Chapter

28 Metallurgy & d-block (Transitional Elements)

Single Correct Option Type Questions

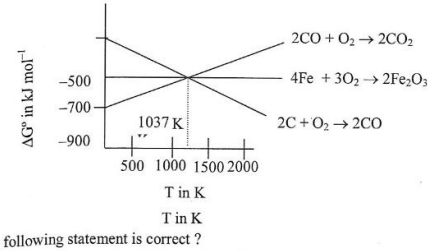
Q.1 On strongly heating, mixture of Cu_2O and Cu_2S gives :
(A) $Cu + S_2$ (B) $Cu + SO_3$ (C) $CuO + CuS$ (D) Cu_2SO_3

Q.2 Which out of Co(II) salts and Cd(II) salts, is attracted or repelled by the magnetic field ?
(A) Co(II) salts are attracted and Cd(II) salts are repelled
(B) Co(II) salts are repelled and Cd(II) salts are attracted
(C) Co(II) salts are attracted while Cd(II) salts are not affected by the magnetic field
(D) Both Co(II) and Cd(II) salt are repelled

Q.3 Which of the following does not responsible for colour of the compound
(A) Polarization (B) d-d transition
(C) charge transfer spectra (D) Dipole moment

Q.4 Which is not correct statement?
(A) Cassiterite, chromite and haematite are concentrated by hydraulic washing (Tabling)
(B) Pure Al_2O_3 is obtained from the bauxite ore by leaching in the Bayer's process
(C) Sulphide ore is concentrated by calcinations method
(D) Roasting can convert sulphide of copper into oxide and part of sulphide may also act as a reducing agent

Q.5



T in K

Which of the following statement is correct ?
(A) Reduction of Fe_2O_3 occurs by CO below 1073 K.
(B) Reduction of Fe_2O_3 occurs by 'C' below 1073K.
(C) Reduction of Fe_2O_3 occurs by CO above 1073 K.
(D) Reduction of Fe_2O_3 occurs by both 'C' and 'CO' at 1073 k.

Q.6 When the permanganate ion, MnO_4^-, acts as an oxidizing agent it forms different products depending on the pH of the solution. Which species correspond to the conditions listed ?

Species	Acidic condition	Basic condition	Neutral condition
P	Mn^{+2}	$Mn(OH)_2$	MnO_2
Q	Mn^{+2}	MnO_4^{-2}	MnO_2
R	MnO_2	MnO_4^{-2}	$Mn(OH)_2$
S	Mn^{+2}	$Mn(OH)_2$	MnO_4^{-2}

(A) P (B) Q (C) R (D) S

Q.7 Which of the following minerals does not contain aluminium ?
(A) Cryolite (B) Mica (C) Feldspar (D) Fluorspar

Q.8 Alum helps in purifying water by
(A) Coagulating the mud particles (B) Making mud water soluble.
(C) Forming Si complex with clay particles. (D) Sulphate part which coming with dirt and remove it.

Q.9 $Ag(CN)_2^-$ is stable while $AgCl_2^-$ is unstable because
(A) CN^- is stronger than Cl^- (B) Ag^+ is soft acid, CN^- is soft base while Cl^- is hard base
(C) both are equally stable (D) None of the above

Q.10 The metal groups whose extraction involve hydrometallurgy
(A) Na, Zn, Al (B) Au, Fe, Cu (C) Cu, Ag, Au (D) Hg, Ag, Au

Q.11 Among the lanthanide some shows bivalent character inspite of their group valence is 3. The most stable bivalent lanthanide among them is
(A) $_{64}Gd$ (B) $_{63}Eu$ (C) $_{60}Nd$ (D) $_{62}Sm$

Q.12 Which of the following is not correct ?
(A) Extraction of Zn from sphalerite involves roasting followed by carbon reduction.
(B) The Scavenger which is used in the manufacture of steel is Mn.
(C) Copper is extracted by hydrometallurgy from $CuFeS_2$:
(D) Na_3AlF_6 is used in the electrolysis of alumina to increase the electrical conductivity.

Q.13 In blast furnace Fe_2O_3 is reduced by
(A) SiO_2 (B) CaO (C) CO (D) $CaCO_3$

Q.14 Arrange the following ions in decreasing order of their magnetic moment
(i) Cr^{2+} (ii) Mn^{4+} (iii) Fe^{3+} (iv) Ni^{2+}
Atomic number of Cr = 24, Mn = 25, Fe = 26, Ni = 28
(A) (i) > (ii) > (iii) > (iv) (B) (iv) > (ii) > (iv) > (i)
(C) (iii) > (i) > (ii) > (iv) (D) (iv) > (iii) > (ii) > (i)

Q.15 Consider the following reaction
$2Cu^{2+} + 4X^- \rightarrow 2CuX(s) + X_2$
Then X^- can be-
(A) F^- (B) Cl^- (C) Br^- (D) I^-

Statement Based Questions

Q.16 **Statement-1:** In the electrolytic reduction of Al_2O_3, cryolite is used.
Statement-2: Cryolite is an ore of aluminium.
(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

Q.17 **Statement-1:** Lead, tin and bismuth are purified by liquation method.
Statement-2: Lead, tin and bismuth have low m.p. as compared to impurities.
(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1.
(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1.
(C) Statement-1 is True, Statement-2 is False.
(D) Statement-1 is False, Statement-2 is True.

Q.18 **Statement-1**: Cr(VI) ion in the form of dichromate in acidic medium is a strong oxidizing agent, where as MoO_3 and WO_3 are not-
Statement-2: Mo(VI) ion and W(VI) ion are found to be more stable than Cr(VI) ion.
(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1
(B) Statement-1 is true, Statement-2 is true and Statement-2 is **NOT** correct explanation of Statement-1
(C) Statement-1 is true, Statement-2 is false
(D) Statement-1 is false, Statement-2 is true

Q.19 **Statement-1**: Cr^{2+} and Mn^{3+} have better reducing and oxidising tendency respectively whenever both have d^4 configuration.
Statement-2: $Cr^{3+}(d^3)$ is more stable than $Cr^{2+}(d^4)$ configuration due to having a half-filled t_{2g} level, on the other hand $Mn^{2+}(d^5)$ is more stable than $Mn^{3+}(d^4)$.
(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1
(B) Statement-1 is true, Statement-2 is true and Statement-2 is **NOT** correct explanation of Statement-1
(C) Statement-1 is true, Statement-2 is false
(D) Statement-1 is false, Statement-2 is true

Q.20 **Statement-1**: Many copper (I) compounds are unstable in aqueous solution and undergo disproportionation.
$2Cu^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + Cu$
Statement-2: The more stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to the much more negative $\Delta H_{hydration}$ of $Cu^{2+}(aq)$ than $Cu^+(aq)$ which compensates for the second ionization enthalpy of Cu.
(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1
(B) Statement-1 is true, Statement-2 is true and Statement-2 is **NOT** correct explanation of Statement-1
(C) Statement-1 is true, Statement-2 is false
(D) Statement-1 is false, Statement-2 is true

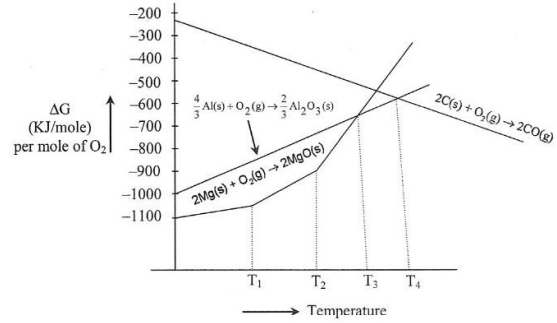
Q.21 **Statement-1**: Transition metals have tendency to form alloy.
Statement-2: Due to almost similar radii and other similar characteristics of transitions metals.
(A) Statement-1 is true, Statement-2 is true and Statement-2 is correct explanation for Statement-1
(B) Statement-1 is true, Statement-2 is true and Statement-2 is **NOT** correct explanation of Statement-1
(C) Statement-1 is true, Statement-2 is false
(D) Statement-1 is false, Statement-2 is true

Multiple Correct Option Type Questions

Q.22 Residue of metallic silver is obtained when, which of the following compound is added into aqueous $AgNO_3$ solution.
(A) H_3PO_2 (B) Adding $Na_2S_2O_3$ followed by warming
(C) Adding Na_2SO_3 followed by boiling (D) Adding Na_2CO_3 followed by boiling

Q.23 Consider the following steps : $Cu_2S \xrightarrow{\text{roast in air}}$ Products (X) $\xrightarrow{\text{heating without air}}$ Products (Y) Select CORRECT statement (S)
(A) Self – reduction is involved in above step.
(B) Dispropotionation reaction ($Cu_2S \xrightarrow{\Delta} Cu + CuS$) is involved in above step.
(C) Products (X) is a mixture of Cu_2O and Cu_2S
(D) products (Y) is a mixture of Cu and SO_2

Q.24



According to the given Ellingham diagram the correct option (s) is / are
(A) Above T_3 reaction $3MgO + 2Al \xrightarrow{\Delta} Al_2O_3 + 3Mg$ occurs
(B) Carbon reduction of MgO is faster then that of Al_2O_3 above T_4 temperature
(C) Above T_4 , Mg metal is extracted in vapour phase by carbon reduction of MgO
(D) Carbides of Al and Mg formed above T_4. On hydrolysis do not liberate C_2H_2

Q.25 During the production of steel from Haematite which of the following statements is/are correct.
(A) Fe_2O_3 is reduced to Fe by carbon in reduction zone of blast furnance.
(B) Impurities of impure iron are removed by oxidation using Bessemer's converter.
(C) spiegeleisan is added to wrought iron
(D) Phosphorus impurities are converted into slag which is used as fertilizer

Q.26 Which of the following stage(s) are involved in the extraction of blister copper from chalcopyrite :
(A) Bessemerization (B) Roasting (C) Poling (D) Slag formation

Q.27 CrO_2Cl_2 (vapour) $\xrightarrow{\text{excess NaOH soln}}$ $\underset{\text{(Coloured sol.)}}{\overset{\text{X}}{}}$ $\xrightarrow{\text{Y Reagent}}$ $\underset{\text{(Coloured ppt)}}{\overset{\text{Z}\downarrow}{}}$ then reagent (Y) can be :
(A) $Sr(NO_3)_2$ (B) $Pb(NO_3)_2$ (C) $AgNO_3$ (D) $Ba(NO_3)_2$

Q.28 In which of the following complex(es) unpaired electron is lying in d-orbital of valance shell of metal cation.
(A) $[Cu(en)_2]^{2+}$ (B) $Fe(CO)_5$ (C) $[Co(CN)_6]^{4-}$ (D) $[Cu(NO_2)_5]^{3-}$

Q.29 Pyrolysite is MnO_2 used to prepare $KMnO_4$. Steps are

$$MnO_2 \xrightarrow{I} MnO_4^{-2} \xrightarrow{II} MnO_4^-$$

Steps (I) and (II) are respectively
(A) Fuse with KOH/air, electrolytic reduction
(B) Fuse with KOH/KNO_3, electrolytic reduction
(C) Fuse with NH_4OH/NH_4NO_3, electrolytic reduction
(D) Dissolve in H_2O oxidation

Q.30 In the process of extraction of silver is
silver ore + $CN^- + H_2O \xrightarrow{O_2}$ [X] + OH^-
[X] + Zn $\longrightarrow$ Y + Ag
Find hybridisation of (X) and also find magnetic behaviour of (Y)
(A) sp hybridisation and paramagnetic (B) dsp^2 hybridisation and paramagnetic
(C) sp hybridisation and diamagnetic (D) sp^3 hybridisation and diamagnetic

Q.31 Select the incorrect statement.
(A) Carbon is a better reducing agent below 983K than carbon monoxide
(B) Sulphide ores generally roasted to oxide for the extraction of metals instead of being directly reduced
(C) Zinc not extracted from zinc oxide through reduction using CO but instead coke is used
(D) Leaching of native ores of silver/gold or of their sulphide ores and the extraction of metals (silver/gold), is an example of hydrometallurgy

Q.32 Which of the following reactions take(s) place during smelting step in carbon reduction process for extraction of Pb?
(A) $PbO + CO \longrightarrow Pb + CO_2$ (B) $PbO + C \longrightarrow Pb + CO$
(C) $3PbO + \frac{1}{2}O_2 \longrightarrow Pb_3O_4$ (D) $CaO + SiO_2 \longrightarrow CaSiO_3$

Q.33 Which of the following statement (s) is / are correct for froth floatation process ?
(A) Pine oil is used as collector. (B) Na_2S acts as activator.
(C) Xanthates used as frothers (D) NaCN used as depressant to ZnS from PbS.

Q.34 Which of the following compounds are coloured due to charge transfer spectrum?
(A) K_2CrO_7 (B) $KMnO_4$ (C) $[Co(NH_3)_6]Cl_3$ (D) $[Cu(NH_3)_4]SO_4$

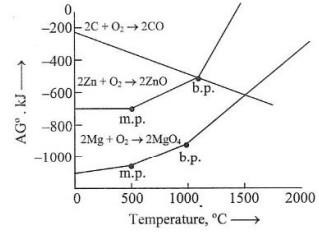
Q.35 The correct statement(s) regarding transition elements is/are-
(A) The last electron goes to the d-orbitals of the penultimate energy level
(B) These elements may have d^{10} configuration in their stable oxidation state
(C) These elements shows variable oxidation state and formation of coloured ions
(D) These elements form complex compound and have catalytic property

Q.36 Which of the following statement(s) is/are correct about interstitial compounds of transition metal.
(A) They have high melting points than pure metals
(B) They are chemically inert under ordinary condition
(C) They are very hard
(D) They retain metallic conductivity

Q.37 Consider the reaction, $3MnO_4^{2-} + 4H^+ \rightarrow$
Then the correct statement(s) regarding this reaction is/are-
(A) This is a disproportionation reaction.
(B) MnO_2 is one of the product of those reaction
(C) MnO_4^- is one of the product of this reaction
(D) Mn_2O_3 is one of the product of this reaction.

Passage Based Questions

Passage # 1 (Ques. 38 – 40)
The Ellingham diagram for zinc, magnesium and carbon converting into corresponding oxides is shown below.



Q.38 At what temperature, zinc and carbon have equal affinity for oxygen ?
(A) 1000°C (B) 1500°C (C) 500°C (D) 1200°C

Q.39 To make the following reduction process spontaneous, temperature should be :

$$ZnO + C \longrightarrow Zn + CO$$

(A) 1000°C (B) > 1100°C (C) < 500°C (D) < 1000°C

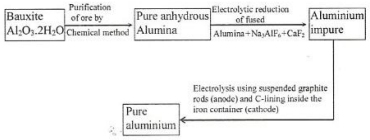
Q.40 At 1100°C, which reaction is spontaneous to a maximum extent ?

(A) $MgO + C \longrightarrow Mg + CO$ (B) $ZnO + C \longrightarrow Zn + CO$

(C) $MgO + Zn \longrightarrow Mg + ZnO$ (D) $ZnO + Mg \longrightarrow MgO + Zn$

Passage # 2 (Ques. 41 – 42)

Following flow diagram represents the extraction of aluminium from bauxite



Q.41 Coke powder is spreaded over the molten electrolyte to :

(A) prevent the loss of heat by radiation from the surface

(B) prevent the corrosion of graphite anode

(C) prevent oxidation of molten aluminium by air

(D) both (A) and (C)

Q.42 Select the incorrect statement

(A) Bauxite is purified by Hall's, Serpeck's and Baeyer's processes

(B) In electrochemical process for aluminium extraction, a molten mixture of Al_2O_3, Na_3AlF_6 and CaF_2 is used as electrolyte

(C) Hydrated alumina is converted to anhydrous alumina by calcinations process

(D) None of these

Passage # 3 (Ques. 43 – 45)

The enthalpy of atomization is an important factor in determining the standard electrode potential of a transition metals, metals with very high enthalpy of atomization tend to be noble in their reactions.

Q.43 The incorrect order of melting points of transition elements is-

(A) W > Re > Os (B) Mo > Ru > Tc (C) Cr > Fe > Mn (D) Mo > Rh > Ru

Q.44 The incorrect statement is-

(A) Transition metals of second and third transition series have greater enthalpies of atomisation than the corresponding elements of the first series.

(B) Greater the unpaired electron in d-orbitals favourable for strong interatomic interaction

(C) Zn, Cd, Hg and Mn have one or more typical metallic structures at normal temperatures

(D) The melting and boiling point of transition elements regularly increases with the atomic number increases.

Q.45 Which of the following reaction has their least negative value of standard electrode potential.

(A) $Ti^{2+} + 2e^- \rightarrow Ti$ (B) $V^{2+} + 2e^- \rightarrow V$

(C) $Cr^{2+} + 2e^- \rightarrow Cr$ (D) $Mn^{2+} + 2e^- \rightarrow Mn$

Passage # 4 (Ques. 46 – 48)

4 "Chromite ore" + 8(P) + $7O_2 \rightarrow$ 8(Q) + $2Fe_2O_3$ + $8CO_2\uparrow$

yellow

$$2(Q) \underset{2OH^-}{\overset{2H^+}{\rightleftharpoons}} (R) + 2Na^+ + H_2O$$

$(R) + 2KCl \rightarrow (S) + 2NaCl$

(orange)

Q.46 The correct statement is-

(A) oxidation number of transition metal ion is same in compound Q and R

(B) (P) is chromate salt

(C) (Q) is dichromate salt

(D) Chromate ore is $FeCr_2O_7$

Q.47 Compound 'P' is-

(A) Na_2CO_3 (B) Na_2O (C) K_2CO_3 (D) None

Q.48 Compound 'S; is-

(A) K_2CrO_4 (B) $K_2Cr_2O_7$ (C) Cr_2O_3 (D) $KHCrO_4$

Passage # 5 (Ques. 49 – 51)

$$2Mn^{2+} + 5S_2O_8^{2-} + 8H_2O \rightarrow 2\,'A' + 10\,'B' + 16H^+$$

KCl ↓

$$\uparrow O_2 + E + D \xleftarrow[513\ K]{\Delta} 2\,'C'$$

(Green) (Purple)

Q.49 The incorrect statement is-

(A) 'C' is isostructural with $KClO_4$ (B) 'C' is diamagnetic

(C) 'D' is paramagnetic (D) Colour of compound 'C' is due to d-d transition

Q.50 The correct match for compound/species is-

	(A)	(B)	(D)	(E)
(A)	MnO_4^-	SO_4^{2-}	K_2MnO_4	MnO_2
(B)	MnO_4^-	SO_3^{2-}	K_2MnO_4	Mn_2O_3
(C)	MnO_4^{2-}	SO_4^{2-}	$KMnO_4$	MnO_2
(D)	MnO_4^{2-}	SO_3^{2-}	$KMnO_4$	Mn_2O_3

Q.51 Acidified permanganate solution can be oxidises-
(A) Oxalates to carbon dioxide
(B) Nitrites to nitrates
(C) Iodide ion to free iodine
(D) All

Column Matching Type Questions

Q.52

Column – I (Processes used for commercial extraction of pure metal)	**Column – II** (metals)
(A) Self Reduction	(P) Fe
(B) Carbon Reduction	(Q) Cu
(C) Distillation	(R) Pb
(D) Bessemerization	(S) Hg
	(T) Zn

Q.53

Column – I	**Column – II**
(A) Purification by oxidation method	(P) Fe
(B) Carbon reduction method applied for commerical extraction of metal	(Q) Zn
(C) Froth floatation method	(R) Cu
(D) Electrolytic refining method	(S) Ag
	(T) Al

Q.54 Select correct match :

List – I	**List – II**
(P) Sn	(1) Cupellation
(Q) Ag	(2) Liquation
(R) Zn	(3) Parke's Process
(S) Pb	(4) Distillation

Code :

	P	Q	R	S
(A)	2	1	4	3
(B)	2	3	1	4
(C)	2	1	3	4
(D)	4	3	1	2

Q.55

List-I	**List-II**
(A) Iron pyrites	(P) FeS_2
(B) Fool's gold	(Q) Sulphide ore
(C) Galena	(R) Fe_2O_3
(D) Haematite	(S) Concentrate by froth floatation process
	(T) Reduction by carbon monoxide (Mainly) as well as carbon at different temperature

Numeric Response Type Questions

Q.56 Find the value of expression | x + y | for commercial extraction of following metals.
Ag, Zn, Hg, Cu, Fe, Mg, Pb, Al, Au
X : Number of metals commercially extracted by pyrometallurgy
Y Number of metals during their extraction chemical leaching is used

Q.57 The number of species among the following, having magnetic moment value of 2.84 BM is ..... .
Fe^{2+}, Cr, Cr^{3+}, Ti^{2+}, Mn^{2+}, V^{3+}

Q.58 The number of electrons in Br^- ion that have the value of magnetic quantum number m = + 1 is ..... .

Q.59 Calculate value of | x – y | where x and y are total number of maximum equivalent 'Cr – O' bonds in CrO_5 and $Cr_2O_7^{2-}$ ion respectively.

Q.60 The following sequence of reactions may be used to extract zinc from its sulphide ore
$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
$ZnO + C \rightarrow Zn + CO$
How many tans of Zn can be obtained from 10 tons of ZnS, assuming that the yield is 75%?
(Zn = 65.3 & S = 32)

Q.61 Of the following reduction processes, how many are the correct process(es) :
(1) $Fe_2O_3 + CO \rightarrow Fe + CO_2$
(2) $ZnO + C \rightarrow Zn + CO$
(3) $Cu_2O + Cu_2S \rightarrow Cu + SO_2$
(4) $PbO + PbS \rightarrow Pb + SO_2$

Q.62 The spin only magnetic moment [in units of Bohr magneton] of Ni^{2+} in aqueous solution would be (At. No. Ni = 28) : [Give your answer in nearest integer]

Q.63 How many ions would be colour less according to the d-d transition.
Ti^{+3}, Ti^{+2}, Ti^{+4}, V^{+5}, V^{+2}, Sc^{+1}, Sc^{+3}, Mn^{+7}

Q.64 $CrO_4^{2-} + H^+ \longrightarrow [X] + H_2O$
Give the answer of the following questions for the reaction product [X].
(P) In how many M-O bonds, the bond lengths are equal..
(Q) Number of peroxide linkage in the product form by reaction of [X] with H_2O_2 in acidic medium. Then P + Q is.

Q.65 How many of the following are the ore of iron ?
Haematite, malachite. azurite. magnetite, cerussite, limonite, argentite.

ANSWER KEY

Single Correct Option type Questions

1. (A), **2.** (A) **3.** (D) **4.** (C) **5.** (A) **6.** (B) **7.** (D)
8. (A) **9.** (B) **10.** (C) **11.** (B) **12.** (C) **13.** (C) **14.** (C)
15. (D)

Statement Based Questions

16. (B) **17.** (A) **18.** (A) **19.** (A) **20.** (A) **21.** (A)

Multiple Correct Option type Questions

22. (A,C) **23.** (A,C,D) **24.** (A,B,C,D) **25.** (B,C,D) **26.** (A,B,C,D) **27.** (A,C,D) **28.** (C,D)
29.(A,B) **30.**(C) **31.**(A) **32.**(A,B,D) **33.**(B,D) **34.**(A,B) **35.** (A,B,C,D) **36.** (A,B,C,D)
37. (A,B,C)

Passage Based Questions

38. (A) **39.** (B) **40.** (D) **41.** (D) **42.** (D) **43.** (D) **44.** (D)
45. (C) **46.** (A) **47.** (A) **48.** (B) **49.** (D) **50.** (A) **51.** (D)

Column Matching Type Questions

52. [**A** → Q,R,S ; **B** → P,T ; **C** → S,T ; **D** → P,Q])

53. [**A** → P,R,S ; **B** → P,Q ; C → Q,R,S ; **D** → Q,R,S,T]

54. [**A**]

55. [**A** → P,Q,S ; **B** → P,Q,S ; C → Q,S ; **D** → R,T]

Numerical Response Type Questions

56. (8) **57.** (2) **58.** (4) **59.** (2) **60.** (5) **61.** (4) **62.** (3)
63. (4) **64.** (8) **65.** (3)