with alcoholic KOH, the possible product/s is/are

    (a) $(CH_3)_2C=CHCH_3$ (b) $CH_2=C(CH_3)CH_2CH_3$ (c) $(CH_3)_2CHCH=CH_2$

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

Space for Rough Work

20. Anisole $\xrightarrow[\text{AlCl}_3]{(\text{CH}_3)_3\text{CCl}}$ $\xrightarrow{\text{Cl}_2 / \text{FeCl}_3}$ $\xrightarrow[\text{heat}]{\text{HBr}}$ X
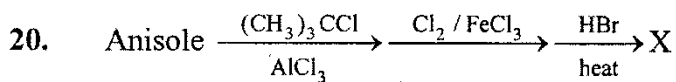
The product 'X' in the above series of reactions is

(A) [structure: benzene ring with OCH₃ at top, Br adjacent, C(CH₃)₃ at bottom]

(B) [structure: benzene ring with Br at top, Cl adjacent, C(CH₃)₃ at bottom]

(C) [structure: benzene ring with Br at top, Br adjacent, C(CH₃)₃ at bottom]

(D) [structure: benzene ring with OH at top, Cl adjacent, C(CH₃)₃ at bottom]

(E) [structure: benzene ring with OCH₃ at top, Cl adjacent, C(CH₃)₃ at bottom]
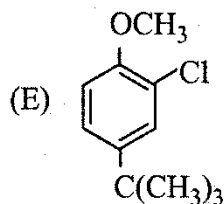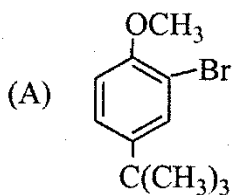
21. Which of the following exists as zwitter ion?
   (A) p-Aminophenol   (B) Sulphanilic acid   (C) Salicylic acid
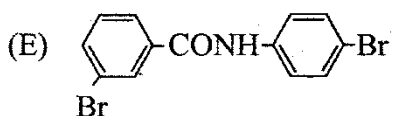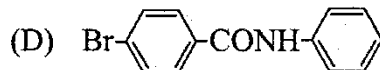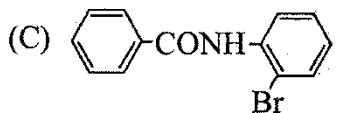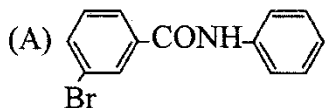   (D) Ethanolamine   (E) p-Amino acetophenone

22. The major product in the reaction of N-phenylbenzamide with Br_2 /Fe is

(A) [structure: phenyl ring with Br—CONH—phenyl]

(B) [structure: phenyl—CONH—phenyl-Br]

(C) [structure: phenyl—CONH—phenyl with Br]

(D) [structure: Br-phenyl—CONH—phenyl]

(E) [structure: Br-phenyl(with Br)—CONH—phenyl-Br]

Space for Rough Work

23. When nitrobenzene is reduced with zinc and methanolic NaOH, the product obtained is

(A) aniline
(B) phenyl hydroxylamine
(C) p-aminophenol
(D) azobenzene
(E) hydrazobenzene

24. Denaturation of protein

(A) disrupts the primary or secondary or tertiary structure of protein
(B) disrupts the secondary and tertiary structures only
(C) disrupts all the primary, secondary and tertiary and even the quaternary structure of protein
(D) will not affect the original biological activity
(E) is always irreversible

25. If one strand of DNA has the sequence ATGCTTGA, the sequence in the complimentary strand would be TACGAACT

(A) TCCGAACT
(B) TACGTAGT
(C) TACGAACT
(D) TACGTAGT
(E) TACGAATC

Space for Rough Work

26. Pick out the incorrect statement(s) from the following
    1. Glucose exists in two different crystalline forms, α-D-glucose and β-D-glucose
    2. α-D-glucose and β-D-glucose are anomers
    3. α-D-glucose and β-D-glucose are enantiomers
    4. Cellulose is a straight chain polysaccharide made of only β-D-glucose units
    5. Starch is a mixture of amylose and amylopectin, both contain unbranched chain of α-D-glucose units

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

27. Which of the following statement is not true?
    (A) Some disinfectants can be used as antiseptic at low concentration
    (B) Sulphadiazine is a synthetic antibacterial
    (C) Pheromones provide chemical means of establishing communication
    (D) Aspirin is analgesic and antipyretic
    (E) Norethindrone is a pheromone

28. The environmental friendly method of killing harmful insects is through the use of
    (A) insecticides
    (B) sex attractants
    (C) sex harmones
    (D) pesticides
    (E) antibiotics

29. The process of 'eutrophication' is due to
    (A) increase in concentration of insecticide in water
    (B) increase in concentration of fluoride ion in water
    (C) the reduction in concentration of the dissolved oxygen in water due to phosphate pollution in water
    (D) attack of younger leaves of a plant by peroxyacetyl nitrate
   (E) increase in concentration of radioactive substances in water

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Space for Rough Work

30. In which one of the following, the number of protons is greater than neutrons but number of protons is less than the number of electrons?

(A) D_3O^+ (B) SO_2 (C) H_2O

(D) S^{2-} (E) OH^-

31. A metal M of equivalent mass E forms an oxide of molecular formula M_xO_y. The atomic mass of the metal is given by the correct equation

(A) $2E\,(y/x)$ (B) xyE (C) E/y

(D) y/E (E) $E/2\,(x/y)$

32. The maximum kinetic energy of photoelectrons ejected from a metal, when it is irradiated with radiation of frequency $2 \times 10^{14}\ s^{-1}$ is 6.63×10^{-20} J. The threshold frequency of the metal is

(A) $2 \times 10^{-14}\ s^{-1}$ (B) $3 \times 10^{14}\ s^{-1}$ (C) $2 \times 10^{14}\ s^{-1}$

(D) $1 \times 10^{-14}\ s^{-1}$ (E) $1 \times 10^{14}\ s^{-1}$

33. Arrange the following ions in the order of decreasing X–O bond length, where X is the central atom in SiO_4^{4-}, ClO_4^-, PO_4^{3-}, SO_4^{2-}

(A) $ClO_4^- > SO_4^{2-} > PO_4^{3-} > SiO_4^{4-}$

(B) $SiO_4^{4-} > PO_4^{3-} > SO_4^{2-} > ClO_4^-$

(C) $SiO_4^{4-} > PO_4^{3-} > ClO_4^- > SO_4^{2-}$

(D) $SiO_4^{4-} > SO_4^{2-} > PO_4^{3-} > ClO_4^-$

(E) $SO_4^{2-} > PO_4^{3-} > ClO_4^- > SiO_4^{4-}$

34. Oxidation number of iodine in IO_3^-, IO_4^- KI and I_2 respectively are

(A) $-1, -1, 0, +1$ (B) $+3, +5, +7, 0$ (C) $+5, +7, -1, 0$

(D) $-1, -5, -1, 0$ (E) $-2, -5, -1, 0$

35. In which of the following ions there is no S–S bond

(A) $S_2O_4^{2-}$ (B) $S_2O_6^{2-}$ (C) $S_2O_2^{2-}$ (D) $S_2O_3^{2-}$ (E) $S_2O_7^{2-}$

Space for Rough Work

36. When a bottle of dry ammonia and a bottle of dry HCl connected through a long tube are opened simultaneously at both ends, at first

(A) a white ring is formed at the centre of the tube
(B) a white ring is formed near the ammonia bottle
(C) entire length of tube turns white
(D) a white ring is formed near HCl bottle
(E) no white ring is formed

37. A 4.0 dm^3 flask containing N$_2$ at 4.0 bar was connected to a 6.0 dm^3 flask containing helium at 6.0 bar, and the gases were allowed to mix isothermally. Then the total pressure of the resulting mixture will be

(A) 10.0 bar   (B) 5.2 bar   (C) 3.6 bar
(D) 1.6 bar   (E) 5.0 bar

38. 4.48 L of an ideal gas at STP requires 12.0 calories to raise its temperature by 15°C at constant volume. The C$_p$ of the gas is

(A) 3 cal   (B) 4 cal   (C) 7 cal
(D) 6 cal   (E) 9 cal

39. In the graph below, the one which represents an alkali metal with the higher atomic number is
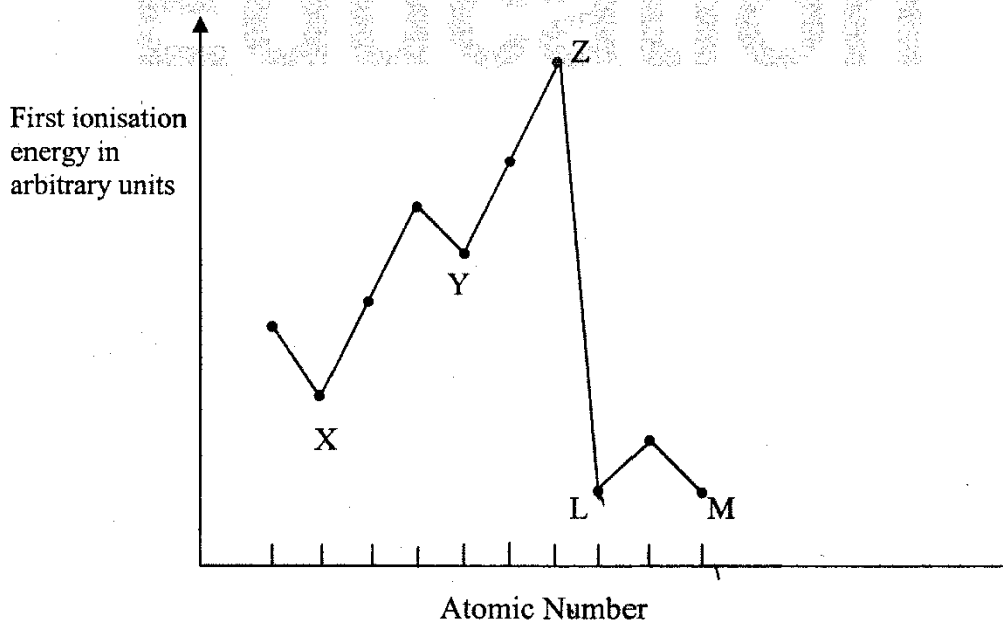
(A) X   (B) Y   (C) Z
(D) L   (E) M

Space for Rough Work

40. Which two elements in the periodic table would you expect to combine in the most violent fashion

(A) H and O
(B) Cl and F
(C) Mg and N
(D) P and O
(E) Cs and F

41. An element 'X' belongs to fourth period and fifteenth group of the periodic table. Which one of the following is true regarding the outer electronic configuration of 'X'? It has

(A) partially filled 'd' orbitals and completely filled 's' orbitals
(B) completely filled 's' orbital and completely filled 'p' orbitals
(C) completely filled 's' orbital and half-filled 'p' orbitals
(D) half-filled 'd' orbitals and completely filled 's' orbitals
(E) completely filled 'd', 's' and 'p' orbitals

42. Which of the following metal is not manufactured by electrolysis?

(A) Na   (B) Mg   (C) Al
(D) Fe   (E) Li

43. The method not used in metallurgy to refine the impure metal is

(A) Mond's process
(B) Van-Arkel process
(C) Amalgamation process
(D) Liquation
(E) Zone-refining

44. Which of the following on thermal decomposition yields a basic as well as an acidic oxide?

(A) $KClO_3$ (B) Na_2CO_3 (C) $NaNO_3$
(D) $CaCO_3$ (E) NH_4NO_3

Space for Rough Work

45. The ion(s) that act/s as oxidizing agent in solution is/are
    (A) Tl^+ and Al^{3+}
    (B) B^{3+} and Al^{3+}
    (C) Tl^{3+} only
    (D) B^{3+} only
    (E) Ti^{3+} only

46. Molecular shapes of SF_4, CF_4 and XeF_4 are
    (A) the same with 1, 1 and 1 lone pairs of electrons respectively on the central atom
    (B) the same with 1, 0 and 2 lone pairs of electrons respectively on the central atom
    (C) different with 0, 1 and 2 lone pairs of electrons respectively on the central atom
    (D) different with 2, 0 and 1 lone pairs of electrons respectively on the central atom
    (E) different with 1, 0 and 2 lone pairs of electrons respectively on the central atom

47. Pick out the stronger reducing agent among the following oxyacids of phosphorus
    (A) hypophosphorous acid   (B) phosphorous acid
    (C) hypophosphoric acid   (D) pyrophosphorous acid
    (E) phosphoric acid

48. A transition metal 'A' has 'spin-only' magnetic moment value of 1.8 BM. When it is reacted with dilute sulphuric acid in the presence of air, its compound 'B' is formed. 'B' reacts with compound 'C' to give compound 'D' with the liberation of iodine. Then the metal A and compounds B, C and D are respectively
    (A) Ti, $TiSO_4$, KI and TiI_2
    (B) Zn, $ZnSO_4$, KI and Zn_2I_2
    (C) Cu, $CuSO_4$, KI and Cu_2I_2
    (D) Cu, $CuSO_4$, Cu_2I_2 and CuI_2
    (E) Cu, $CuSO_4$, KI and CuI_2

Space for Rough Work

49. Which of the following pairs of transition metal ions are the stronger oxidising agents in aqueous solutions?
    (A) V^{2+} and Cr^{2+}
    (B) Ti^{2+} and Cr^{2+}
    (C) Mn^{3+} and Co^{3+}
    (D) V^{2+} and Fe^{2+}
    (E) Ni^{2+} and Fe^{2+}

50. Which one of the following d-block elements has half-filled penultimate d-subshell as well as half-filled valence s-subshell?
    (A) Cr   (B) Pd   (C) Pt
    (D) Cu   (E) Au

51. Which one of the following combinations will give the highest stability to a nucleus with atomic number Z and mass number N ?
    (A) Even Z and odd N
    (B) Odd Z and even N
    (C) Even Z and even N
    (D) Odd Z and odd N
    (E) Same value of Z and N

52. The mass of helium atom is 4.0026 amu, while that of the neutron and proton are 1.0087 and 1.0078 amu respectively on the same scale. Hence, the nuclear binding energy per nucleon in the helium atom is about
    (A) 5 MeV   (B) 12 MeV   (C) 14 MeV
    (D) 10 MeV   (E) 7 MeV

53. The number of β-particles emitted during the change $_a^c X \rightarrow _d^b Y$ is given by

    (A) $\dfrac{2a+b}{4}$ (B) $d+\dfrac{a-2b}{2}+c$ (C) $d+\dfrac{c-b}{2}+a$

    (D) $d+\dfrac{c-b}{2}-a$ (E) $a+\dfrac{c-b}{2}-d$

Space for Rough Work

54. For the hypothetical reversible reaction $\frac{1}{2}A_2(g) + \frac{3}{2}B_2(g) \rightarrow AB_3(g)$ the value of ΔH is $- 20$ kJ mol^{-1} while the values of standard entropies of A_2, B_2 and AB_3 are 60, 40 and 50 JK^{-1} mol^{-1} respectively. The temperature (in Kelvin) at which the above reaction attains equilibrium is

(A) 400   (B) 250   (C) 200
(D) 350   (E) 500

55. Change in internal energy, when 4 kJ of work is done on the system and 1 kJ of heat is given out by the system, is

(A) +1 kJ   (B) −5 kJ   (C) +5 kJ
(D) +3 kJ   (E) −3 kJ

56. Which one of the ions in the table below would have the largest value of enthalpy of hydration?

	Ionic radius in nm	Charge of ion
(A)	0.065	+2
(B)	0.095	+1
(C)	0.135	+2
(D)	0.169	+1
(E)	0.181	−1

57. Number of H$^+$ ions present in 250 ml of lemon juice of pH=3 is

(A) 1.506×10^{22} (B) 1.506×10^{23} (C) 1.506×10^{20}
(D) 3.012×10^{21} (E) 2.008×10^{23}

58. Equimolar concentrations of H_2 and I_2 are heated to equilibrium in a 2 litre flask. At equilibrium, the forward and the backward rate constants are found to be equal. What percentage of initial concentration of H_2 has reacted at equilibrium?

(A) 33%   (B) 66%   (C) 50%
(D) 40%   (E) 20%

59. Which one of the following solutions will have pH close to unity?

(A) 100 ml of M/10 HCl + 100 ml of M/10 of NaOH
(B) 55 ml of M/10 HCl + 45 ml of M/10 of NaOH
(C) 10 ml of M/10 HCl + 90 ml of M/10 of NaOH
(D) 75 ml of M/5 HCl + 25 ml of M/5 of NaOH
(E) 50 ml of M/5 HCl + 50 ml of M/5 of NaOH

Space for Rough Work

60. The geometry at which carbon atoms in diamond are bonded to each other is

(A) linear
(B) tetrahedral
(C) square planar
(D) octahedral
(E) hexagonal

61. Which among the following gas will greatly deviate from Henry's law in water ?
(A) H_2 (B) N_2 (C) CH_4
(D) CO_2 (E) Ar

62. The temperature at which 10% aqueous solution (w/v) of glucose will exhibit the osmotic pressure of 16.4 atm, is (R=0.082 dm^3 atm K^{-1} mol^{-1})
(A) 360° C   (B) 180 K   (C) 90 K
(D) 300 K   (E) 360 K

63. A direct current deposits 54 g of silver (Atomic mass = 108) during the electrolysis reaction. How much aluminium (Atomic mass = 27) would be deposited from aluminium chloride solution by the same amount of electricity ?
(A) 4.5 g   (B) 5.4 g   (C) 54 g
(D) 2.7 g   (E) 27 g

64. The equilibrium constant of the following redox reaction at 298 K is 1×10^8
$$2 Fe^{3+}(aq) + 2I^-(aq) \rightleftharpoons 2 Fe^{2+}(aq) + I_2(s)$$
If the standard reduction potential of iodine becoming iodide is + 0.54 V, what is the standard reduction potential of Fe^{3+}/Fe^{2+}?
(A) + 1.006 V
(B) − 1.006 V
(C) + 0.77 V
(D) − 0.77 V
(E) − 0.652 V

Space for Rough Work

65. A gas P at 1 atm. is bubbled through a solution containing a mixture of 1 M Q⁻ and 1 M R⁻ ions at 25°C. If the E° value for them lie in the order R>Q>P then

(A) Q will oxidize P but not R

(B) Q will oxidize R but not P

(C) Q will oxidize both P and R

(D) Q will reduce both P and R

(E) Q will neither oxidize nor reduce P

66. For a reaction taking place in three steps, the rate constants are k_1, k_2 and k_3. The overall rate constant $k = \dfrac{k_1 k_2}{k_3}$. If the energy of activation values for the first, second and third stages are respectively 40, 50 and 60 kJ mol⁻¹, then the overall energy of activation in kJ mol⁻¹ is

(A) 30   (B) 40   (C) 60

(D) 50   (E) 150

67. Which among the following plots are linear? $(a - x)$ is the concentration of reactant remaining after time, t ?

(1) $(a-x)$ vs t, for a first order reaction

(2) $(a-x)$ vs t, for a zero order reaction

(3) $(a-x)$ vs t, for a second order reaction

(4) $1/(a-x)$ vs t, for a second order reaction

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

(D) 2 and 4   (E) 1 and 4

68. The average molar heat capacities of ice and water are respectively 37.8 J mol⁻¹ and 75.6 J mol⁻¹ and the enthalpy of fusion of ice is 6.012 kJ mol⁻¹. The amount of heat required to change 10 g of ice at − 10°C to water at 10°C would be

(A) 2376 J   (B) 4752 J   (C) 3970 J

(D) 1128 J   (E) 1985 J

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69. Statement: 'To stop bleeding from an injury ferric chloride can be applied.'
Which comment about the statement is justified
(A) It is not true; ferric chloride is a poison
(B) It is true; Fe^{3+} ions coagulate blood which is a negatively charged sol
(C) It is not true; Cl^- ions form positively charged sol; profuse bleeding takes place
(D) It is true; coagulation takes place because of formation of negatively charged sol with Cl^-
(E) It is not true; ferric chloride is ionic and gets into the blood stream

70. Shape-selective catalysis is a reaction catalysed by
(A) zeolites
(B) enzymes
(C) platinum
(D) Zeigler-Natta catalyst
(E) acids or bases

71. In an electrical field, the particles of a colloidal system move towards cathode. The coagulation of the same sol is studied using K_2SO_4(I), Na_3PO_4(II), $K_4[Fe(CN)_6]$(III) and NaCl(IV). Their coagulating power should be

(A) (I) > (II) > (III) > (IV)
(B) (III) > (II) > (I) > (IV)
(C) (III) > (I) > (II) > (IV)
(D) (IV) > (III) > (I) > (II)
(E) (IV) > (I) > (II) > (III)

72. Both geometrical and optical isomerisms are exhibited by
(A) Dichlorobis(ethylenediamine)cobalt(III) ion
(B) Pentaamminechlorocobalt(III) ion
(C) Triamminotrichlorocobalt(III)
(D) Tetraamminedichlorocobalt(III) ion
(E) Trioxalatochromate(III) ion

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73. A spring of force constant k is cut into two pieces such that one piece is double the length of the other. The force constant of the longer piece will be

(A) $1.5k$ (B) $3k$ (C) $2k$ (D) $\frac{2}{3}k$ (E) $\frac{1}{3}k$

74. An organ pipe P closed at one end vibrates in its first harmonic. Another organ pipe Q open at both ends vibrates in its third harmonic. When both are in resonance with a tuning fork, the ratio of the length of P to that of Q is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$ (C) $\frac{1}{6}$ (D) $\frac{1}{8}$ (E) $\frac{1}{3}$

75. A string is hanging from a rigid support. A transverse pulse is excited at its free end. The speed at which the pulse travels a distance x is proportional to

(A) x (B) $\frac{1}{x}$ (C) $\frac{1}{\sqrt{x}}$

(D) x^2 (E) $\sqrt{x}$

76. The direction of electric field intensity $\left(\vec{E}\right)$ at a point on the equatorial line of an electric dipole of dipole moment $\left(\vec{P}\right)$ is

(A) along the equatorial line towards the dipole

(B) along the equatorial line away from the dipole

(C) perpendicular to the equatorial line and opposite to $\vec{P}$

(D) perpendicular to the equatorial line and parallel to $\vec{P}$

(E) along the axial line in the direction of $\vec{P}$

Space for Rough Work

77. Six capacitors each of capacitance of 2 µF are connected as shown in the figure. The effective capacitance between A and B is
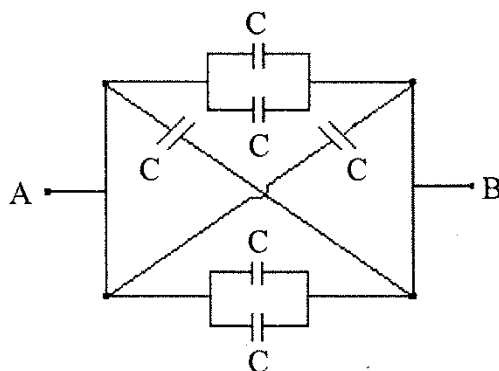
(A) 12 µF   (B) 8/3 µF   (C) 3 µF
(D) 6 µF   (E) 2/3 µF

78. Consider a non-spherical conductor shown in the figure which is given a certain amount of positive charge. The charge distributes itself on the surface such that the charge densities are σ_1, σ_2, and σ_3 at the regions 1, 2 and 3 respectively. Then
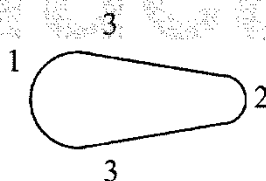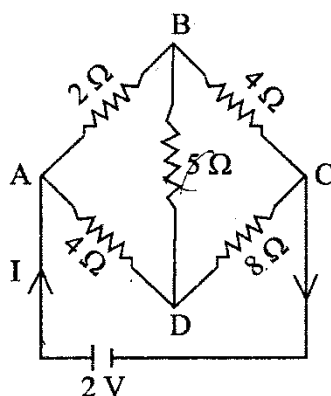

(A) $\sigma_1 > \sigma_2 > \sigma_3$ (B) $\sigma_2 > \sigma_3 > \sigma_1$ (C) $\sigma_3 > \sigma_1 > \sigma_2$
(D) $\sigma_2 > \sigma_1 > \sigma_3$ (E) $\sigma_1 > \sigma_3 > \sigma_2$

79. A carbon resistor is marked with the rings coloured brown, black, green and gold. The resistance in ohm is

(A) $3.2 \times 10^5 \pm 5\%$ (B) $1 \times 10^6 \pm 10\%$ (C) $1 \times 10^7 \pm 5\%$
(D) $1 \times 10^6 \pm 5\%$ (E) $1 \times 10^5 \pm 5\%$

Space for Rough Work

80. In the Wheatstone's network shown in the figure, the current I in the circuit is

(A) 1 A   (B) 2 A   (C) 0.25 A   (D) 0.5 A   (E) 0.33 A

81. A wire of resistance 5.5 ohm is drawn out uniformly so that its length is increased twice. Then its new resistance is

(A) 44 Ω (B) 42 Ω (C) 40 Ω (D) 11 Ω (E) 22 Ω

82. A strong magnetic field is applied on a stationary electron. Then the electron
(A) moves in the direction of the field
(B) remains stationary
(C) moves perpendicular to the direction of the field
(D) begins to spin
(E) moves opposite to the direction of the field

83. The resistance of the shunt required to allow 2% of the main current through the galvanometer of resistance 49 Ω is

(A) 1 Ω (B) 2 Ω (C) 0.2 Ω (D) 0.1 Ω (E) 0.01 Ω

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84. A long wire carrying a steady current is bent into a circle of single turn. The magnetic field at the centre of the coil is B. If it is bent into a circular loop of n turns, the magnetic field at the centre of the coil for the same current is

(A) $2nB$ (B) $2n^2B$ (C) n^2B (D) nB (E) $\dfrac{n}{2}B$

85. The readings of ammeter and voltmeter in the following circuit are respectively
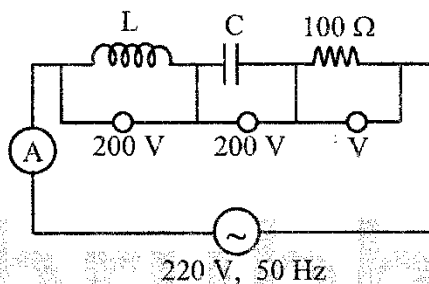
(A) 2 A, 200 V   (B) 1.5 A, 100 V   (C) 2.7 A, 220 V
(D) 1.7 A, 200 V   (E) 2.2 A, 220 V

86. In the transmission of a.c. power through transmission lines, when the voltage is stepped up n times, the power loss in transmission

(A) increases n times
(B) decreases n times
(C) increases n^2 times
(D) decreases n^2 times
(E) decreases n^4 times

87. In an LCR series a.c. circuit, if ω_0 is the resonant angular frequency, then the quality factor (Q-factor) is given by

(A) $\omega_0 L/C$ (B) $(1/R)\sqrt{\dfrac{L}{C}}$ (C) $\omega_0 C/R$

(D) $L/\omega_0 R$ (E) L/CR

Space for Rough Work

88. Given below is a list of electromagnetic spectrum and its mode of production. Which one does not match?

(A) Gamma rays − Radioactive decay of the nucleus ✓
(B) Ultraviolet − Magnetron valve
(C) Infra-red − Vibration of atoms and molecules
(D) Radiowave − Rapid acceleration and deceleration of electrons in conducting wires
(E) X-rays − Coolidge tube

89. The two slits are 1 mm apart from each other and illuminated with a light of wavelength 5×10^{-7} m. If the distance of the screen is 1 m from the slits, then the distance between third dark fringe and fifth bright fringe is

(A) 1.5 mm   (B) 0.75 mm   (C) 1.25 mm
(D) 0.625 mm   (E) 2.5 mm

90. The angle of minimum deviation in an equilateral prism of refractive index 1.414 is

(A) 60° (B) 30° (C) 90° (D) 45° (E) 15°

91. Light is incident on a glass surface at polarising angle of 57.5°. Then the angle between the incident ray and the refracted ray is

(A) 57.5° (B) 115° (C) 65° (D) 145° (E) 205°

92. A proton accelerated through a potential V has de-Broglie wavelength λ. Then the de-Broglie wavelength of an α-particle, when accelerated through the same potential V is

(A) $\dfrac{\lambda}{2}$ (B) $\dfrac{\lambda}{\sqrt{2}}$ (C) $\dfrac{\lambda}{2\sqrt{2}}$

(D) $\dfrac{\lambda}{8}$ (E) $\dfrac{\lambda}{4}$

93. Two radioactive samples have decay constants $15x$ and $3x$. If they have the same number of nuclei initially, the ratio of number of nuclei after a time $\dfrac{1}{6x}$ is

(A) $\dfrac{1}{e}$ (B) $\dfrac{e}{2}$ (C) $\dfrac{1}{e^4}$ (D) $\dfrac{2e}{3}$ (E) $\dfrac{1}{e^2}$

Space for Rough Work

94. If the mass defect of $_8O^{16}$ nucleus is 0.128 amu, then the binding energy per nucleon of oxygen is

(A) 8.2 MeV

(B) 7.45 MeV

(C) 7.3 MeV

(D) 7.1 MeV

(E) 8.15 MeV

**95.** The output Y, when all the three inputs are first high and then low, will respectively be
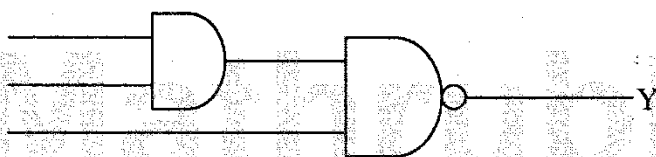
(A) 1, 0　　(B) 1, 1　　(C) 0, 0　　(D) 0, 1　　(E) 1, −1

96. In a common emitter configuration of a transistor, the voltage drop across a 500 Ω resistor in the collector circuit is 0.5 V when the collector supply voltage is 5 V. If the current gain in the common base mode is 0.96, the base current is

(A) $\dfrac{1}{20}\,\mu A$　　(B) $\dfrac{1}{5}\,\mu A$　　(C) $\dfrac{1}{20}\,mA$　　(D) $\dfrac{1}{10}\,mA$　　(E) $\dfrac{1}{24}\,mA$

97. In the given circuit, the current through the resistor 2 kΩ is
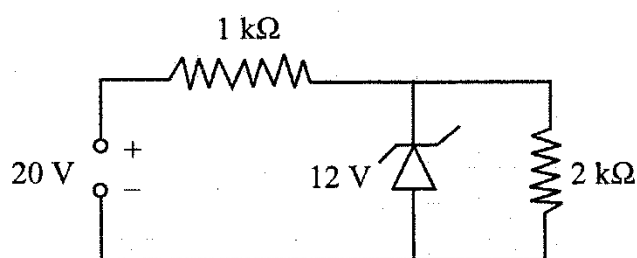
(A) 2 mA　　(B) 4 mA　　(C) 6 mA　　(D) 1 mA　　(E) 10 mA

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98. A transmitting antenna of height h and the receiving antenna of height 45 m are separated by a distance of 40 km for satisfactory communication in line-of-sight mode. Then the value of h is (given radius of earth is 6400 km)

(A) 15 m   (B) 20 m   (C) 30 m

(D) 25 m   (E) 40 m

99. If the critical frequency for sky wave propagation is 12 MHz, then the maximum electron density in the ionosphere is

(A) $1.78 \times 10^{12} / m^3$ (B) $0.178 \times 10^{10} / m^3$ (C) $1.12 \times 10^{12} / m^3$

(D) $0.56 \times 10^{12} / m^3$ (E) $0.148 \times 10^{12} / m^3$

100. A 1000 kHz carrier wave is modulated by an audio signal of frequency range 100-5000 Hz. Then the width of the channel in kHz is

(A) 10   (B) 20   (C) 30   (D) 40   (E) 50

Space for Rough Work

101. Match the following

a.	capacitance	i.	volt (ampere)$^{-1}$
b.	magnetic induction	ii.	volt – sec (ampere)$^{-1}$
c.	inductance	iii.	newton (ampere)$^{-1}$ (metre)$^{-1}$
d.	resistance	iv.	coulomb^2 (joule)$^{-1}$

(A) a – ii , b – iii, c – iv, d – i

(B) a – iv, b – iii, c – ii, d – i

(C) a – iii, b – iv, c – i, d – ii

(D) a – iv, b – i, c – ii, d – iii

(E) a – ii, b – iv, c – i, d – iii

102. A 175 m long train is traveling along a straight track with a velocity 72 kmph. A bird is flying parallel to the train in the opposite direction with a velocity 18 kmph. The time taken by the bird to cross the train is

(A) 35 s   (B) 27 s   (C) 11.6 s

(D) 8.75 s   (E) 7 s

103. Two bodies are thrown vertically upwards with their initial speeds in the ratio 2 : 3. The ratio of the maximum heights reached by them and the ratio of their time taken by them to return back to the ground respectively are

(A) 4 : 9 and 2 : 3   (B) 2 : 3 and √2 : √3   (C) √2 : √3 and 4 : 9

(D) √2 : √3 and 2 : 3   (E) 4 : 9 and √2 : √3

104. When a ceiling fan is switched off, its angular velocity reduces to half its initial value after it completes 36 rotations. The number of rotations it will make further before coming to rest is (Assume angular retardation to be uniform)

(A) 10   (B) 20   (C) 18

(D) 12   (E) 16

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105. Two particles starting from a point on a circle of radius 4 m in horizontal plane move along the circle with constant speeds of 4 ms⁻¹ and 6 ms⁻¹ respectively in opposite directions. The particles will collide with each other after a time of
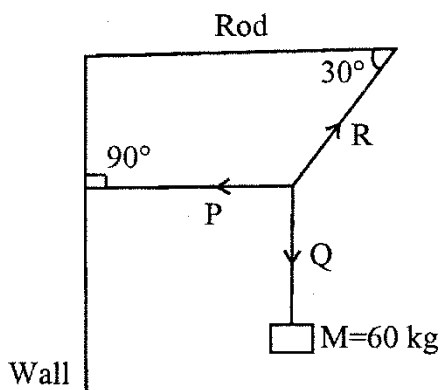
(A) 3.0 s   (B) 2.5 s   (C) 2.0 s

(D) 1.5 s   (E) 3.5 s

106. Two blocks of masses 7 kg and 5 kg are placed in contact with each other on a smooth surface. If a force of 6 N is applied on the heavier mass, the force on the lighter mass is
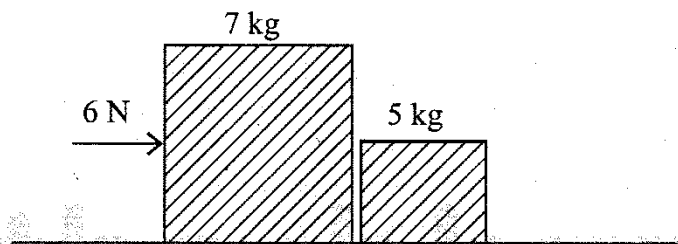
(A) 3.5 N   (B) 2.5 N   (C) 7 N

(D) 5 N   (E) 6 N

107. A body of mass 60 kg is suspended by means of three strings P, Q and R as shown in the figure is in equilibrium. The tension in the string P is

(A) 130.9 g N   (B) 60 g N   (C) 50 g N

(D) 103.9 g N   (E) 100 g N

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108. Two springs P and Q ($K_P = 2K_Q$) are stretched by same weight. The ratio of work done in stretching is

(A) 2 : 1   (B) 2 : 3   (C) 1 : 2

(D) 1 : 1   (E) 3 : 4

109. Two identical balls A and B collide head on elastically. If the velocity of A and B before collision are 0.5 ms^{-1} and -0.3 ms^{-1} respectively, then their velocities after collision will be

(A) 0.5 ms^{-1} and 0.3 ms^{-1} (B) -0.5 ms^{-1} and 0.3 ms^{-1}

(C) 0.3 ms^{-1} and -0.5 ms^{-1} (D) 0.3 ms^{-1} and 0.5 ms^{-1}

(E) -0.3 ms^{-1} and 0.5 ms^{-1}

110. In uniform circular motion of a particle
(A) velocity is constant but acceleration is variable
(B) velocity is variable but acceleration is constant
(C) both speed and acceleration are constants
(D) speed is constant but acceleration is variable
(E) both speed and acceleration are variables

111. A system consisting of two masses connected by a massless rod lies along the x-axis. A 0.4 kg mass is at a distance $x = 2$ m while a 0.6 kg mass is at a distance $x = 7$ m. The x-coordinate of the centre of mass is

(A) 5 m   (B) 3.5 m   (C) 4.5 m

(D) 4 m   (E) 3 m

112. A simple pendulum has a time period T_1 on the surface of earth of radius R. When taken to a height of R above the earth's surface, its time period is T_2. Then the ratio $\dfrac{T_2}{T_1}$ is

(A) $\dfrac{1}{\sqrt{2}}$ (B) $\sqrt{2}$ (C) 2   (D) 4   (E) 1/2

113. Two planets have radii r_1 and r_2 and densities d_1 and d_2 respectively. Then the ratio of accelerations due to gravity on them is

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

Space for Rough Work

114. A body floats in water with one-third of its volume above the surface of water. If it is placed in oil, it floats with half of its volume above the surface of the oil. The specific gravity of the oil is

(A) $\dfrac{5}{3}$ (B) $\dfrac{4}{3}$ (C) $\dfrac{3}{2}$ (D) 1   (E) $\dfrac{3}{4}$

115. Which one of the following statements is wrong ?
   (A) Young's modulus for a perfectly rigid body is zero
   (B) Bulk modulus is relevant for solids, liquids and gases
   (C) Rubber is less elastic than steel
   (D) The Young's modulus and shear modulus are relevant for solids
   (E) The stretching of a coil spring is determined by its shear modulus

116. In the figure, the velocity V_3 will be

$A_2 = 0.2 \text{ m}^2$

$V_1 = 4 \text{ ms}^{-1}$ $V_2 = 2 \text{ ms}^{-1}$

$A_1 = 0.2 \text{ m}^2$

$A_3 = 0.4 \text{ m}^2$ V_3
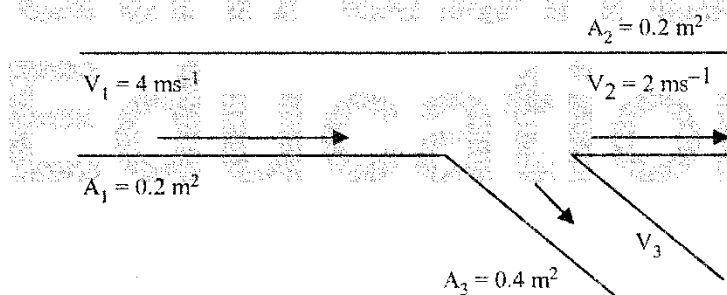
   (A) zero   (B) 4 ms^{-1} (C) 1 ms^{-1}
   (D) 3 ms^{-1} (E) 2 ms^{-1}

117. If a quantity of heat 1163.4 joule is supplied to one mole of nitrogen gas, at room temperature at constant pressure, then the rise in temperature is
   (Given R = 8.31 J mole^{-1} K^{-1})
   (A) 54 K   (B) 28 K   (C) 65 K
   (D) 8 K   (E) 40 K
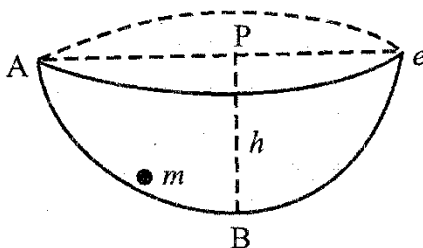
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118. An ideal gas is taken around the cycle ABCA as shown in the P-V diagram
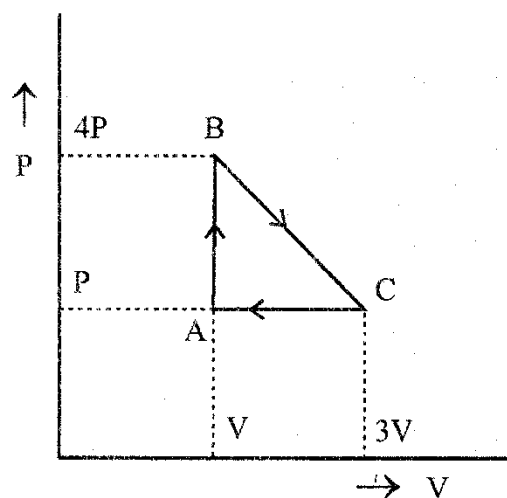
The total work done by the gas during the cycle is

(A) PV   (B) 2 PV   (C) 4 PV

(D) 3 PV   (E) 6 PV

119. A hot liquid is filled in a container and kept in a room of temperature of 25°C. The liquid emits heat at the rate of 200 Js^{-1} when its temp is 75°C. When the temperature of the liquid becomes 40°C, the rate of heat loss in Js^{-1} is

(A) 160   (B) 140   (C) 80

(D) 60   (E) 40

120. A sphere of mass m makes SHM in a hemispherical bowl ABC and it moves from A to C and back to A via ABC, so that PB = h. If acceleration due to gravity is g the speed of the ball when it just crosses the point B is

(A) $2\,gh$ (B) mgh (C) $\sqrt{2\,gh}$ (D) $\dfrac{gh}{2}$ (E) $\sqrt{5\,gh}$

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