DENTAL ADMISSION TESTING PROGRAM

Sample Test Items

Dental Admission Testing Program
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American Dental Association
www.ada.org

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DENTAL ADMISSION TEST PREPARATION MATERIALS

How does one prepare for the DAT? There are no shortcuts to the process of learning, and these test preparation materials are not designed to provide the applicant with an opportunity to bypass the extensive process of absorbing basic information through class participation and months of study. These test preparation materials contain samples of the four tests used in the Dental Admission Testing Program. These are available to DAT applicants as a means of discovering possible areas of weakness in their comprehension of subjects covered by the test. They will also enable the candidates to become familiar with the types of material included in the test as well as with the general coverage and format of the various parts of the test battery.

The entire DAT takes 4 hours and 45 minutes (including a 15-minute optional tutorial and break). In the real DAT, the time limit will be indicated in the upper right hand corner on the computer screen. Therefore, you will need to pace yourself as you proceed through each test in the Dental Admission Test. If you have time remaining for a section of the test, you can review your responses. When time expires, the computer screen will move to the next test or optional break period. The structure of the test is given below.

You are encouraged to review the DAT Tutorial at www.ada.org/dat.aspx under Step 4 before taking the actual DAT. The tutorial provides some sample items and information on navigating through the test.

Dental Admission Test		
Components of the Test	Number of Items	Time Allowance
Optional Tutorial		15 minutes
Survey of the Natural Sciences	100	90 minutes
Perceptual Ability Test	90	60 minutes
Optional Break		15 minutes
Reading Comprehension Test	50 - across three reading passages	60 minutes
Quantitative Reasoning Test	40	45 minutes

The **Survey of the Natural Sciences** is a test of achievement. The content is limited to those areas covered by an entire first-year course in biology, general chemistry, and organic chemistry. The examination is comprised of 100 items: 40 biology items, 30 general chemistry items, and 30 organic chemistry items. Since separate sub-scores will be given for each of the three science sections, you should pace yourself through each section. A periodic table is available in the front of the Sample Test Items booklet and will be available as an Exhibit button on the actual DAT.

The **Perceptual Ability Test** includes various types of nonverbal visual acuity items. There are six sections to the Perceptual Ability Test. One section covers two-dimensional perception, while the other sections cover three-dimensional perception. It is important that you read and understand the instructions at the beginning of each section. You must pace yourself so that you complete all six sections of the Perceptual Ability Test within the given time frame. You are not permitted to use measuring devices (i.e., pencils and fingers) while taking the Perceptual Ability Test.

The **Reading Comprehension Test** consists of three reading passages, each with 16 to 17 items. The reading passages are scientific in nature and may reflect topics covered in dental school. Candidates are encouraged to read each passage before attempting to answer the corresponding questions. On the actual DAT, the Reading Comprehension Test is presented in a split-screen format with the items presented on the upper half of the screen, while the reading passage is presented in a scrollable format on the lower half of the screen. One reading passage is provided in the Sample Test Items.

The **Quantitative Reasoning Test** measures your ability to reason with numbers, to manipulate numerical relationships, and deal intelligently with quantitative materials. On the actual DAT, a basic calculator will be available as a pop-up image for the Quantitative Reasoning Test only.

PERIODIC TABLE OF THE ELEMENTS

1 IA																	18 Noble gases
1 H 1.01	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.40	47 Ag 107.87	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.91	54 Xe 131.30
55 Cs 132.91	56 Ba 137.34	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.20	76 Os 190.20	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 209.00	84 Po 209.00	85 At ~210	86 Rn (~222)
87 Fr (223)	88 Ra 226.02	89 Ac (227)	104 Unq (261)	105 Unp (262)	106 Sg (263)	107 Une (262)	108 Uno (265)	109 Une (266)									

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.40	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lr (257)

This examination is comprised of 100 items:
Biology (1-40), General Chemistry (41-70), and Organic Chemistry (71-100)

1. Organisms that obtain their energy from light can be termed

A. autotrophic.
B. holotrophic.
C. chemotrophic.
D. heterotrophic.
E. heliotrophic.

2. Fermentation

A. produces pyruvic acid as an end product.
B. yields less energy per mole of glucose than aerobic respiration.
C. occurs only in the presence of oxygen.
D. prevents glycolysis from occurring.
E. converts ethanol to glucose.

3. In respiration, oxygen

A. combines with lactic acid to form pyruvic acid.
B. acts as a cofactor for glycolytic enzymes.
C. yields energy in the form of ATP as it is passed down the respiratory chain.
D. acts as an acceptor for electrons (and protons), forming water.
E. combines directly with carbon, forming CO_2.

4. An enzyme is added to an aqueous solution of ATP, DNA, albumen, fat and glycogen; the reaction mixture is incubated for 10 minutes. If an analysis of the mixture reveals the presence of all of the above compounds plus glucose, it can be concluded that the enzyme hydrolyzed some of the

A. albumen.
B. fat.
C. glycogen.
D. ATP.
E. DNA.

5. What cellular organelles would you expect to be absent from fungi?

A. Mitochondria
B. Lysosomes
C. Ribosomes
D. Golgi bodies
E. Chloroplasts

6. Intracellular organelles that participate in metabolic oxidations involving H_2O_2 are called

A. centrioles.
B. endoplasmic granules.
C. peroxisomes.
D. lysosomes.
E. macrobodies.

7. The two daughter cells formed by mitosis and cytokinesis have

A. half the number of chromosomes present in the parent cell.
B. half the number of the chromosomes present in the parent cell if this parent cell is found in the testicular or ovarian tissue.
C. the same number of chromosomes present in the parent cell.
D. twice the number of chromosomes present in the parent cell.
E. a variable number of chromosomes so that an exact prediction cannot be made.

8. Starch, cellulose and glycogen are all

A. proteins.
B. linked internally by hydrogen bonds.
C. water soluble.
D. polymers of glucose.
E. nucleic acids.

9. Each of the following cell organelles have a membranous structure EXCEPT one. Which one is the EXCEPTION?

A. Golgi complex
B. Centrioles
C. Mitochondria
D. Lysosomes
E. Endoplasmic reticulum

10. In anaerobic glycolysis in muscle cells, one mole of glucose is oxidized to

A. six moles of carbon dioxide.
B. two moles of acetic aid.
C. two moles of lactic acid.
D. two moles of acetyl CoA.
E. two moles of carbon dioxide and six moles of water.

11. The movement of water soluble molecules through cell membranes, from higher to lower concentrations, by attachment to a carrier protein, describes

A. diffusions.
B. osmosis.
C. pinocytosis.
D. active transport.
E. facilitated diffusion.

12. As far as their products are concerned, all biosynthetic reactions in living cells result in

A. a more ordered state, therefore a decrease in entropy.
B. a more ordered state, therefore an increase in entropy.
C. energy released in the form of ATP.
D. energy made available for motion.
E. a more ordered state with no entropy change.

13. Which is the smallest organelle in the cell?

A. Golgi body
B. Nucleus
C. Mitochondrion
D. Ribosome
E. Chloroplast

14. For a given diameter of an axon, one factor which increases the velocity of a nerve impulse is

A. the length of the axon.
B. the ploidy of the nucleus.
C. the density of mitochondria along the axon.
D. maximal stimulation of the neuron.
E. the presence of a myelin sheath.

15. Which chiefly stimulates action of the respiratory center?

A. Carbon dioxide in the blood
B. Relaxin
C. Lack of oxygen in the blood
D. Inflation of the alveolus
E. Vagus nerve

16. The term *motor unit* refers to

A. an entire muscle.
B. a single muscle fiber.
C. all the muscle fibers innervated by one nerve fiber.
D. all the motor nerves in one muscle.
E. all the sliding filaments of actin and myosin in one muscle fiber.

17. The human heart beat is initiated within the

A. sinus venosus.
B. Hensen's node.
C. conus arteriosus.
D. artio-ventricular node.
E. sino-atrial node.

18. In the nephron of the kidney, filtration occurs between

A. Bowman's capsule and Henle's loop.
B. the glomerulus and Bowman's capsule.
C. the proximal tubule and Henle's loop.
D. Henle's loop and the vasa recta.
E. the peritubular network and the convoluted tubules.

19. The addition of potassium iodide as a nutritional supplement to common table salt would most directly affect the function of which of these glands?

A. Thyroid
B. Sweat glands
C. Adrenal cortex
D. Kidneys
E. Parathyroid

20. Each of the following is synthesized by the anterior lobe of the pituitary gland of vertebrates EXCEPT one. Which one is the EXCEPTION?

A. Thyrotropic hormone
B. Adrenocorticotropic hormone
C. Follicle-stimulating hormone
D. Growth hormone
E. Oxytocin

21. Clotting of human blood

A. requires that hemoglobin be present.
B. results from fibrin joining globulin.
C. is a result of platelets releasing fibrinogen.
D. depends on the formation of fibrin from fibrinogen.
E. is accelerated when Ca^{2+} is removed.

22. At some stage of development, all chordates have

A. a pharynx, a vertebral column, and a notochord.
B. pharyngeal pouches, a notochord, and a dorsal tubular nerve cord.
C. pharyngeal pouches, a notochord, and a ventral nerve cord.
D. pharyngeal pouches, vertebral column, and a dorsal tubular nerve cord.
E. a pharynx and an ectodermally derived, solid nerve cord.

23. Organisms that have the characteristics of radial symmetry, water vascular system, a spiny skin, and are found exclusively in a marine habitat would be in which phylum?

A. Annelida
B. Chordata
C. Cnidaria
D. Porifera
E. Echinodermata

24. Of the following, which group of invertebrates is apparently most closely related to primitive vertebrates?

A. Annelida
B. Mollusca
C. Cnidaria
D. Arthropoda
E. Echinodermata

25. Under the five-kingdom classification, members of the kingdom Monera are generally separated from the members of all the other kingdoms by having

A. heterotrophic nutrition versus autotrophic nutrition.
B. unicellular organization versus multicellular organization.
C. microscopic size versus macroscopic size.
D. prokaryotic cells versus eukaryotic cells.
E. parasite-host relationship versus predator-prey relationship.

26. A segment of DNA with the sequence GGCATTAGG would be transcribed into a messenger RNA segment with the sequence

A. CCGUAAUCC.
B. AATGCCGTT.
C. CCGTAATCC.
D. AAUGCCGUU.
E. CCGTUUTGG.

27. Assuming no linkage, how many different kinds of gametes can be produced by an organism with the genotype AaBbcc?

A. 32
B. 16
C. 8
D. 6
E. 4

28. Which statement concerning alleles is true for diploid organisms?

1. At most only two alleles occur at a given locus in an organisms genome.
2. Alleles occupy an identical locus in homologous chromosomes.
3. Alleles of a given gene usually occur on non-homologous chromosomes.
4. A single chromosome usually carries two alleles of each gene.

A. 4
B. 1 and 2
C. 3
D. 1, 2 and 4
E. 3 and 4

29. In watermelons, the unlinked genes for green color (G) and for short length (S) are dominant over alleles for striped color (g) and long length (s). Predict the phenotypes and their ratios for the cross Ggss x ggSs.

A. All green short
B. 1:2:1 green short: striped long: striped short
C. All striped long
D. 1:1:1:1 green short: striped short: green long: striped long
E. 1:1 green short: striped long

30. Sexual and asexual reproduction usually differ in

A. the ability of the new offspring to reproduce.
B. the rate at which mutations occur.
C. the amount of genotypic variation between parent and offspring.
D. the viability of offspring.
E. whether or not natural selection can occur.

31. In human beings, color blindness is controlled by an X-linked recessive allele. In a cross involving this X-linked trait, the male parent has normal color vision, but the female parent is a carrier. What are the chances (in %) that a male offspring will inherit color blindness?

A. 10
B. 25
C. 50
D. 75
E. 100

32. Consider a pair of homologous human chromosomes. In this pair one would expect

A. them to be genetically identical.
B. one chromosome to carry dominant alleles and the other recessive alleles.
C. one chromosome to have been inherited from the mother and the other from the father.
D. the two chromosomes to synapse during mitotic prophase.
E. them to have different shapes.

33. Embryonic induction is a process in which

A. embryonic tissues influence adjacent tissues to differentiate.
B. an unfertilized egg is induced to develop.
C. genes are transferred from one developing tissue to another.
D. resting potentials are induced in neurons of embryos.
E. the maternal parent induces expression of recessive genes in embryos.

34. Which statement is true of the archenteron?

A. The cavity of the archenteron is called the blastocoele.
B. The cavity of the archenteron represents the beginning of the primitive gut.
C. The archenteron is formed during blastula formation.
D. The cavity of the archenteron represents the first cavity of the developing heart.
E. The archenteron is formed by a closing of the neural tube.

35. Of the germ layers comprising the early human embryo, which one forms most of the central nervous system?

A. Ectoderm
B. Mesoderm
C. Endoderm
D. Notochord
E. Dermis

36. Of the following, the rate and type of cleavage occurring after fertilization would be most affected by the

A. amount and distribution of yolk.
B. number of chromosomes.
C. thickness of the cell membrane.
D. temperature.
E. thickness of the zona pellucida.

37. The long-term natural process by which a pond eventually becomes a terrestrial community is referred to as

A. environmental disruption.
B. habitat development.
C. organic evolution.
D. ecological succession.
E. desertification.

38. The initial step in the speciation process often involves

A. inbreeding within the species.
B. geographical separation of populations.
C. intraspecific-random mating.
D. the inheritance of acquired characteristics.
E. a Hardy-Weinberg equilibrium.

39. A complex behavioral response to a specific cue or releaser, which is exhibited by all members of the species as a stereotyped response to the same stimulus, is known as a

A. conditioned response.
B. fixed-action pattern.
C. reflex.
D. kinesis.
E. taxis.

40. Each of the following changes the frequency of alleles in a population EXCEPT one. Which one is the EXCEPTION?

A. Mutation
B. Natural selection
C. Immigration
D. Random interbreeding
E. Genetic drift

41. A 49-gram sample of sulfuric acid, H_2SO_4 ($98\ g \bullet mol^{-1}$) contains

A. 1 mol of S atoms.
B. 16.0 grams of O.
C. 2.0 grams of H.
D. 2 moles of O atoms.
E. 1 mole of molecules.

42. If 1 mole of N_2 and 1 mole of H_2 are mixed and allowed to react according to the equation $N_2 + 3H_2 \longrightarrow 2NH_3$. What is the maximum number of moles of NH_3 that could be produced?

A. 2/3
B. 3/2
C. 2/1
D. 1/2
E. 1/1

43. A flask weighs 95 g when empty. When filled with 200 mL of a certain liquid, the weight is 328 g. What volume (in milliliters) would 1,000 g of the liquid occupy?

A. $\dfrac{200}{[(1,000)(328-95)]}$

B. $\dfrac{[(200)(1,000)]}{(328-95)}$

C. $(200)(1,000)(328-95)$

D. $\dfrac{(328-95)}{[(200)(1,000)]}$

E. $\dfrac{[(200)(1,000)]}{328}$

44. If 3.00 g of a nitrogen-oxygen compound is found to contain 2.22 g of oxygen, what is the percentage of nitrogen in the compound?

A. $\left(\frac{3.00}{2.22}\right)(100)$

B. $\left[\frac{(3.00+2.22)}{3.00}\right](100)$

C. $\left(\frac{2.22}{3.00}\right)(100)$

D. $\left[\frac{(3.00-2.22)}{3.00}\right](100)$

E. $\left[\frac{(3.00-2.22)}{2.22}\right](100)$

45. A 10.0 liter sample of oxygen at 100°C and 1 atm is cooled to 27°C and expanded until the pressure is 0.5 atm. Find the final volume of the oxygen.

A. $10.0\left(\frac{1}{0.5}\right)\left(\frac{27}{100}\right)$

B. $10.0\left(\frac{1}{0.5}\right)\left(\frac{373}{300}\right)$

C. $10.0\left(\frac{0.5}{1}\right)\left(\frac{373}{300}\right)$

D. $10.0\left(\frac{1}{0.5}\right)\left(\frac{300}{373}\right)$

E. $10.0\left(\frac{0.5}{1}\right)\left(\frac{300}{373}\right)$

46. When the volume of a gas is decreased at constant temperature, the pressure increases because the molecules

A. move faster.
B. move slower.
C. become heavier.
D. become lighter.
E. strike a unit area of the container more often.

47. Water has a higher boiling point than compounds of a similar molecular weight. Which best explains this phenomenon?

A. Extensive hydrogen bonding exists between water molecules.
B. One of the natural isotopes of hydrogen, deuterium, is present in sufficient quantities to significantly raise the boiling point.
C. Water is a polar covalent compound.
D. Van der Waals forces exist between individual water molecules.
E. Water is largely dissociated leading to large electrostatic forces between individual water molecules.

48. A substance is non-conducting as a solid and melts at 750°C. The melt conducts electricity. The solid is observed to be soluble in water. This substance would be best classified as

A. molecular.
B. ionic.
C. macromolecular.
D. metallic.
E. polymeric.

49. How many grams of NaOH (40 g $\bullet$ mol^{-1}) are there in 250 mL of 0.4 M NaOH solution?

A. 0.1
B. 0.4
C. 4
D. 10
E. 40

50. Which will be the final volume when 400 mL of 0.6 M HCl is diluted to 0.5 M HCl?

A. $400\left(\frac{0.5}{0.6}\right)$

B. $(0.6-0.5)(400)$

C. $(400)\left(\frac{0.6}{0.5}\right)$

D. $(1,000-400)\left(\frac{0.5}{0.6}\right)$

E. $\left(\frac{0.6}{0.5}\right)(1,000-400)$

51. During a titration it was determined that 30.00 mL of a 0.100 M Ce^{4+} solution was required to react completely with 20.00 mL of a 0.150 M Fe^{2+} solution. Which reaction occurred?

A. $Ce^{4+} + 3Fe^{2+} + H_2O \longrightarrow 3Fe^{3+} + CeO^- + 2H^+$
B. $2Ce^{4+} + Fe^{2+} \longrightarrow Fe^{4+} + 2Ce^{3+}$
C. $Ce^{4+} + Fe^{2+} \longrightarrow Fe^{3+} + Ce^{3+}$
D. $Ce^{4+} + 2Fe^{2+} \longrightarrow 2Fe^{3+} + Ce^{2+}$
E. $Ce^{4+} + 2Fe^{2+} \longrightarrow 2Fe^{4+} + Cs^{2+} + 2e^-$

52. If 25 mL of 0.5 M NaOH neutralizes 35 mL of a monoprotic acid, which is the molarity of the acid?

A. $\frac{[(0.025)(0.5)]}{0.035}$

B. $\frac{0.035}{[(0.025)(0.5)]}$

C. $\frac{0.025}{[(0.5)(0.035)]}$

D. $(0.025)(0.5)(0.035)$

E. $\frac{[(0.035)(0.5)]}{0.025}$

53. In which reaction is H_2O considered to be acting as an acid?

A. $Zn(s) + 2H_3O^+ \longrightarrow Zn^{2+} + H_2(g) + H_2O$
B. $HCl(g) + H_2O \longrightarrow H_3O^+ + Cl^-$
C. $HC_2H_3O_2 + H_2O \leftrightharpoons H_3O^+ + C_2H_3O_2^-$
D. $NH_3 + H_2O \leftrightharpoons NH_4^+ + OH^-$
E. $NH_3 + H_3O^+ \longrightarrow NH_4^+ + H_2O$

54. At constant temperature when the following reactions involving gases are at equilibrium, which reaction shifts to the right if the pressure is increased?

A. $2H_2 + O_2 \leftrightharpoons 2H_2O$
B. $2NH_3 \leftrightharpoons N_2 + 3H_2$
C. $2SO_3 \leftrightharpoons 2SO_2 + O_2$
D. $2NO \leftrightharpoons N_2 + O_2$
E. $2CO_2 \leftrightharpoons 2CO + O_2$

55. For the equilibrium

$Ag_2SO_4(s) \quad 2Ag^+(aq) + SO_4^{2-}(aq)$

The solubility product expression (K_{sp}) is

A. $2[Ag^+][SO_4^{2-}]$

B. $[Ag^+][SO_4^{2-}]/[Ag_2SO_4]$

C. $[Ag^+][SO_4^{2-}]$

D. $2[Ag^+]^2[SO_4^{2-}]/[Ag_2SO_4]$

E. $[Ag^+]^2[SO_4^{2-}]$

56. The concentrations of silver ion and chloride ion in an aqueous solution in equilibrium with solid silver chloride are 1.0×10^{-6} M. What is the value of K_{sp} for AgCl equal to?

A. $(2.0 \times 10^{-6})(1.0 \times 10^{-6})$

B. $\sqrt{1.0 \times 10^{-6}}$

C. 1.0×10^{-6}

D. $1(1.0 \times 10^{-6})$

E. $(1.0 \times 10^{-6})^2$

57. Determine the heat in kcal/mol available from the oxidation of one mole of glucose ($C_6H_{12}O_6$).

$C_6H_{12}O_6(s) + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(1)$

The heats of formation are:

Substance	**ΔH_f^o, kcal/mol**
$C_6H_{12}O_6(s)$	-297
$CO_2(g)$	-94
$H_2O(l)$	-68

A. -94 - 68 - 297
B. 6(-94) + 6(-68) + 1(-297)
C. 6(-94) + 6(-68) - 1(-297)
D. 1(-297) - 6(-94) - 6(-68)
E. 297 - 94 - 68

58. Which process is accompanied by a decrease in entropy?

A. Sublimation of carbon dioxide
B. Evaporation of water
C. Freezing of water
D. Shuffling a deck of cards
E. Heating a balloon filled with a gas

59. If a solution which is 0.50 M in compound X decomposes for 5.0 minutes at an average rate of 0.040 $M \bullet min^{-1}$, the new concentration of X will be

A. 0.04 M.
B. 0.05 M.
C. 0.20 M.
D. 0.30 M.
E. 0.50 M.

60. For the reaction A + B $\longrightarrow$ C, the experimentally determined rate of formation of C is given by: Rate = $k[A][B]^2$. Doubling the concentration of B will

A. quadruple the initial reaction rate.
B. double the initial reaction rate.
C. have no effect on the initial rate.
D. halve the initial reaction rate.
E. reduce the rate to one-fourth its initial value.

61. The following is a spontaneous oxidation-reduction reaction:

$$Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 2Cr^{3+} + 7H_2O + 3I_2$$

Which is the best reducing agent?

A. $Cr_2O_7^{2-}$

B. H^+

C. I_2

D. H_2O

E. I^-

62. Given the following half-cell reactions:

$Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq)$ E°= +1.36v

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$ E°= +0.34v

What is the value of E° for the following reaction?

$$Cu^{2+}(aq) + 2Cl^-(aq) \longrightarrow Cu(s) + Cl_2(g)$$

A. -2.38v
B. -1.70v
C. -1.02v
D. +1.02v
E. +1.70v

63. In which two compounds does nitrogen have the same oxidation number?

A. N_2O_3 and HNO_3
B. N_2O_5 and HNO_3
C. NO_2 and N_2O_3
D. N_2O_4 and HNO_2
E. HNO_2 and NH_3

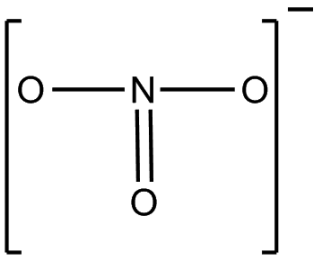
64. Which species is linear?

A. H_2O
B. H_2Se
C. SO_2
D. ClO_2
E. CO_2

65. The three common isotopes of oxygen: ^{16}O, ^{17}O, ^{18}O, have

A. the same atomic number and an equal number of protons.
B. the same mass number and an equal number of neutrons.
C. the same atomic number and an equal number of neutrons.
D. the same mass number and an equal number of protons.
E. the same mass number and an equal number of electrons.

66. A Lewis structure for the NO^-_3 ion is



Including this structure, the total number of ground state resonance structures for this ion is

A. 1.
B. 2.
C. 3.
D. 4.
E. 5.

67. The electronic configuration of a particular neutral atom is $1s^2 2s^2 2p^6 3s^2 3p^2$. What is the number of unpaired electrons in this atom?

A. 1
B. 2
C. 3
D. 4
E. 0

68. Which property increases with atomic number among the representative elements of period two?

A. Atomic radius
B. Electronegativity
C. Metallic character
D. Normal boiling point
E. Melting temperature

69. Which pair would give the bond with the most ionic character?

A. Al and S
B. P and O
C. B and Br
D. C and S
E. Li and O

70. In the reaction shown below a nitrogen nucleus containing six neutrons emits a positron. What is the second product of the balanced reaction?

$$^{13}_{7}\text{N} \longrightarrow {}^{0}_{+1}\text{e} + \underline{\quad\quad}$$

A. $^{13}_{7}\text{N}$

B. $^{14}_{7}\text{N}$

C. $^{14}_{6}\text{C}$

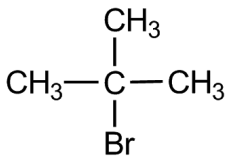
D. $^{13}_{6}\text{C}$

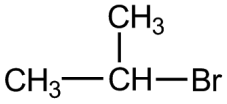
E. $^{13}_{8}\text{O}$

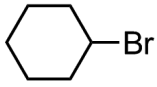
71. A characteristic feature of the S_N2 reaction mechanism is that

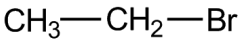
A. it follows first-order kinetics.
B. it produces stereochemical inversion of configuration.
C. there is no rate-determining step.
D. steric factors have little influence on the reaction rate constant.
E. collision of three or more particles is required.

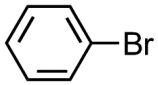
72. Which alkyl bromide will most readily undergo S_N2 reaction with NaOH?

A. 

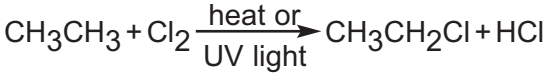
B. 

C. 

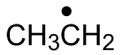
D. 

E. 

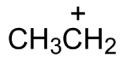
73. Ethane reacts with chlorine in the presence of heat or ultraviolet light to give chloroethane.



Which is an intermediate in this reaction?

A. 

B. Cl^-

C. 

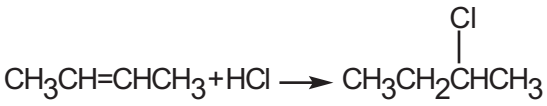
D. $H\bullet$

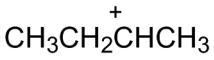
E. Cl^+

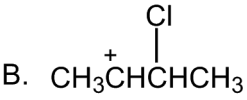
74. How does the energy content of the transition state of a chemical reaction compare with that of the reactants and products?

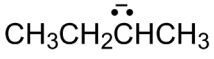
A. It is greater than products but less than reactants.
B. It is greater than reactants but less than products.
C. It is equal to both reactants and products.
D. It is less than both reactants and products.
E. It is greater than both reactants and products.

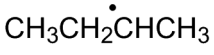
75. Which intermediate is most likely to be involved in the reaction shown below?

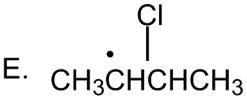


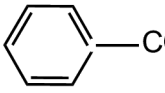
A. 

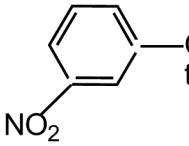
B. 

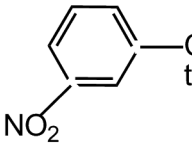
C. 

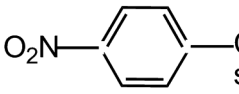
D. 

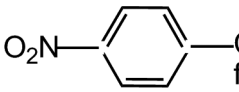
E. 

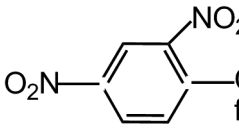
76. The reaction of  with HNO_3/H_2SO_4 will give

A.  and will be slower than nitration of benzene.

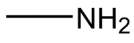
B.  and will be faster than nitration of benzene.

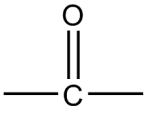
C.  and will be slower than nitration of benzene.

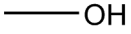
D.  and will be faster than nitration of benzene.

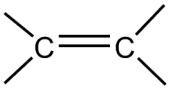
E.  and will be faster than nitration of benzene.

77. A strong infrared absorption band between 1,750 and 1,700 cm^{-1} (5.71-5.88μ) indicates the presence of

A. 

B. 

C. 

D. 

E. 

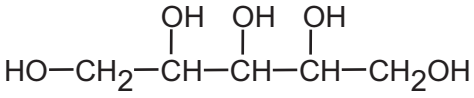
78. If partitioned between equal volumes of ether and water, which would show the greatest preference for the water layer?

A. $CH_3CH_2CH_2CH_2CH_3$

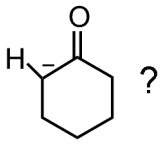
B. $CH_3CH_2CH_2CH_2CH_2Cl$

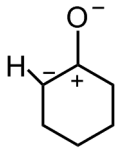
C. $CH_3CH_2CH_2CH_2CH_2OH$

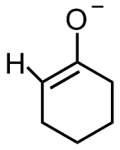
D. $HO—CH_2CH_2CH_2CH_2CH_2OH$

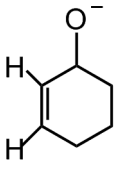
E. 

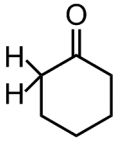
79. Which structure below is an important resonance form of

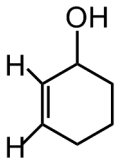
 ?

A. 

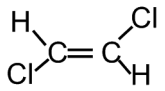
B. 

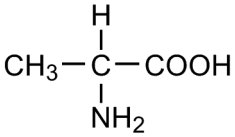
C. 

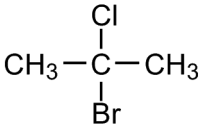
D. 

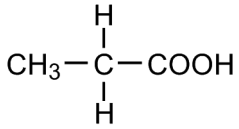
E. 

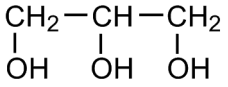
80. Which of the structures below is chiral?

A. 

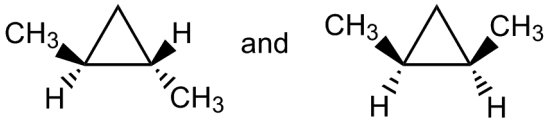
B. 

C. 

D. 

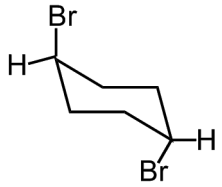
E. 

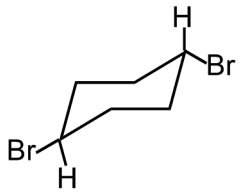
81. What are the following?

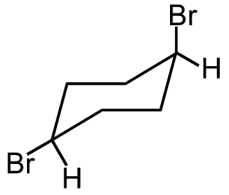


A. Structural isomers
B. Enantiomers
C. Diastereomers
D. Identical compounds
E. Meso compounds

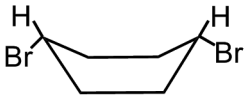
82. Which conformation of 1, 4- dibromocyclohexane is the most stable?

A. 

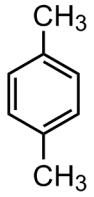
B. 

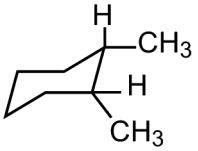
C. 

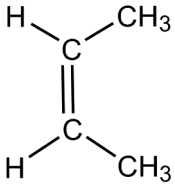
D. 

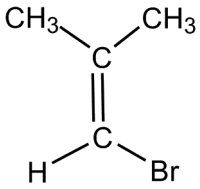
E. 

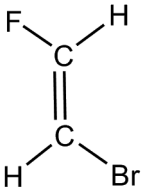
83. Which structure represents a trans (E) isomer?

A. 

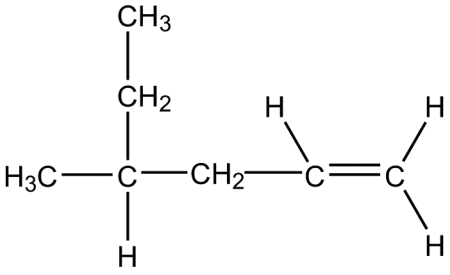
B. 

C. 

D. 

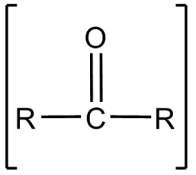
E. 

84. Which is the IUPAC name for this compound?



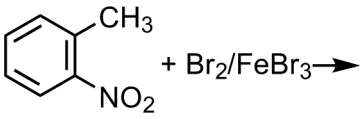
A. 4-methyl-l-hexene
B. 4-ethyl-1-pentene
C. 2-ethyl-4-pentene
D. sec-butyl propylene
E. 3-methyl-5-hexene

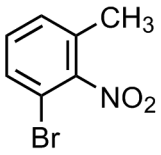
85. The reduction of a ketone

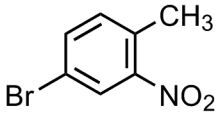


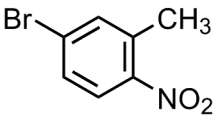
A. an aldehyde first, then a primary alcohol.
B. a primary alcohol.
C. a secondary alcohol.
D. a tertiary alcohol.
E. a carboxylic acid.

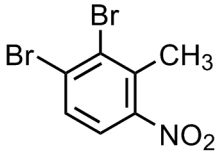
86. What is the major product of the following reaction?

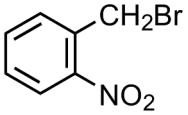


A. 

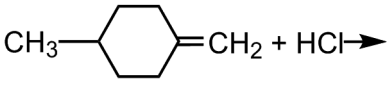
B. 

C. 

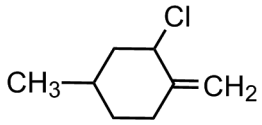
D. 

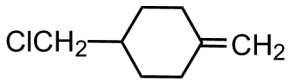
E. 

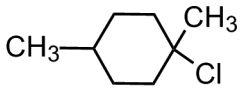
87. In the reaction,

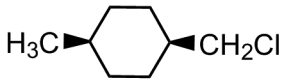


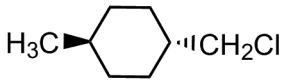
the major product is

A. 

B. 

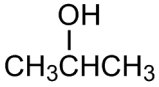
C. 

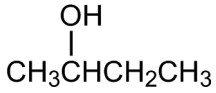
D. 

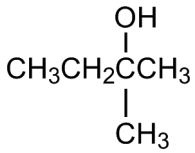
E. 

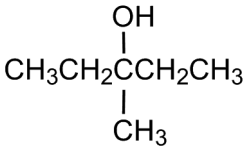
88. The reaction of CH_3CH_2MgBr with

followed by hydrolysis with dilute aqueous acid gives

A. 

B. 

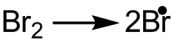
C. 

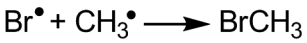
D. 

E. 

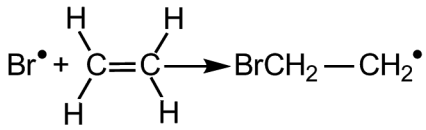
89. Which reaction is an example of a free radical chain termination step?

A. 

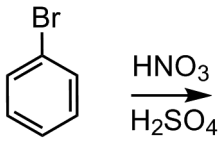
B. 

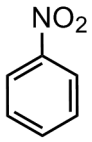
C. 

D. 

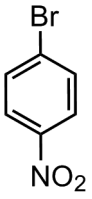
E. 

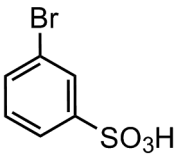
90. What is the product of the reaction shown below?

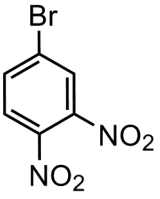


A. 

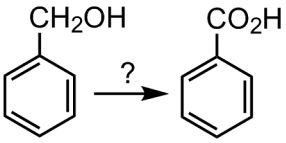
B. 

C. 

D. 

E. 

91. Which could be used in the following conversion?



A. $LiAlH_4$

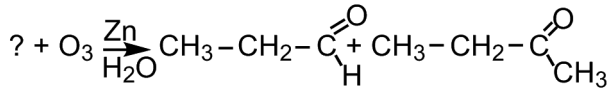
B. CrO_3, H^+

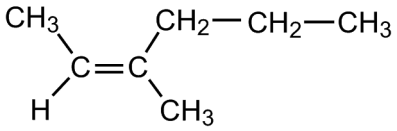
C. $SOCl_2$

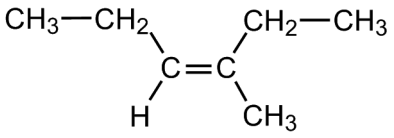
D. PBr_3

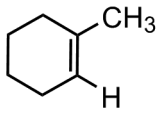
E. H_3O^+

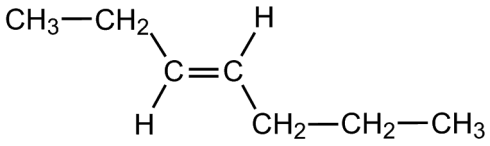
92. Which of the alkenes shown below reacts with ozone to give the products shown?

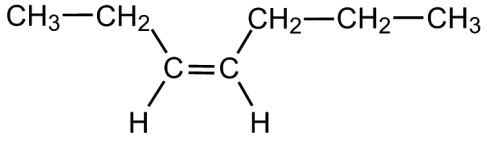


A. 

B. 

C. 

D. 

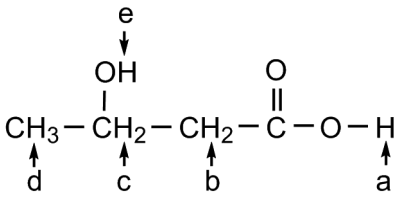
E. 

93. The two Bronsted-Lowry bases in the equilibrium below are

HOAc + NaCN ⇋ HCN + NaOAc

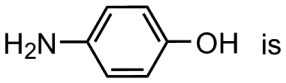
A. HoAc + NACN
B. HOAc + NaOAc
C. NaCN + NaOAc
D. NaCN + HCN
E. HOAc + HCN

94. The most acidic type of hydrogen in the following compound is

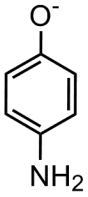


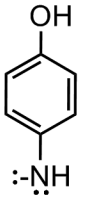
A. a
B. b
C. c
D. d
E. e

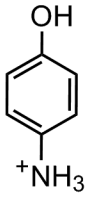
95. The conjugate acid of p-aminophenol

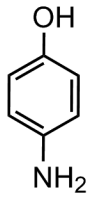


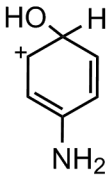
is

A. 

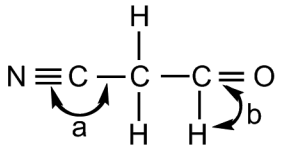
B. 

C. 

D. 

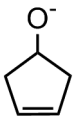
E. 

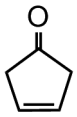
96. The structure below is shown without complete geometrical detail. What is the correct assignment of bond angles?

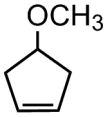


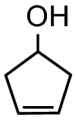
A. a = 90° b = 90°
B. a = 180° b = 109.5°
C. a = 120° b = 120°
D. a = 180° b = 120°
E. a = 180° b = 180°

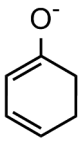
97. Which is stabilized by resonance?

A. 

B. 

C. 

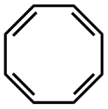
D. 

E. 

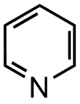
98. Which of the following is aromatic?

A. 

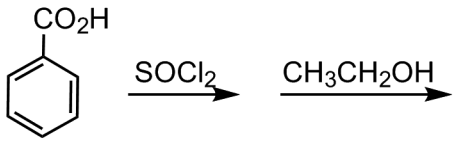
B. 

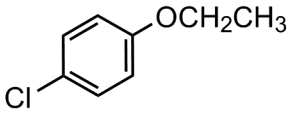
C. 

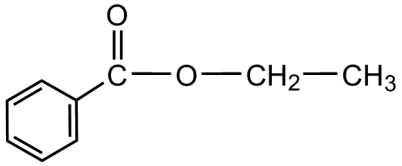
D. 

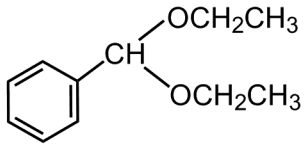
E. 

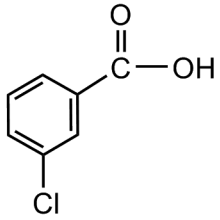
99. Treatment of benzoic acid with thionyl chloride followed by addition of ethanol gives which as the major product?

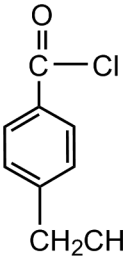


A. 

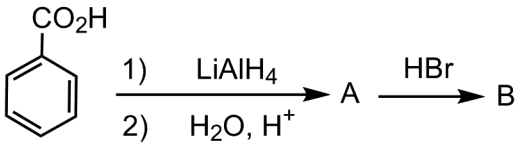
B. 

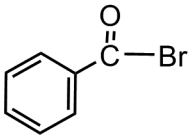
C. 

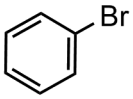
D. 

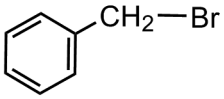
E. 

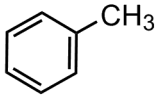
100. What is the final product (B) of the sequence below?

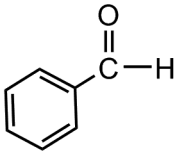


A. 

B. 

C. 

D. 

E. 

Perceptual Ability Test
PAT - Test Number 56

Time limit: 60 minutes

PART/1

For questions 1 through 15

This visualization test consists of a number of items similar to the sample below. A three-dimensional object is shown at the left. This is followed by outlines of five apertures or openings.

In each item the task is exactly the same. First, you are to imagine how the object looks from all directions (rather than from a single direction as shown). Then, pick from the five apertures outlined, the opening through which the object could pass directly if the proper side were inserted first. Finally, mark on your answer sheet (after the number of the item) the letter corresponding to the answer you have chosen.

Here are the rules:

1. Prior to passing through the aperture, the irregular solid object may be turned in any direction. It may be started through the aperture on a side not shown.

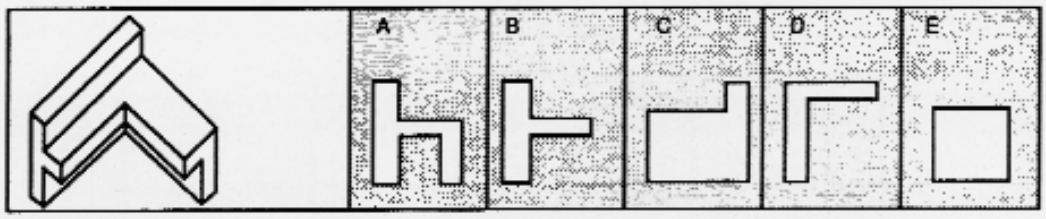
2. Once the object is started through the aperture, it may not be twisted or turned. It must pass completely through the opening. The opening is always the exact shape of the appropriate external outline of the object.

3. Both objects and apertures are drawn to the same scale. Thus it is possible for an opening to be the correct shape but too small for the object. In all cases, however, differences are large enough to judge by eye.

4. There are no irregularities in any hidden portion of the object. However, if the figure has symmetric indentations, the hidden portion is symmetric with the part shown.

5. For each object there is only one correct aperture.

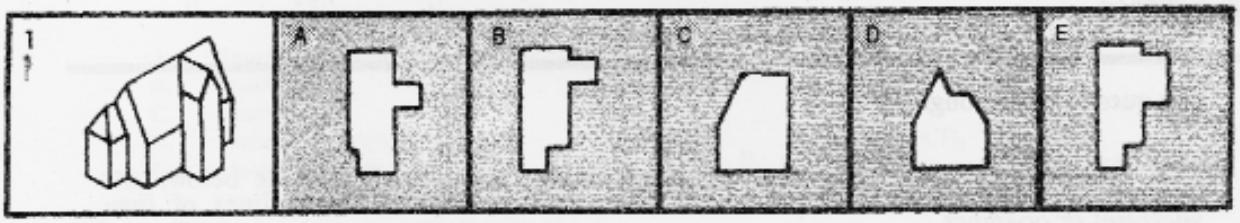
Example: (Do not mark the answer to this example on the answer sheet)

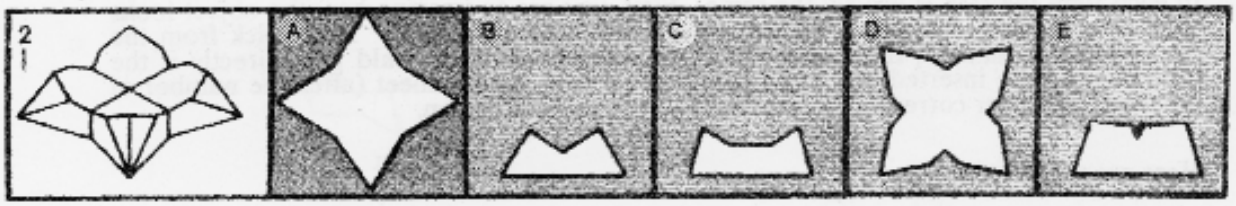


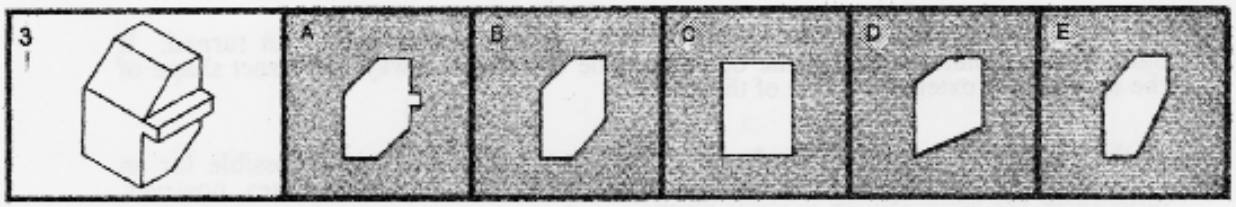
The correct answer is C since the object would pass through this aperture if the side at the left were introduced first.

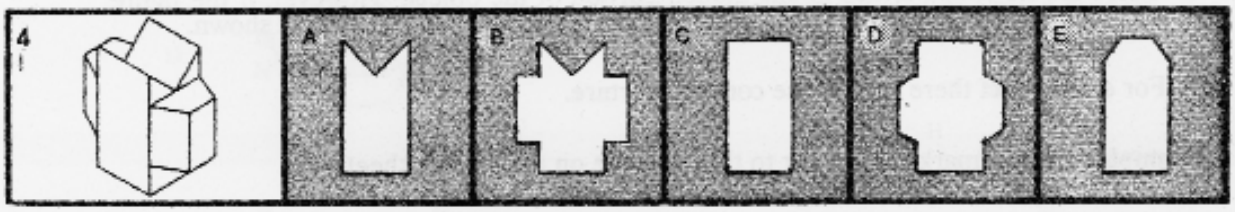
Proceed to Questions

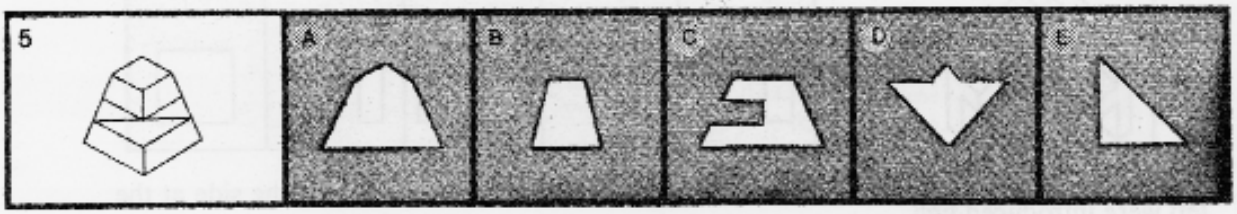
DO NOT WRITE IN OR MARK THIS BOOKLET

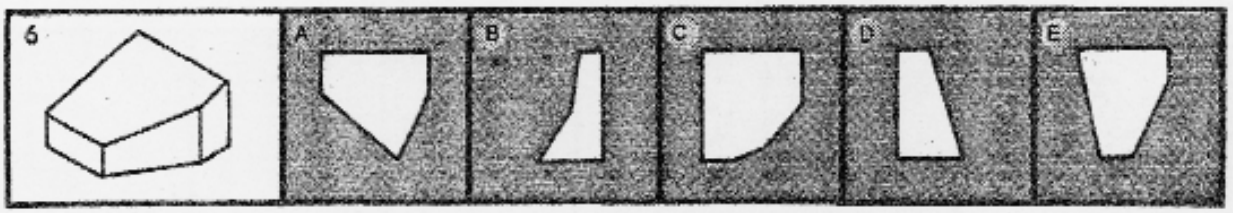


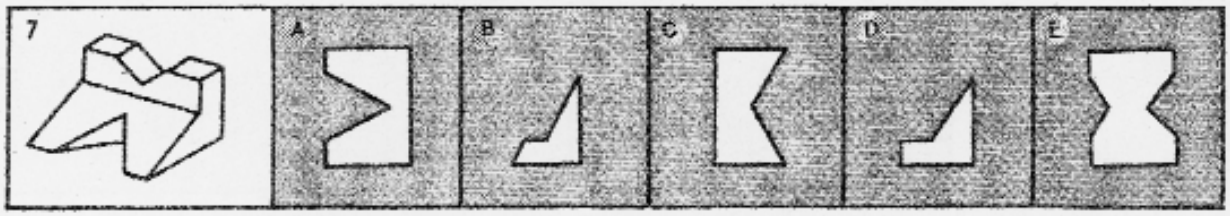


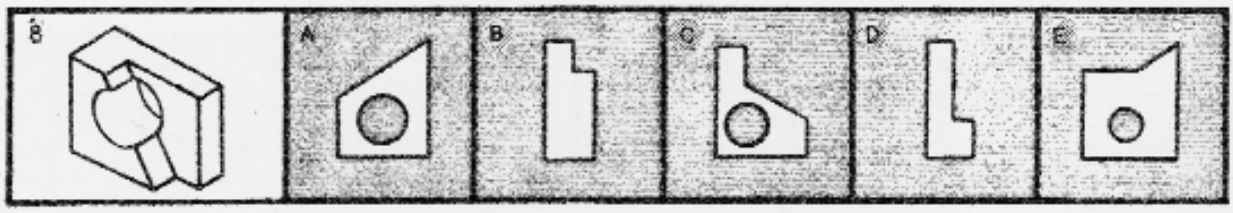


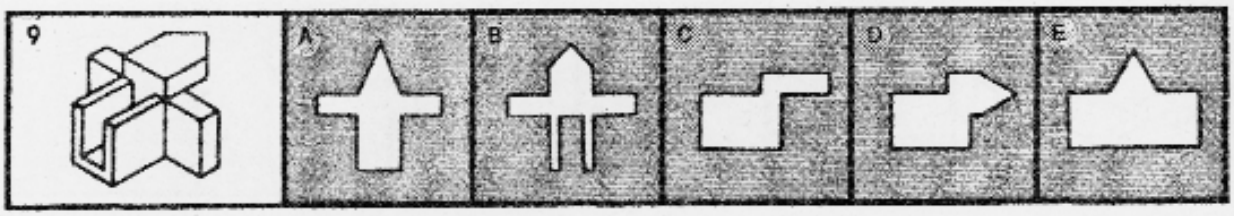


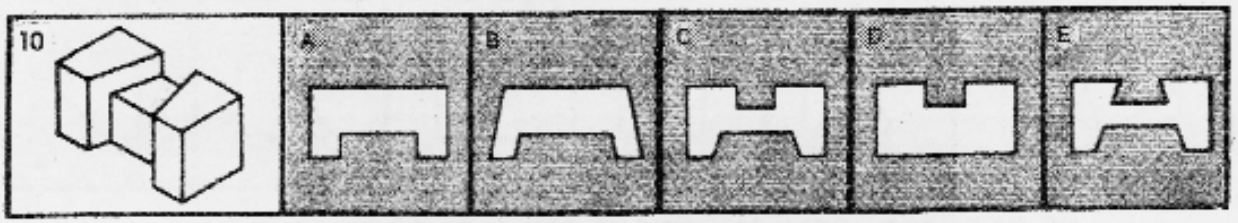


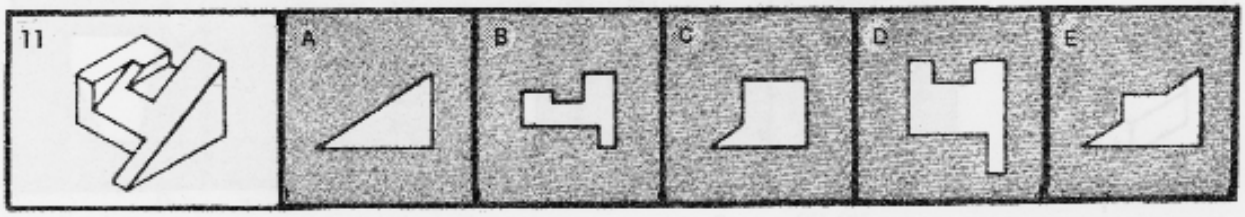


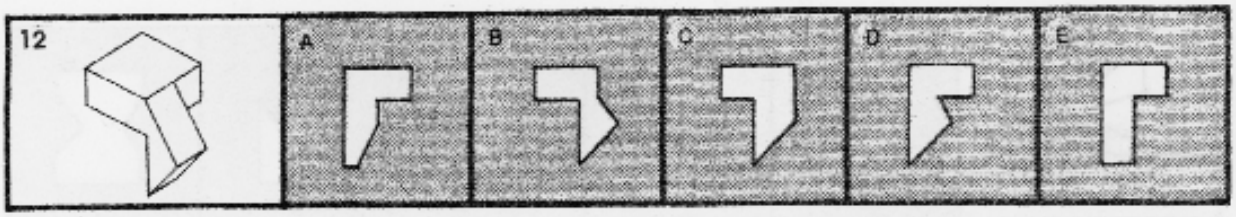


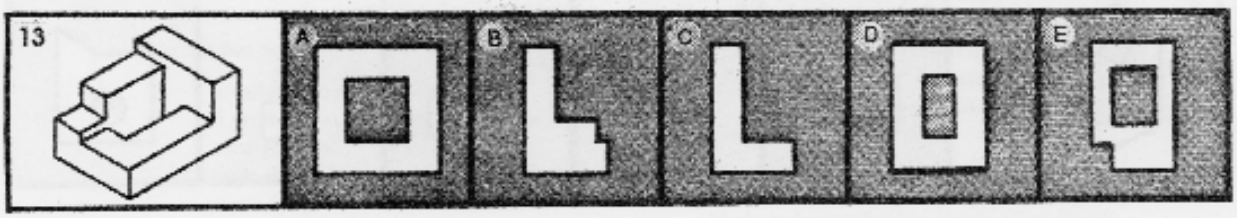


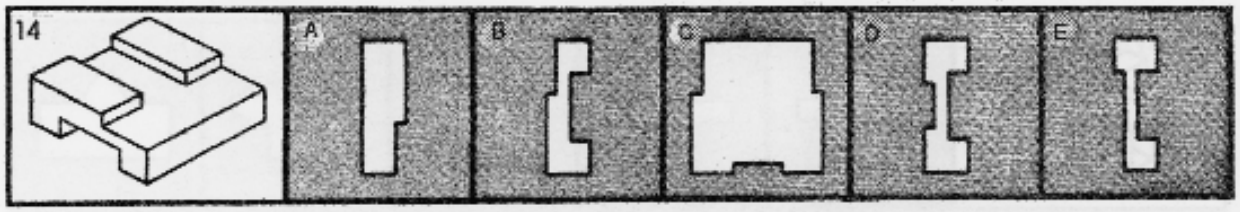


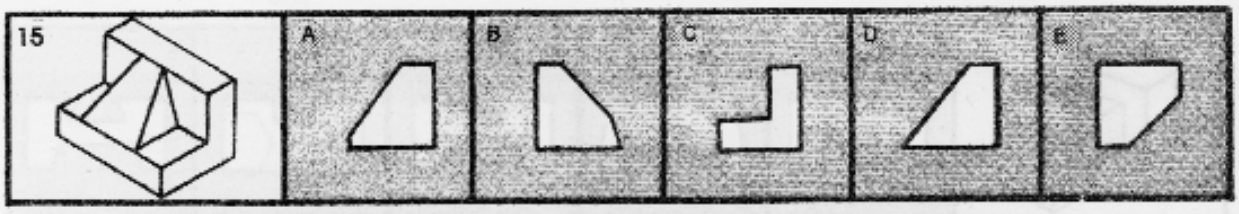










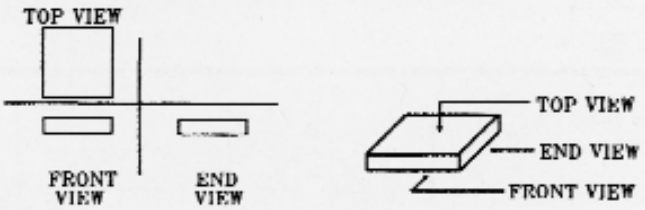


DO NOT STOP - READ DIRECTIONS FOR PART 2 AND CONTINUE

PART/2

For questions 16 through 30

The pictures that follow are top, front, and end views of various solid objects. The views are without perspective. That is, the points in the viewed surface are viewed along parallel lines of vision. The projection looking DOWN on it is shown in the upper left-hand corner (TOP VIEW). The projection looking at the object from the FRONT is shown in the lower left-hand corner (FRONT VIEW). The projection looking at the object from the END is shown in the lower right-hand corner (END VIEW). These views are ALWAYS in the same positions and are labeled accordingly.

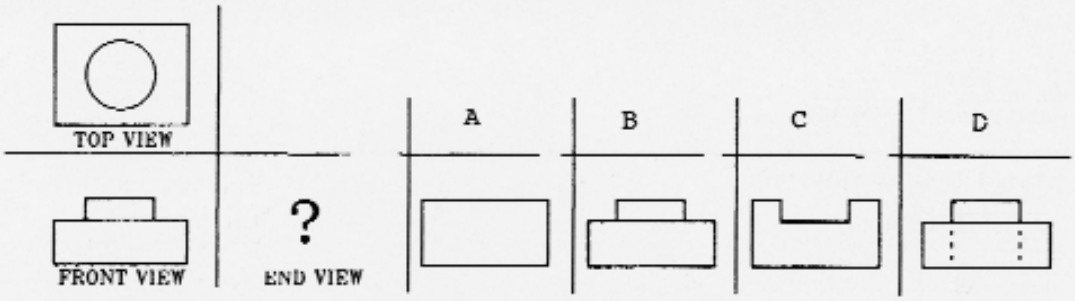


If there were a hole in the block, the views would look like this:

Note that lines that cannot be seen on the surface in some particular view are DOTTED in that view.

In the problems that follow, two views will be shown, with four alternatives to complete the set. You are to select the correct one and mark it on the answer sheet.

Example: Choose the correct END VIEW (Do not mark this on the answer sheet).

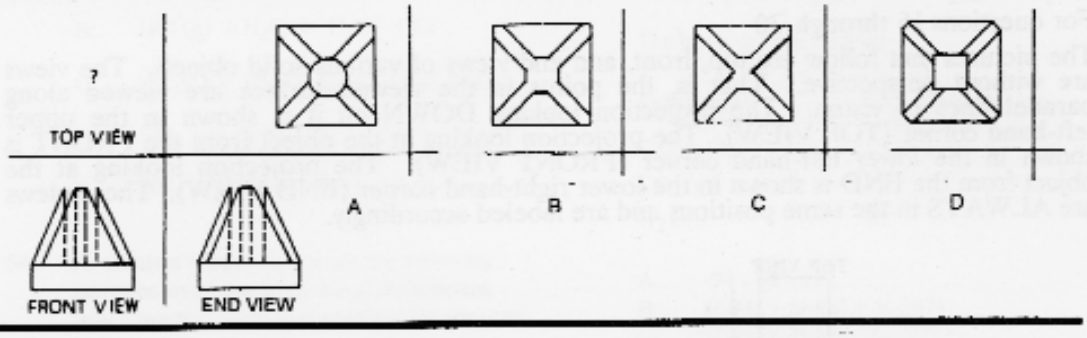


The front view shows that there is a smaller block on the base and that there is no hole. The top view shows that the block is round and in the center of the base. The answer, therefore, must be **B**.

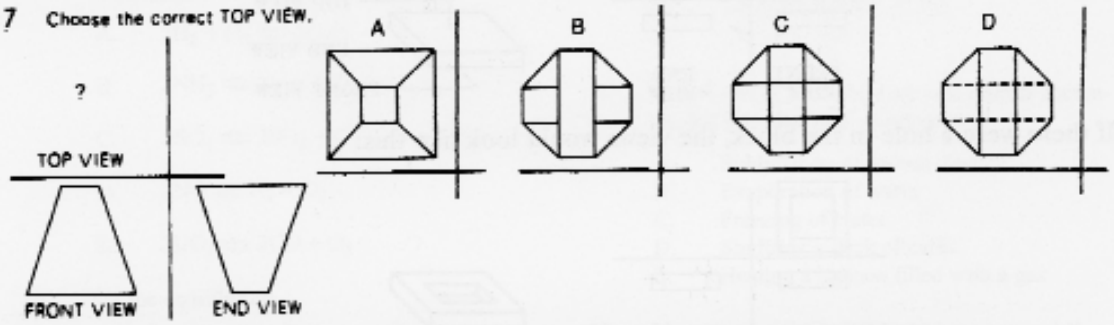
In the problems that follow, it is not always the end view that must be selected, sometimes it is the top view or front view that is missing. Now, proceed to the questions, marking the correct view on your answer sheet.

Proceed to Questions

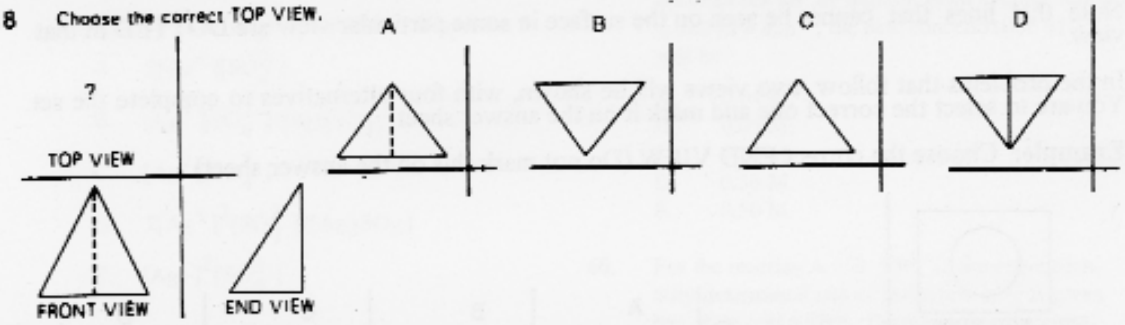
16 Choose the correct TOP VIEW.



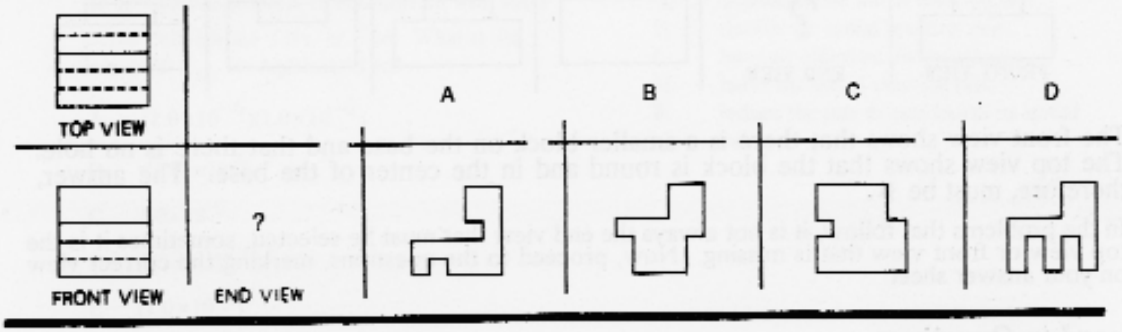
17 Choose the correct TOP VIEW.



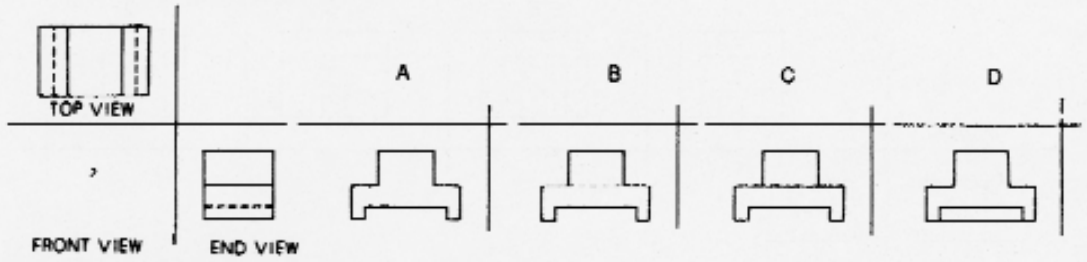
18 Choose the correct TOP VIEW.



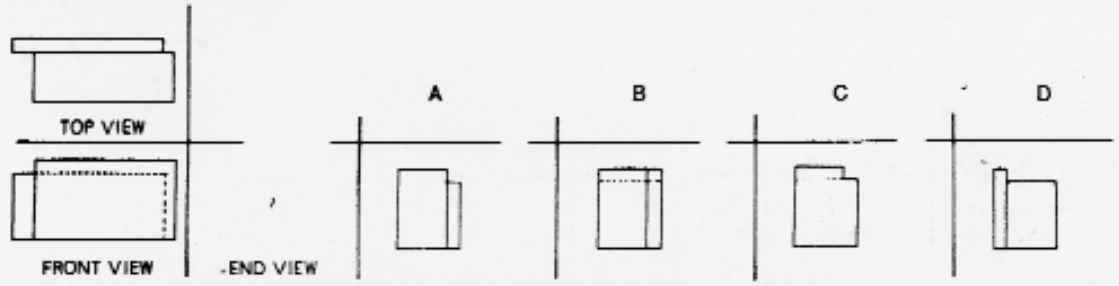
19 Choose the correct END VIEW.



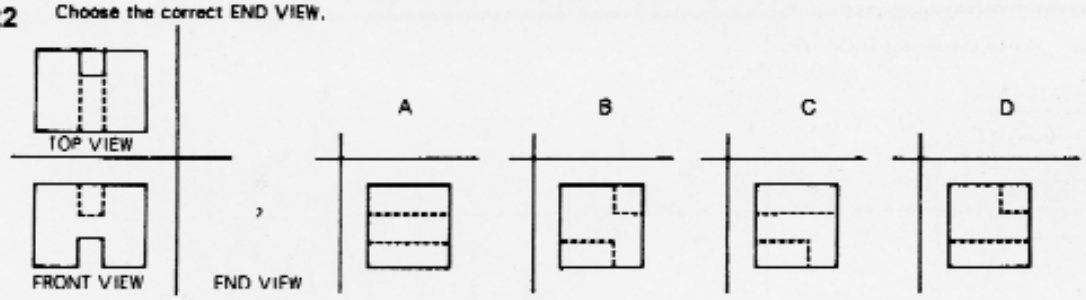
20 Choose the correct **FRONT VIEW.**



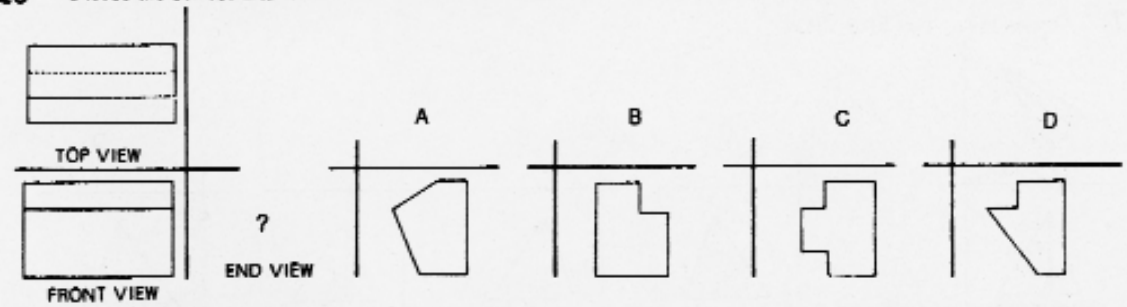
21 Choose the correct END VIEW.



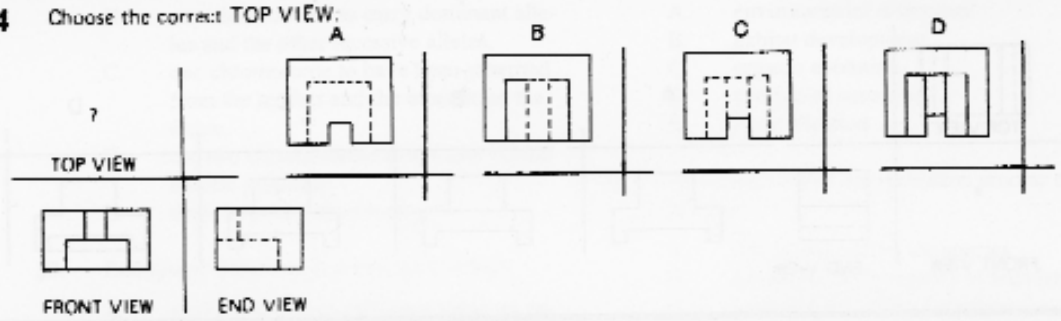
22 Choose the correct END VIEW.



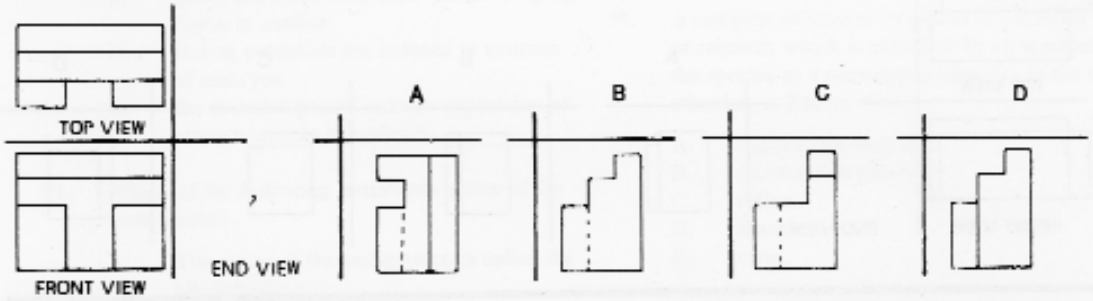
23 Choose the correct END VIEW.



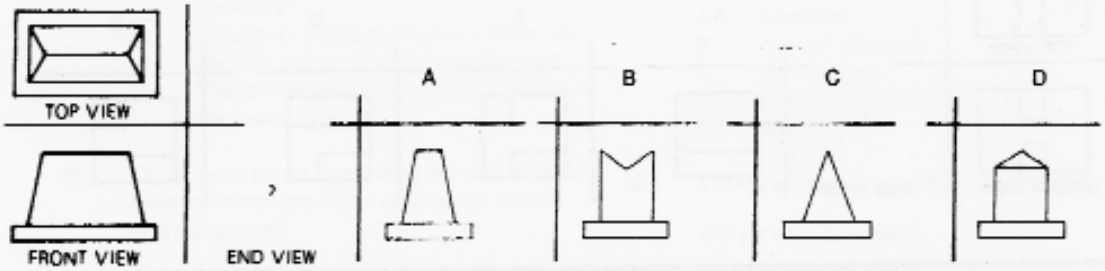
24 Choose the correct TOP VIEW.



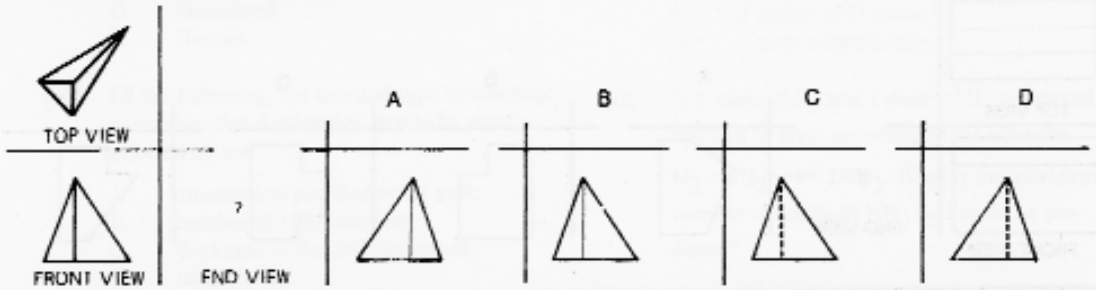
25 Choose the correct END VIEW.



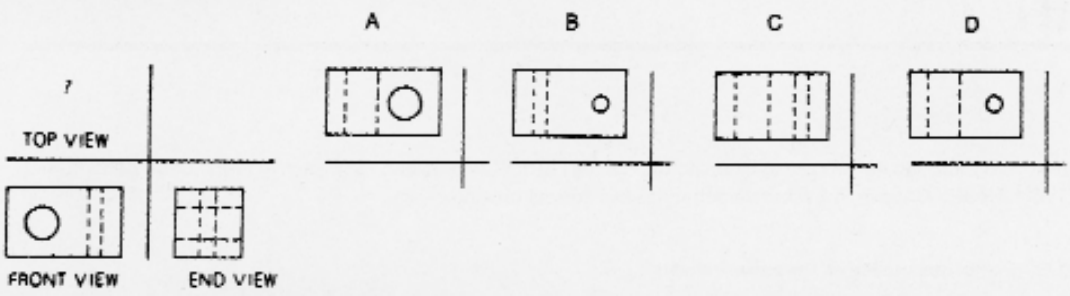
26 Choose the correct END VIEW.



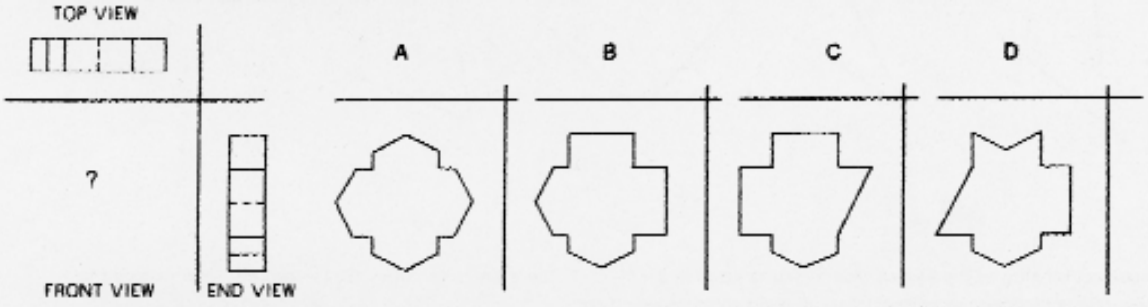
27 Choose the correct END VIEW.



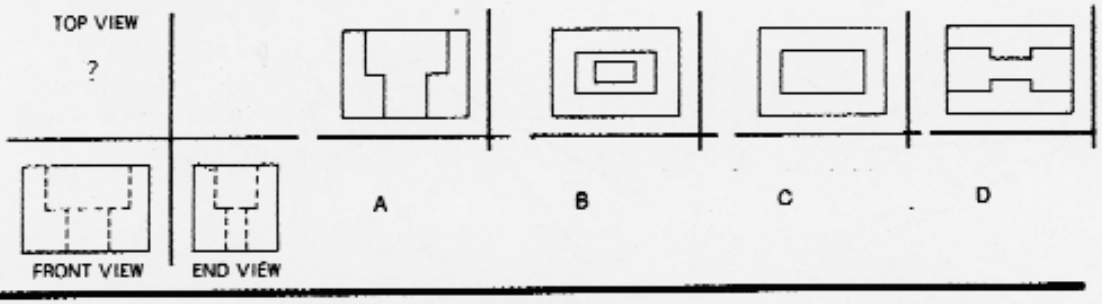
28 Choose the correct TOP VIEW.



29 Choose the correct FRONT VIEW.



30 Choose the correct TOP VIEW.

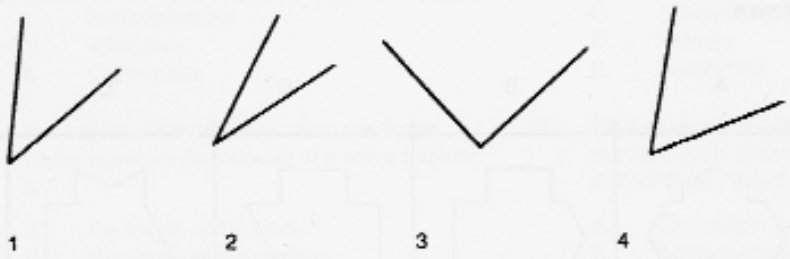


DO NOT STOP – READ DIRECTIONS FOR PART 3 AND CONTINUE

PART/3

For questions **31** through **45** you are to examine the four INTERIOR angles and rank each in terms of degrees from SMALL TO LARGE. Choose the alternative that has the correct ranking.

EXAMPLE: (Do not mark these on the answer sheet)



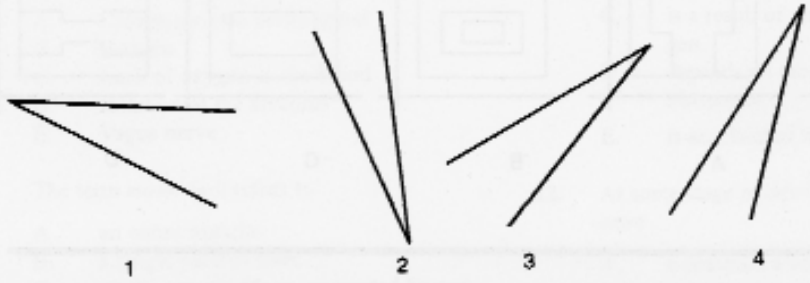
ALTERNATIVES:

(A.) 1 - 2 - 3 - 4
(B.) 2 - 1 - 4 - 3
(C.) 1 - 3 - 2 - 4
(D.) 3 - 4 - 1 - 2

The correct ranking of the angles from small to large is 2 - 1 - 4 - 3; therefore, alternative (B) is correct. Now proceed to the questions marking the correct alternative on your answer sheet.

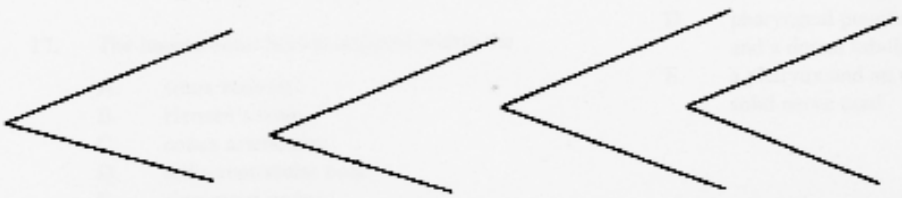
PROCEED TO QUESTIONS

31



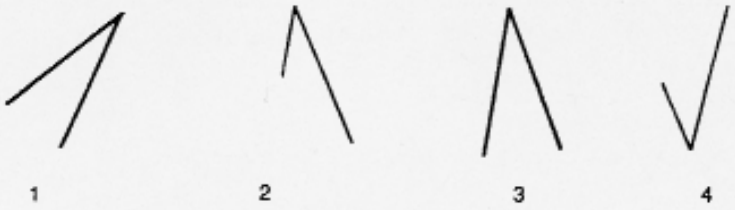
(A.) 2 - 1 - 3 - 4
(B.) 2 - 1 - 4 - 3
(C.) 1 - 2 - 3 - 4
(D.) 2 - 4 - 3 - 1

32



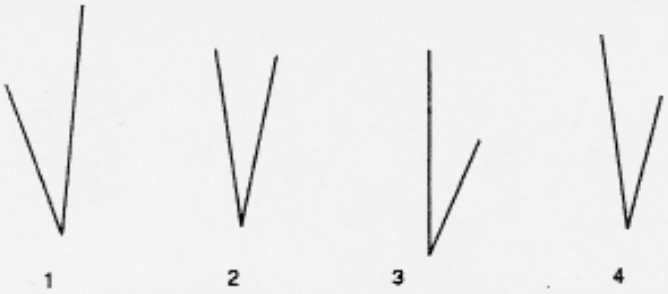
(A.) 2 - 4 - 1 - 3
(B.) 4 - 3 - 2 - 1
(C.) 1 - 2 - 3 - 4
(D.) 3 - 2 - 1 - 4

33



(A.) 3 - 1 - 4 - 2
(B.) 1 - 3 - 4 - 2
(C.) 1 - 3 - 2 - 4
(D.) 3 - 2 - 1 - 4

34

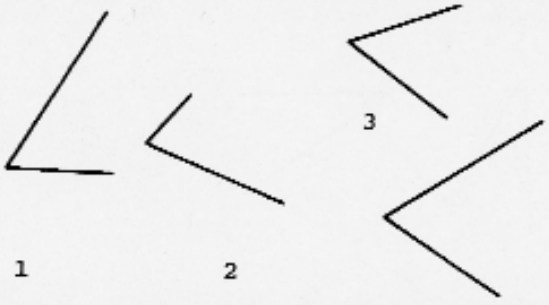


(A.) 4 - 3 - 2 - 1
(B.) 2 - 4 - 1 - 3
(C.) 2 - 4 - 3 - 1
(D.) 4 - 2 - 3 - 1

35

(A.) 3 - 1 - 4 - 2
(B.) 1 - 4 - 3 - 2
(C.) 3 - 4 - 2 - 1
(D.) 3 - 1 - 2 - 4

36

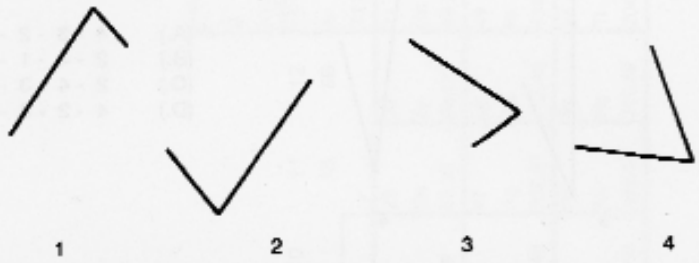


(A.) 3 - 1 - 2 - 4
(B.) 1 - 3 - 2 - 4
(C.) 3 - 1 - 4 - 2
(D.) 1 - 3 - 4 - 2

37

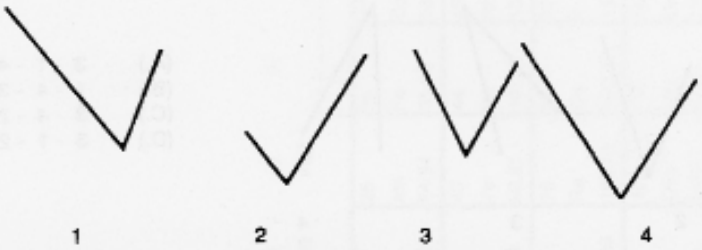
(A.) 2 - 1 - 3 - 4
(B.) 2 - 1 - 4 - 3
(C.) 1 - 2 - 3 - 4
(D.) 2 - 4 - 3 - 1

38



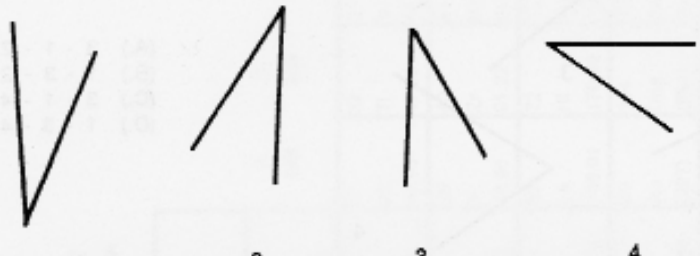
(A.) 3 - 2 - 4 - 1
(B.) 4 - 3 - 2 - 1
(C.) 3 - 4 - 1 - 2
(D.) 4 - 1 - 3 - 2

39



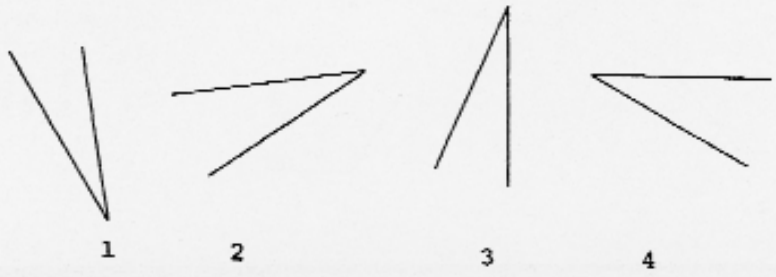
(A.) 3 - 1 - 2 - 4
(B.) 1 - 3 - 2 - 4
(C.) 3 - 1 - 4 - 2
(D.) 1 - 3 - 4 - 2

40



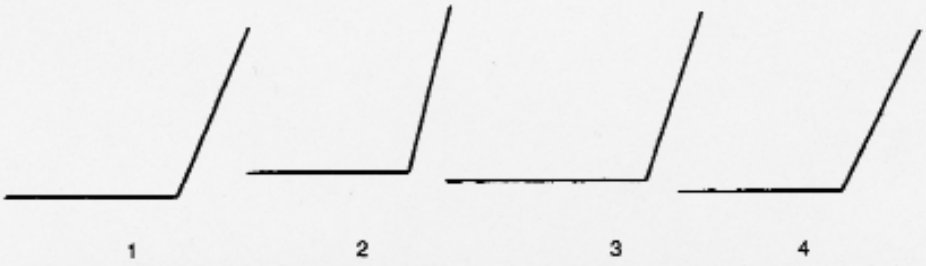
(A.) 3 - 1 - 4 - 2
(B.) 1 - 3 - 4 - 2
(C.) 1 - 2 - 3 - 4
(D.) 3 - 1 - 2 - 4

41



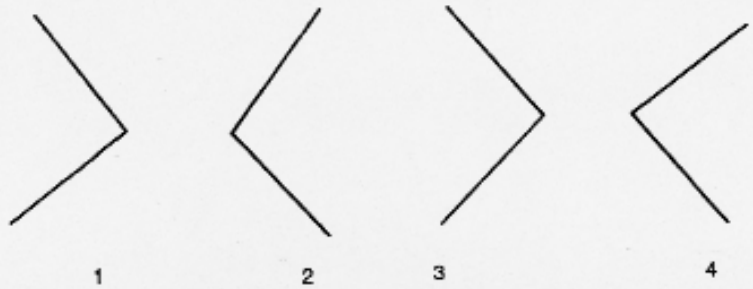
(A.) 3 - 1 - 4 - 2
(B.) 1 - 3 - 4 - 2
(C.) 1 - 3 - 2 - 4
(D.) 3 - 2 - 1 - 4

42



(A.) 2 - 1 - 3 - 4
(B.) 2 - 3 - 1 - 4
(C.) 2 - 1 - 4 - 3
(D.) 2 - 3 - 4 - 1

43

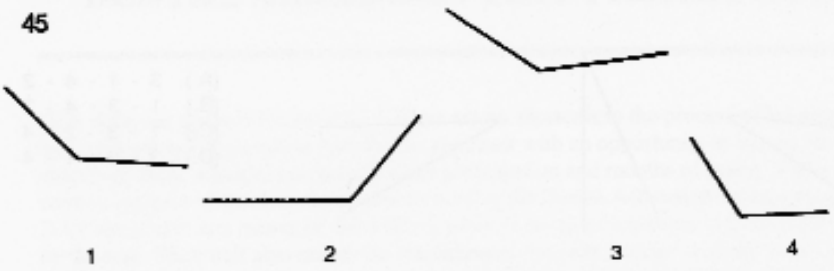


(A.) 4 - 1 - 2 - 3
(B.) 1 - 4 - 3 - 2
(C.) 4 - 1 - 3 - 2
(D.) 1 - 4 - 2 - 3

44

(A.) 4 - 3 - 2 - 1
(B.) 2 - 4 - 1 - 3
(C.) 2 - 4 - 3 - 1
(D.) 4 - 2 - 3 - 1

45



(A.) 4 - 2 - 1 - 3
(B.) 2 - 4 - 1 - 3
(C.) 2 - 4 - 3 - 1
(D.) 4 - 2 - 3 - 1

DO NOT STOP – READ DIRECTIONS FOR PART 4 AND CONTINUE

PART /4

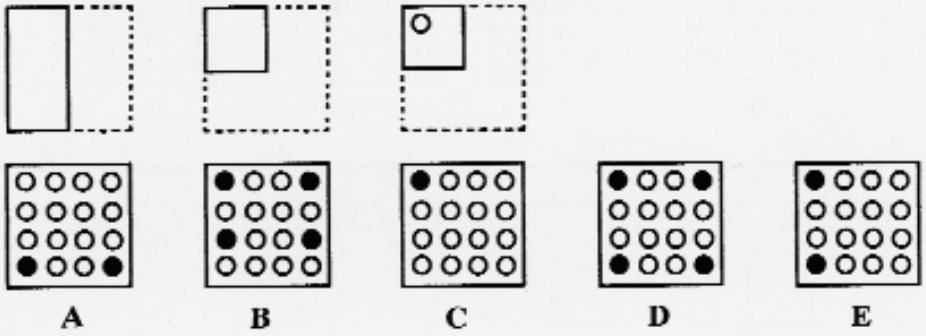
For questions 46 through 60 a flat square of paper is folded one or more times. The broken lines indicate the original position of the paper. The solid lines indicate the position of the folded paper. The paper is never turned or twisted. The folded paper always remains within the edges of the original square. There may be from one to three folds in each item. After the last fold a hole is punched in the paper. Your task is to mentally unfold the paper and determine the position of the holes on the original square. Choose the pattern of black circles that indicates the position of the holes on the original square. There is only one correct pattern for each item.

Example 1:

In Example 1 figure A shows the original paper. Figure B shows the result of the first fold. Figure C shows the position of the punched hole on the folded paper. When the paper is unfolded the pattern of the holes on the original square is shown by the dark circles in Figure D. The answer has two holes since the paper was two thicknesses when punched.

Example 2 shows an item as it appears on the test.

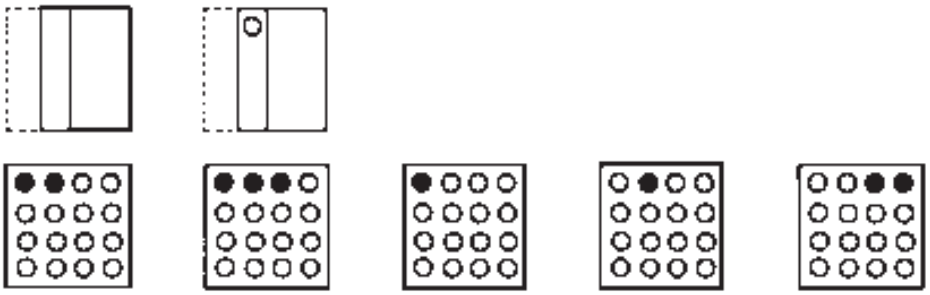
Example 2:



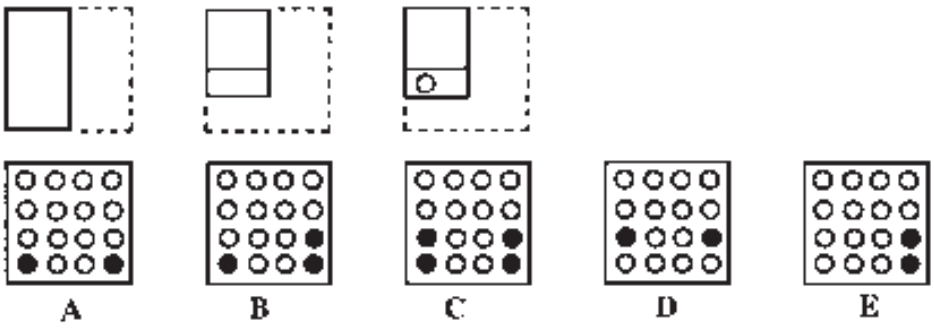
The correct answer to Example 2 is D. The paper was four thicknesses when punched and the holes are located in each of the four corners.

Proceed to Questions

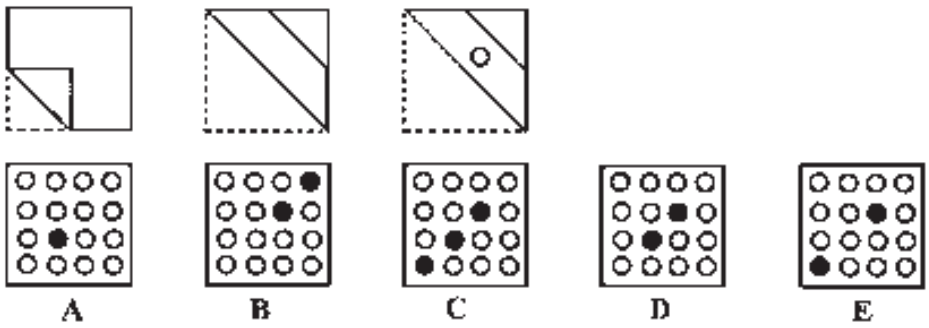
46



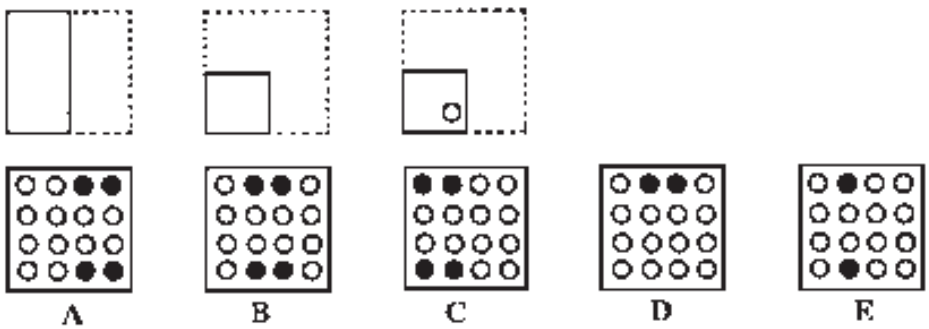
47



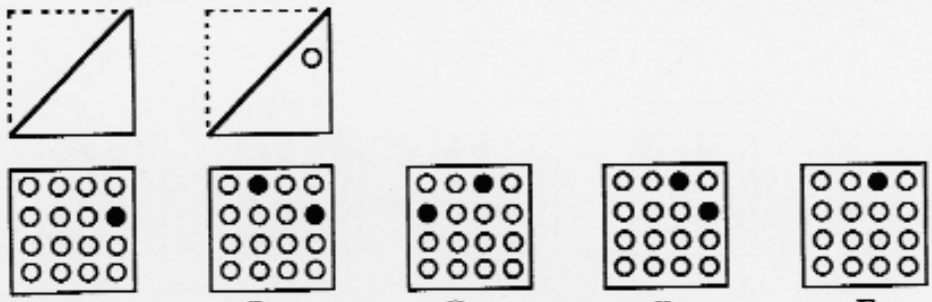
48



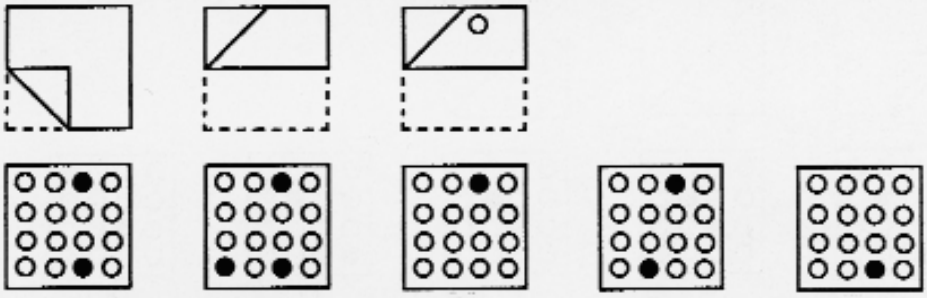
49



50



51



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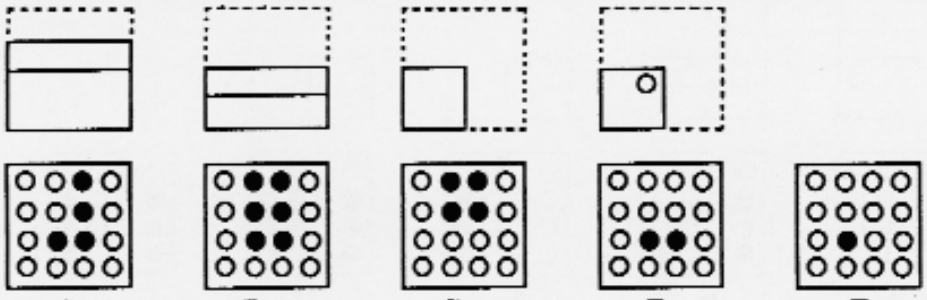

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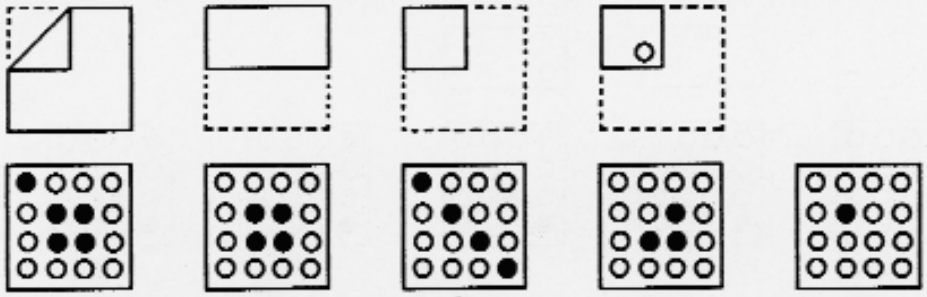

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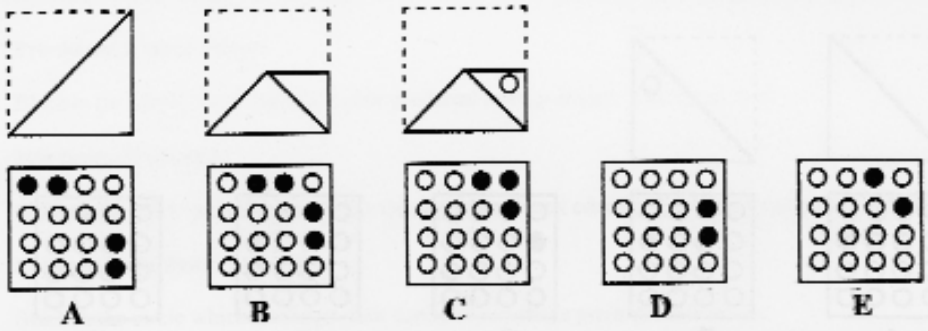

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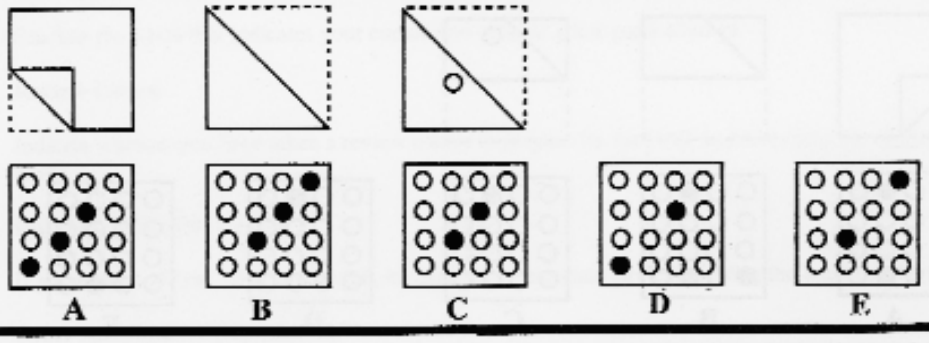

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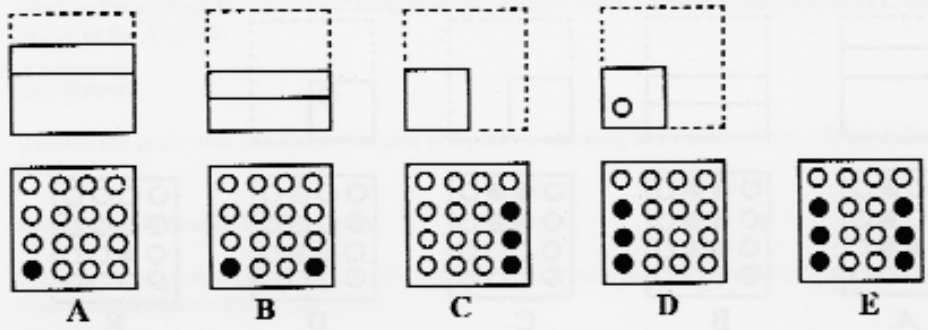
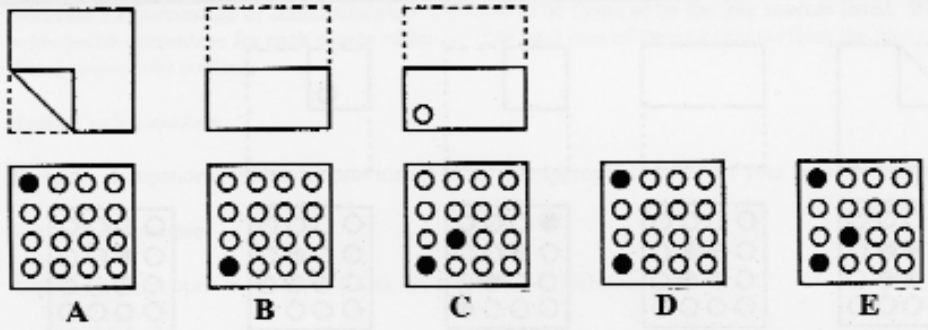
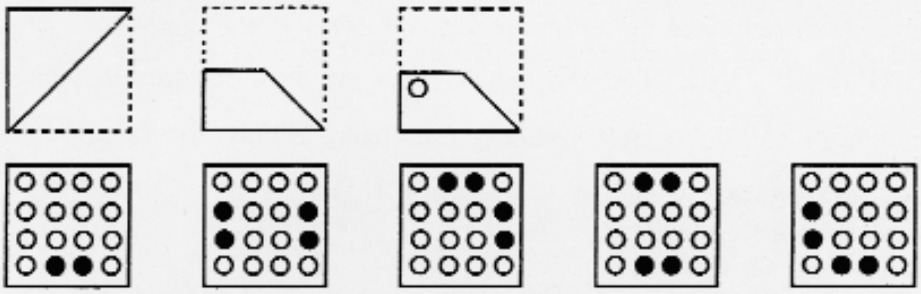


57



58



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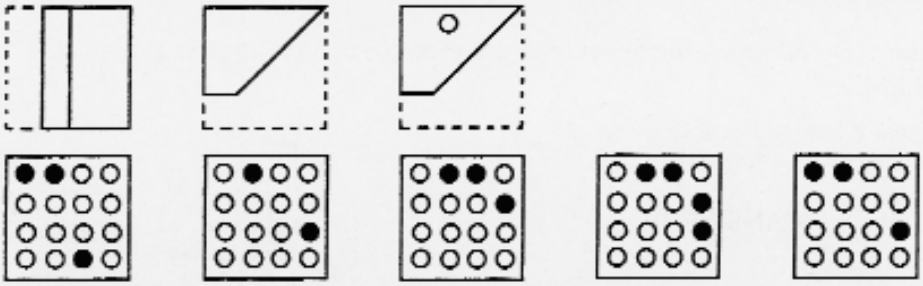
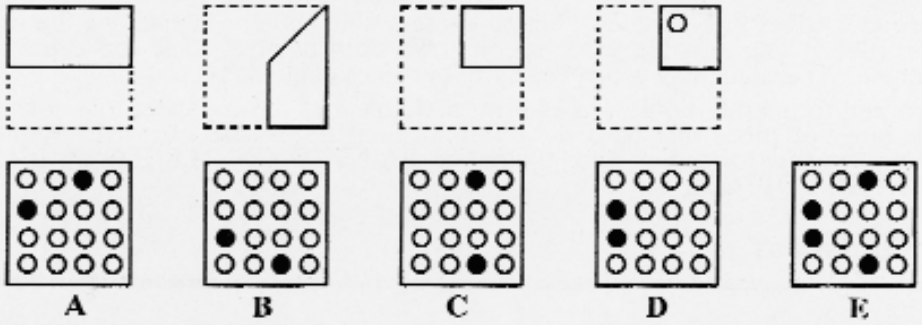


60



DO NOT STOP - READ DIRECTIONS FOR PART 5 AND CONTINUE

PART/5

Each figure has been made by cementing together cubes of the same size. After being cemented each group was painted on all sides EXCEPT FOR THE BOTTOM ON WHICH IT IS RESTING. The only hidden cubes are those required to support other cubes.

For questions 61 to 75 you are to examine each figure closely to determine how many cubes have:

only **one** of their sides painted.
only **two** of their sides painted.
only **three** of their sides painted.
only **four** of their sides painted.
all **five** of their sides painted.

Note: There are no problems for which zero (0) is the correct answer.

Example: (Do not mark the answers to this example on your answer sheet)

PROBLEM Z

In Figure Z how many cubes have two of their exposed sides painted?

A. 1 cube — ANSWER
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

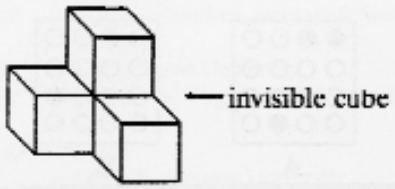


FIGURE Z

There are four cubes in Figure Z. Three that are visible and one supporting the top cube that is invisible. The invisible cube has only two sides painted. The top cube has five sides painted. The remaining two cubes have four sides painted.

Now, proceed to the questions. Darken the circle on your answer sheet that corresponds to the number of cubes that have the different numbers of sides painted. Remember, after being cemented together, each figure was PAINTED ON ALL EXPOSED SIDES EXCEPT THE BOTTOM.

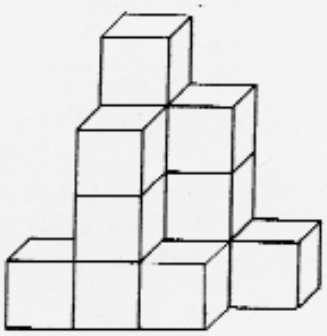
Proceed to Questions

PROBLEM A

61 In Figure A, how many cubes have one of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

FIGURE A



62. In Figure A, how many cubes have two of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

63. In Figure A, how many cubes have three of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

64. In Figure A, how many cubes have four of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

PROBLEM B

65. In Figure B, how many cubes have two of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

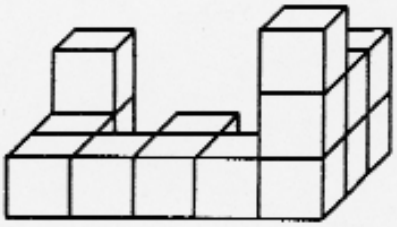


FIGURE B

PROBLEM B

66. In Figure B, how many cubes have four of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

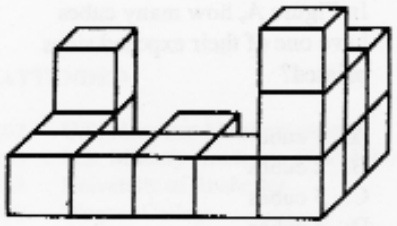


FIGURE B

PROBLEM C

67. In Figure C, how many cubes have two of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

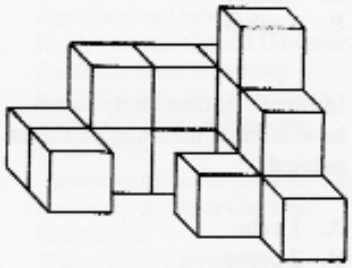


FIGURE C

68. In Figure C, how many cubes have three of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

69. In Figure C, how many cubes have four of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

PROBLEM D

70. In Figure D, how many cubes have one of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

71. In Figure D, how many cubes have two of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

72. In Figure D, how many cubes have three of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

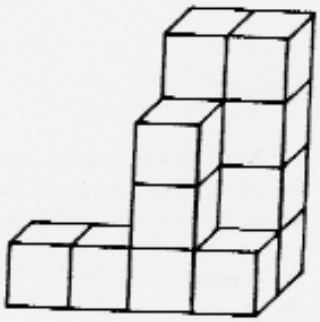


FIGURE D

PROBLEM E

73. In Figure E, how many cubes have one of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

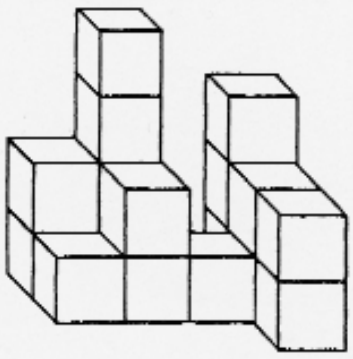


FIGURE E

PROBLEM E

74. In Figure E, how many cubes have two of their exposed sides painted?

A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

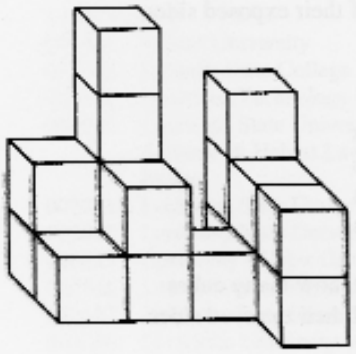


FIGURE E

75. In Figure E, how many cubes have four of their exposed sides painted?

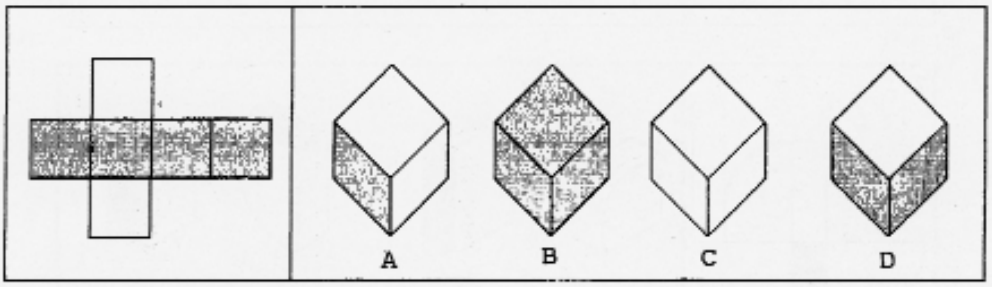
A. 1 cube
B. 2 cubes
C. 3 cubes
D. 4 cubes
E. 5 cubes

DO NOT STOP -
READ DIRECTIONS FOR PART 6 AND CONTINUE

PART/6

In questions **76** through **90** a flat pattern will be presented. This pattern is to be folded into a three dimensional figure. The correct figure is one of the four given at the right of the pattern.There is only one correct figure in each set. The outside of the pattern is what is seen at the left.

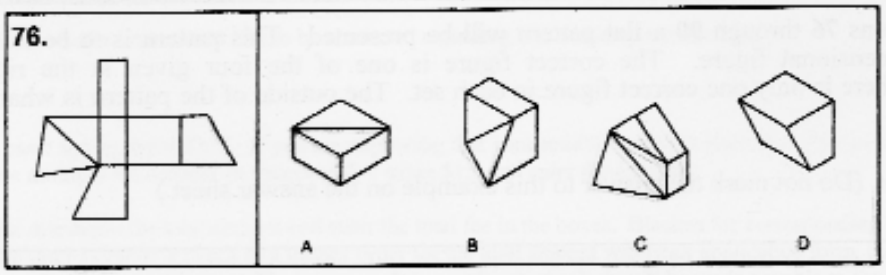
Example: (Do not mark the answer to this example on the answer sheet.)



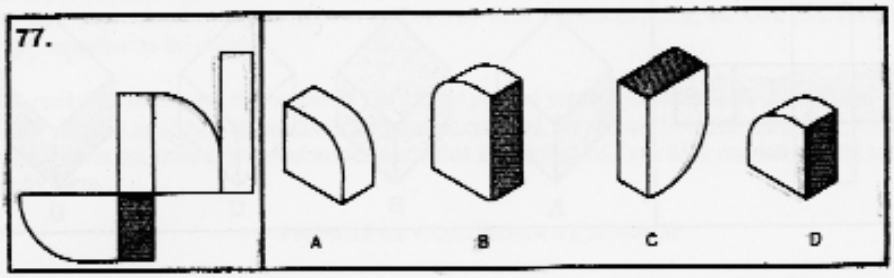
One of the above figures (A, B, C, or D) can be formed from the flat pattern given at the left. The only figure that corresponds to the pattern is D. If the shaded surfaces are looked at as the sides of the box, then all four sides must be shaded, while the top and bottom are white.

Proceed to Questions

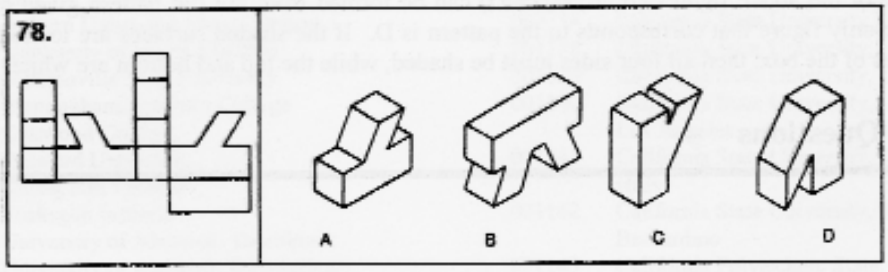
76.



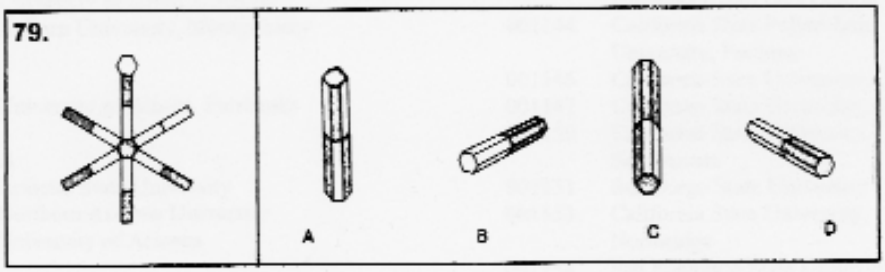
77.



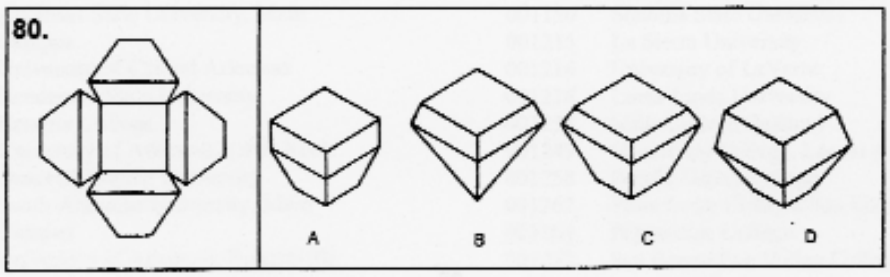
78.



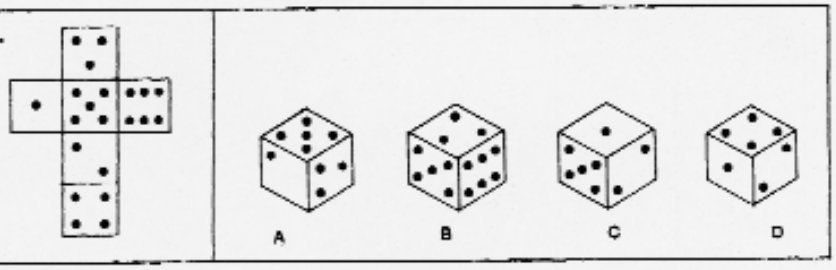
79.



80.



81.



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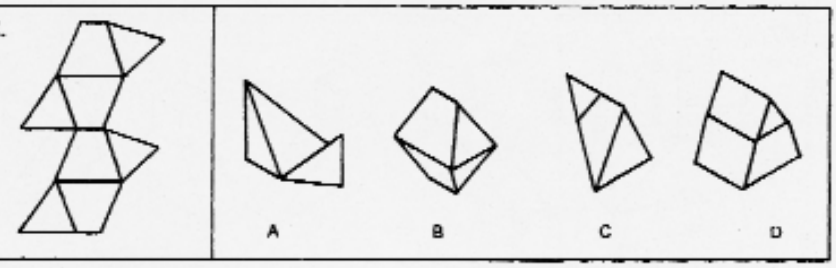
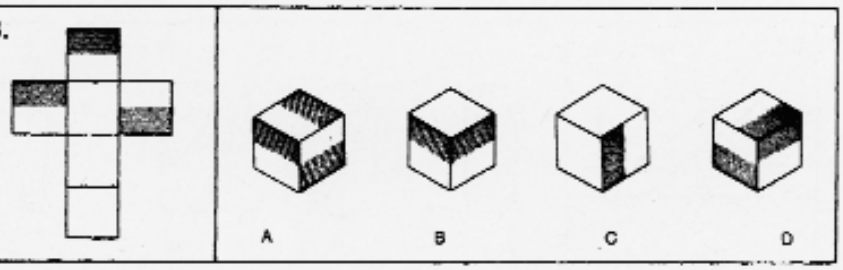
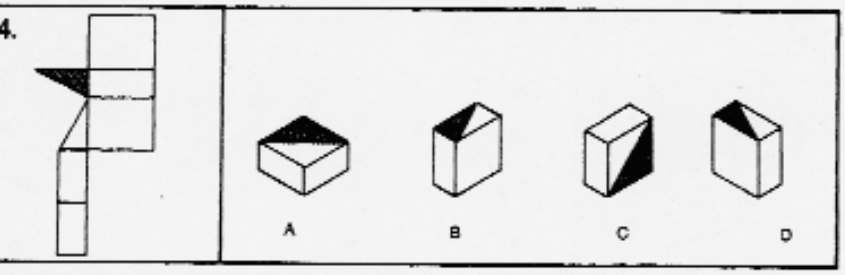


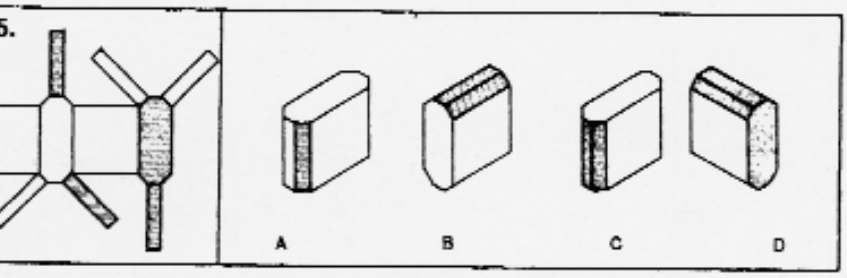
83.



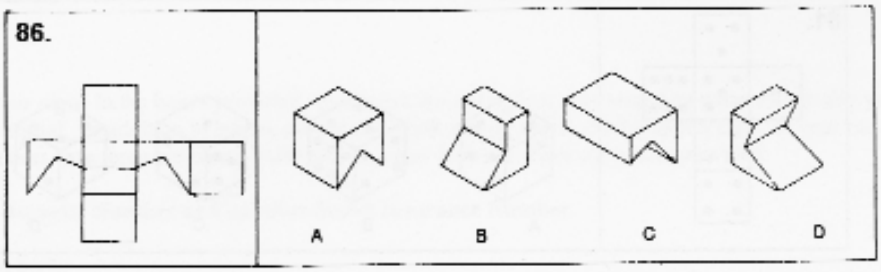
84.



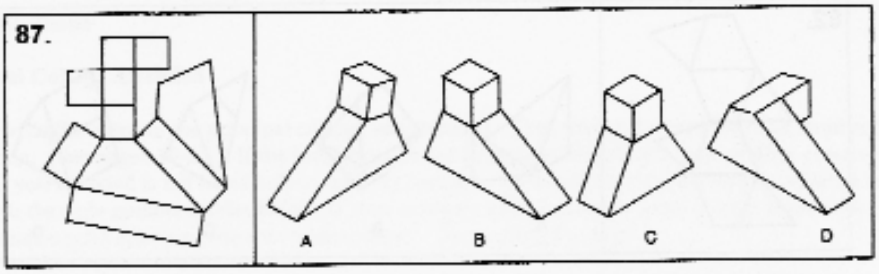
85.



86.



87.



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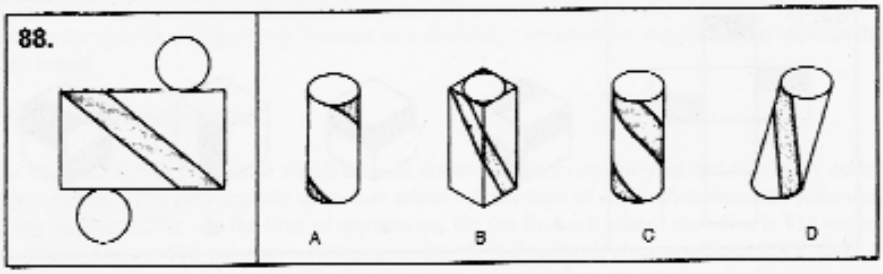
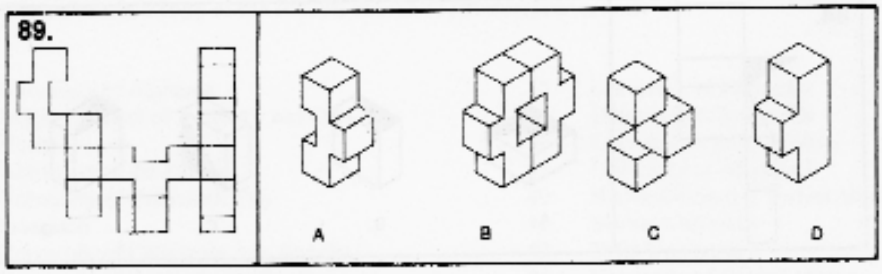
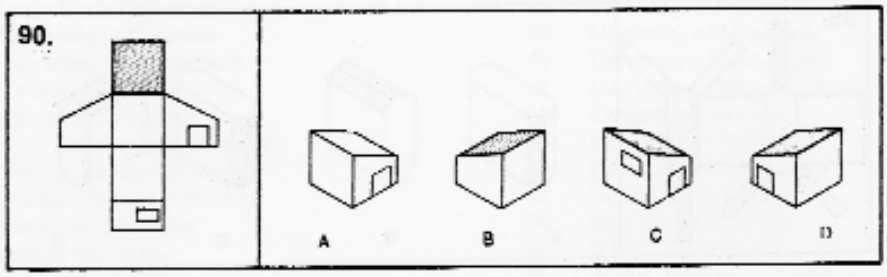


89.



90.



THE END

Reading Comprehension Test
RCT - Test Number 52

Time limit: 15 minutes
(Actual Test will contain three passages and the time limit will be 60 minutes)

IONIZING RADIATION: RISK AND BENEFIT

X radiation is a form of energy which was discovered by the German physicist, Wilhelm Conrad Roentgen in 1895. Like visible light, radiowaves, and microwaves, X-rays belong to a group of radiations known as the electromagnetic spectrum. Electromagnetic radiations are comprised of units of pure energy called photons or quanta. Unlike corpuscular, or particular, radiations which are composed of subatomic particles, electromagnetic radiations have no mass or weight. Subatomic particles that can be involved in corpuscular radiations include the alpha particle or helium radical, the beta particle or electron, neutrons and protons. Corpuscular radiations can cause ionization; however, for the purposes of the present discussion only electromagnetic radiations capable of causing ionization will be considered.

All photons of electromagnetic radiation travel in direct lines in a wave motion at the speed of 300,000 kilometers per second. Many of our conceptual ideas about wave motion are the result of our sensory experience with the transverse waves which occur in water and in the stretched string of a musical instrument. It is a pity in some way that the same term, wave, is given to both this transverse wave form and the oscillatory movement which is propagated along the direction of travel by electromagnetic radiations. This oscillatory movement, or longitudinal wave propagation, can be seen when a coiled spring is tapped sharply at one end, and as such this is a good paradigm for electromagnetic wave motion. Whereas for transverse waves the wavelength is between successive crests, the wavelength for electromagnetic radiations is the distance between successive areas of compression. This distance can vary enormously and electromagnetic radiations of different wavelengths have different properties. At one end of the spectrum there are very long wavelengths. Electromagnetic radiation of long wavelength is used in the transmission of radio messages. At the other end of the spectrum are the short wavelength radiations such as gamma radiations, which arise from naturally occurring unstable elements, and X-rays which are similar in property to gamma radiations, but are man-made by bombarding a target material with electrons in an X-ray tube. For gamma and x radiations the wavelengths are so small that they are measured in Angstrom units, where an Angstrom unit is 1/100,000,000 centimeter. The shorter the wavelength, the higher the energy and penetrating power of the photon, and (as all electromagnetic radiations travel at the speed of light) the higher the frequency of waves. X-ray wavelengths used in diagnostic radiology range from approximately 0.1 to 0.5 Angstroms. At such wavelengths the radiation has sufficient energy to cause ionization of atoms and molecules. If such atoms or molecules are within living systems, there is the potential for biological harm. This is the reason for the paradox that X-rays can cause cancer, can be used to help in diagnosis of disease, and in high doses can be used to destroy cancer cells.

Consideration of the potential benefits of an activity is involved in the decision of risk acceptability. In diagnostic radiology, the risk-benefit equation is difficult to estimate. Risk is generally given in units of equivalent radiation dose, while the benefit is expressed in such terms as saved or disease cured. Gibbs and his fellow workers have noted that estimates of risk whole-body exposure, which is not generally the case for the diagnostic use of

x radiation. Moreover, they indicated that it has not yet been possible to define the value of a life saved in units of dose equivalence. Because of these uncertainties, diagnostic radiation is to be regarded as a potentially noxious agent. Hence radiological examination should be carried out only if it is likely that the information obtained will be useful for the clinical management of the patient.

Undoubtedly ionizing radiation in high doses can be harmful. The first report of patient injury from a diagnostic radiological procedure, namely skin burns, was made within a few months of Roentgen's discover of the X-ray. In that case the exposure time was one hour, but it is impossible to estimate the dose received. As early as 1902 the first case of cancer attributed to radiation injury was reported in the literature. Nonetheless, the magnitude of the risk (or even if there is a risk) from the small doses of x radiation presently employed for diagnostic purposes is still undetermined.

Various accidents, such as the recent reactor incident at Chernobyl in the Soviet Union, knowledge gained from follow-up studies on survivors from the atom bomb explosions in Hiroshima and Nagasaki at the end of World War II, and experiments subjecting various plant and animal species to ionizing radiation indicate that radiation bioeffects can be divided into two basic types where relatively high doses of radiation are concerned. One category of effects requires a threshold dose can be met before detectable change occurs. Such effects are termed non-stochastic, and are primarily a result of cell death. Examples are the acute radiation syndrome and the development of cataracts. On the other hand, stochastic effect show statistical probability of occurrence as a function of dose, but no threshold cut off for the effect. Examples of stochastic effects are carcinogenesis and genetic mutations.

The problem in evaluating the risk of cancer or mutation in human populations due to the diagnostic use of x radiation is that there is no known method to distinguish between disease resulting from the radiation and that which is spontaneous or due to other factors in environment. The only way to assess the magnitude of the risk would be to determine the excess incidence of cancer or mutations in an irradiated population. Where the excess incidence is expected to be small, extremely large populations and long periods of observation are required. Land, for example, suggested that the risk of breast cancer from mammography is numerically so small when compared to the spontaneous incidence of one in 13 for breast cancer in U.S. women, that the epidemiologic methods of evaluation would require a population of at least 60 million women followed from age 35 until death. Half of them would receive mammograms and the other half, the control group, would not. It goes without saying, that such a study would take at least 40 years to conduct and would be so prohibitively expensive that it is not likely to be carried out. Similar considerations apply to the evaluation of risks from small doses of ionizing radiation of all human cancers and mutations. Hence, it has been common practice to use quantitative estimates and interpolations from observations of human and animal populations exposed to large radiation doses, when attempting to make numeric estimates of the risks to humans from low doses of ionizing radiation.

In view of the uncertainty surrounding possible risks from the diagnostic use of X-rays, the International Commission on Radiological Protection has originated the concept of keeping exposure levels "as low as reasonably achievable." This concept has been summarized in cryptic acronym form as the ALARA Principle. The three key ways of minimizing exposure to radiation are minimizing the duration of exposure, maximizing the distance from the source, and using barriers such as leaded clothing or screens. Diagnostic X-ray production occurs only when the X-ray tube is energized, and this is only necessary when radiographs are being exposed. The time that the X-ray tube is energized can be reduced by using fast image receptors, and by

reducing the number of radiographs taken by high-yield selection criteria of the exposures to be performed. As the intensity of the X-ray beam is inversely proportional to the square of the distance from the source (e.g. when the distance is doubled the intensity of the beam is reduced by a factor of four, when tripled it is reduced by a factor of nine…) the operation should be as far as possible to stand behind a barrier impregnable to the X-rays being used. By conscientious use of ALARA Principle, the practitioners reduce risks for themselves, their staff and their patients.

1. Which was the earliest descriptor of ill effects attributed to x radiation?

A. Cancer in atom bomb survivors
B. Genetic mutations following mammography
C. Radiation burns due to prolonged exposure
D. Acute radiation syndrome after the Chernobyl incident
E. Cataracts

2. Of the following, which is the electro-magnetic radiation having the longest wavelength?

A. Gamma radiation
B. Alpha radiation
C. Beta radiation
D. X radiation
E. Radiowave radiation

3. From statements in the passage, it can be inferred that the author probably is a(n)

A. sentimentalist whose judgments are influenced primarily by his emotions.
B. skeptic who refuses to believe anything without absolute proof.
C. realist who adheres to practical considerations and rejects the impractical.
D. idealist who places his own standards of perfection before practical matters.
E. conformists who follows the ideas of authority without question.

4. Wave motion for x radiation most closely resembles the oscillating movement of a

A. fast-moving helium radical.
B. coiled spring that has been sharply tapped at one end.
C. plucked stretched string of a musical instrument.
D. Wave in water caused by disturbance from a fast moving motor boat.
E. transverse wave form.

5. The paradox of x radiation is stated to be that

A. it is used for diagnostic purposes when the risks involved have not been fully determined.
B. it was discovered, but not invented, as gamma radiation is naturally occurring counterpart.
C. it can be controlled by mankind.
D. it can both cause and cure cancer.
E. None of the above

6. Which electromagnetic radiations carries the most energy, and is therefore most penetrating?

A. Microwaves
B. Radiowaves
C. Visible light
D. Gamma rays
E. They all have the same energy.

7. With which statement would the author of the passage agree?

A. Rigorous experimentation must be carried out to more accurately asses damage caused by the diagnostic use of X-rays.
B. Epidemiologic data from individuals receiving high doses of radiation can accurately be interpolated to assess the effects of low levels of radiation.
C. Non-stochastic effects of radiation are a more serious problem for diagnostic radiology than are stochastic effects.
D. The most effective way to improve the risk-benefit ratio is to minimize the number of exposures performed by using careful radiographs selection.
E. It is easy to differentiate between disease caused by exposure to ionizing radiation and that from other causes.

8. The beta particle is the same as a(n)

A. neutron.
B. photon of pure energy.
C. proton.
D. helium radical.
E. electron.

9. According to the inverse square law, the intensity of radiation received is reduced by a factor of ___ times when a practitioner stands 4 meters away from a source of radiation rather than 1 meter.

A. 4
B. 0.25
C. 16
D. 0.06
E. 2

10. The probability of genetic mutation being caused by low levels of x or gamma radiation is believed to be

A. stochastic in nature.
B. greater than the risk of cancer.
C. threshold dose related.
D. unrelated to dose.
E. a result of cell death.

11. The principal difficulty encountered when evaluating the risk of cancer developing due to the use of diagnostic radiology is

A. inability to distinguish between disease caused by radiation and that due to other factors.
B. the relatively long life span of humans.
C. the size of the population one needs to follow.
D. the difficulty in obtaining a good control group.
E. the financial outlay necessary for the study.

12. Of the following, which according to the text are definitely capable of causing ionization?

1. Visible light
2. Gamma radiation
3. Microwaves
4. Radiowave radiation

A. All of the above
B. 2, 3 and 4 only
C. 2 only
D. 3 only
E. 4 only

13. For diagnostic radiology, which statement is false?

A. Potentially noxious radiations are employed.
B. This use of X-rays was first developed very shortly after Roentgen's discovery.
C. Particulate radiations are not employed.
D. Attempts have been made to develop high yield selection criteria.
E. Such use of X-rays is excluded from the ALARA Principle as doses are negligible.

14. Gibbs and his co-workers considered the risk-benefit ratio for the diagnostic use of ionizing radiation

A. should be estimated as being equivalent to that for whole body exposure to the same radiation level.
B. is complicated by uncertainties in the definition of the value of a life saved in units of dose equivalence.
C. can readily be determined by examining the excess incidence of cancer an mutations in an irradiated population.
D. always shows a linear relationships between risk and the radiation dose.
E. More than one of the above

15. Which electromagnetic radiations travels at the greatest velocity?

A. X-rays
B. Visible light
C. Radiowaves
D. Microwaves
E. None of these

16. Which statement is true for ionizing radiation?

A. Certain cancers have been attributed to radiation injury.
B. Radiation burns are a frequent complication of the diagnostic use of x radiation.
C. All levels of ionizing radiation are known to be dangerous to living systems.
D. Practitioners adhering to the ALARA Principle are under no risk from the use of ionizing radiation.
E. More than one of the above.

17. The paradigm referred to in paragraph 2 is a(n)

A. precise description for the wave motion of radiations in the electro-magnetic spectrum.
B. conceptual model helping to explain a principal characteristic of electro-magnetic radiations.
C. explanation for longitudinal wave motion in the coiled spring.
D. representation of the movement of physical matter in the electro-magnetic spectrum.
E. More than one of the above

Quantitative Reasoning Test
QRT – Test Number 51

Time limit: 45 minutes
(An electronic calculator will be available for the QRT section of the DAT at the test center)

1. Evaluate the expression $5 \times 10^{-3} \times 3 \times 10^{7}$.

A. 1.5×10^{-10}
B. 1.5×10^{-4}
C. 1.5×10^{4}
D. 1.5×10^{5}
E. 1.5×10^{10}

2. The perimeter of a square is 20. Which represents the area?

A. 5
B. 10
C. 20
D. 25
E. 100

3. What is the approximate value of

$$\frac{(.01)^2\left(\sqrt{.16}+\ 4.5\right)}{.003}\ ?$$

A. 1.6
B. 0.16
C. 0.016
D. 0.0016
E. 0.00016

4. Which is the smallest?

A. 11/15
B. 4/5
C. 21/25
D. 5/6
E. 13/17

5. At a certain convention the ratio of men to women was 3 to 8. If there were 352 people there, how many were men?

A. 32
B. 96
C. 132
D. 220
E. 256

6. If $x = \frac{1}{2}$ and $z = \frac{14}{35}$, then which is equal to $\frac{1}{x} \div z$?

A. 1/5
B. 4/5
C. 5/4
D. 5/2
E. 5

7. Which is the value of $\sqrt{.00000009}$?

A. 0.003
B. 0.0003
C. 0.00003
D. 0.000003
E. 0.0000003

8. $\frac{81}{3} + \frac{42}{7} - \frac{54}{3}$ is what % of $\frac{45}{3}$?

A. 1.0
B. 15
C. 33.3
D. 100
E. 340

9. A rectangular room is 3 meters wide, 4 meters long and 2 meters high. How far is it from the northeast corner at the floor to the southwest corner at the ceiling?

A. $\sqrt{29}$ meters

B. $\sqrt{11}$ meters

C. $\sqrt{9}$ meters

D. 9 meters

E. 5 meters

10. A person travels to work at an average speed of 40 mph, and returns home at 60 mph. What, in mph, is the average speed for the entire trip?

A. 45
B. 46
C. 48
D. 52
E. 54

11. If [b (c + d) + e]a = 135, then which variable cannot be zero?

A. a
B. b
C. c
D. d
E. e

12. Which is the equation of the line that contains the point (3, -1) and is perpendicular to the line y = 3x + 3?

A. y = 3x - 8
B. y = 3x - 10
C. y = (-1/3)x + 2
D. y = (-1/3)x - 2
E. y = (-1/3)x

13. 10 is to 2y as 25x is to

A. 5x.
B. 5xy.
C. 5x/y.
D. x/5y.
E. 5y/x.

14. If 3 liters of 40% orange juice and 1 liter of 50% orange juice are mixed, which is the percentage of orange juice in the mixture?

A. 90
B. 85
C. 47.5
D. 45
E. 42.5

15. If 2x - 3 > 3x + 7, then which must be true?

A. x >
B. x > -4
C. x > -10
D. x < -4
E. x < -10

16. Which represents 5% of 2% of 0.4?

A. 4
B. 0.04
C. 0.004
D. 0.0004
E. 0.00004

17. One pump can fill a vat in 10 minutes. Another pump can fill the vat in 15 minutes. How many minutes does it take to fill the vat if both pumps are operating at the same time?

A. 1/6
B. 6
C. 12
D. 12.5
E. 25

18. If 1 inch equals 2.5 centimeters, then 25 meters equal how many inches?

A. 0.01
B. 0.1
C. 10
D. 62.5
E. 1,000

19. In a given course a student receives preliminary examination grades of 81, 85, and 95. The final examination is weighed for one-third and the average of the preliminary grades is weighed as 2/3 of the final grade. What should the final examination grade be for a semester average of 90?

A. 99
B. 96
C. 93
D. 88
E. 87

20. If $f(z) = 3z^2 - 2z$, then $f(-1)$ equals

A. 1.
B. 4.
C. 5.
D. 7.
E. 11.

21. Mary took 9 minutes to walk 3/8 of a mile. At this rate, how many minutes will it take to walk the rest of the mile?

A. 11
B. 12
C. 15
D. 18
E. 24

22. What is the distance on a two-dimensional graph between (7, 6) and (2, -6)?

A. 5
B. 9
C. 13
D. 17
E. $\sqrt{153}$

23. In a right triangle ABC with right angle at C and AB = 6, BC = 3, find AC.

A. 3
B. 6
C. 27
D. 33
E. $3\sqrt{3}$

24. When each of the sides of a square is increased by 1 yard, the area of the new square is 53 square yards more than that of the original square. What is the length of the sides of the original square?

A. 25
B. 26
C. 27
D. 52
E. 54

25. A mother's age is three times her daughter's age. In twelve years the mother's age will be twice the daughter's age at that time. How old is the mother now?

A. 18
B. 20
C. 24
D. 30
E. 36

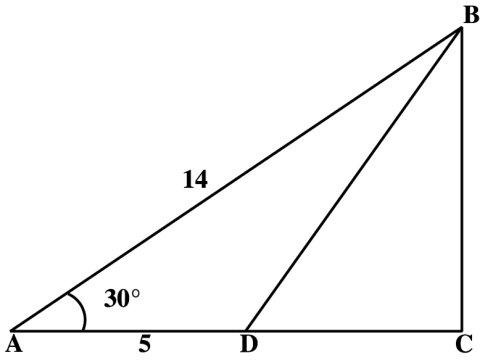
26. Find the average of the following list of three weights: 3 lb. 2oz., 4 lb. 6 oz., and 9 lb. 10 oz.

A. 5 lb. 6 oz.
B. 5 lb. 6 1/3 oz.
C. 5 lb. 11 1/3 oz.
D. 5 lb. 39 1/3 oz.
E. 8 lb. 9 oz.

27. If $x = 5$, then $x + 4$ is what percent of $x^2 + 2$?

A. 19
B. 33 1/3
C. 75
D. 300
E. 540

28. Which of the following is the length of the line segment BC, if AB = 14, AD = 5, and angle BAD = 30°?



A. 7
B. 9
C. $7\sqrt{3}$
D. $\sqrt{171}$
E. $\sqrt{221}$

29. A painting which is 4 feet wide and 5 feet long is surrounded by a rectangular frame 6-inches wide. What percent of the area of the picture and the frame is occupied by the frame?

A. 10 1/2
B. 20
C. 30
D. 33 1/3
E. 50

30. A bowl contains 7 green and 3 red marbles. What is the probability that two marbles selected at random from this bowl without replacement are both red?

A. 1/15
B. 9/100
C. 21/100
D. 47/90
E. 3/5

31. If 1 meter = 3.28 feet, 4/5 of a foot is approximately what fraction of a meter?

A. 1/5
B. 1/4
C. 1/3
D. 1/2
E. 3/4

32. If $y = \frac{x+2}{x-3}$, then which of the following represents x?

A. (3y + 2)/(y - 1)
B. (3y + 2)/(y)
C. (3y - 2)/(y + 1)
D. (5y)/(y + 1)
E. (3y - 2)/(y - 1)

33. For all y, the cos y is equal to

A. sin y
B. cos $(y + \pi)$
C. sin $(-y)$
D. sin y + cos y
E. cos $(-y)$

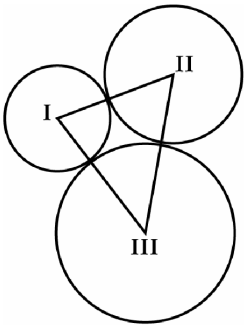
34. The value of cos $(\pi/3)$ equals the value of

A. -cos $(2\pi/3)$.
B. cos $(2\pi/3)$.
C. cos $(6\pi/3)$.
D. -cos $(5\pi/3)$.
E. cos $(4\pi/3)$.

35. What is the maximum number of 3-inch squares (squares that are three inches on a side) that can be cut from a sheet of tin 19 x 23 inches?

A. 42
B. 48
C. 49
D. 145
E. 146

36. Each of the circles I, II, and III is tangent to the other two circles. The areas of the circles are 4π, 9π, and 16π, respectively. Which represents the length of the perimeter of the triangle formed by joining the centers of three circles?



A. 3.0
B. 9.0
C. 14.5
D. 18.0
E. 29.0

37. The numbers (1, 2, 3, 6) have an average (arithmetic mean) of 3 and a variance of 3.5. What is the average (arithmetic mean) and variance of the set of numbers (3, 6, 9, 18)?

A. 9, 31.5
B. 3, 10.5
C. 3, 31.5
D. 6, 7.5
E. 9, 27.5

38. Jill has six different books. She will select one book on Monday and a different one to read on Wednesday. In how many ways can Jill select two different books?

A. 36
B. 30
C. 18
D. 15
E. 12

39. A vehicle covers 100 yards in 12.5 seconds. Find the average speed of the vehicle in feet per second.

A. 2 2/3
B. 4
C. 8
D. 12
E. 24

40. $\sqrt{6+\frac{1}{x}}=8,\ x=\ ?$

A. $\sqrt{\frac{1}{28}}$
B. 1/2
C. 1/58
D. 2
E. 58

Dental Admission Preparation Material

Answer Keys

SURVEY OF THE NATURAL SCIENCES

1.	A	26.	A	51.	C	76.	A
2.	B	27.	E	52.	A	77.	B
3.	D	28.	B	53.	D	78.	E
4.	C	29.	D	54.	A	79.	B
5.	E	30.	C	55.	E	80.	B
6.	C	31.	C	56.	E	81.	C
7.	C	32.	C	57.	C	82.	B
8.	D	33.	A	58.	C	83.	E
9.	B	34.	B	59.	D	84.	A
10.	C	35.	A	60.	A	85.	C
11.	E	36.	A	61.	E	86.	B
12.	A	37.	D	62.	C	87.	C
13.	D	38.	B	63.	B	88.	C
14.	E	39.	B	64.	E	89.	C
15.	A	40.	D	65.	A	90.	C
16.	C	41.	D	66.	C	91.	B
17.	E	42.	A	67.	B	92.	B
18.	B	43.	B	68.	B	93.	C
19.	A	44.	D	69.	E	94.	A
20.	E	45.	D	70.	D	95.	C
21.	D	46.	E	71.	B	96.	D
22.	B	47.	A	72.	D	97.	E
23.	E	48.	B	73.	A	98.	E
24.	E	49.	C	74.	E	99.	B
25.	D	50.	C	75.	A	100.	C

READING COMPREHENSION

1.	C
2.	E
3.	C
4.	B
5.	D
6.	D
7.	D
8.	E
9.	C
10.	A
11.	A
12.	C
13.	E
14.	B
15.	E
16.	A
17.	B

PERCEPTUAL ABILITY TEST

1.	C	21.	A	41.	C	61.	B	81.	B
2.	A	22.	D	42.	B	62.	C	82.	B
3.	B	23.	D	43.	C	63.	C	83.	C
4.	A	24.	A	44.	B	64.	D	84.	D
5.	B	25.	B	45.	A	65.	C	85.	C
6.	D	26.	C	46.	A	66.	B	86.	D
7.	D	27.	C	47.	C	67.	E	87.	A
8.	B	28.	D	48.	C	68.	C	88.	A
9.	C	29.	B	49.	B	69.	E	89.	A
10.	D	30.	B	50.	D	70.	A	90.	B
11.	E	31.	D	51.	A	71.	D		
12.	E	32.	C	52.	B	72.	E		
13.	D	33.	C	53.	A	73.	B		
14.	B	34.	C	54.	B	74.	C		
15.	E	35.	A	55.	A	75.	D		
16.	B	36.	C	56.	B	76.	B		
17.	D	37.	B	57.	A	77.	C		
18.	C	38.	B	58.	E	78.	A		
19.	A	39.	C	59.	E	79.	D		
20.	A	40.	C	60.	D	80.	C		

QUANTATATIVE REASONING TEST

1.	D	15.	E	29.	D
2.	D	16.	D	30.	A
3.	B	17.	B	31.	B
4.	A	18.	E	32.	A
5.	B	19.	B	33.	E
6.	E	20.	C	34.	A
7.	B	21.	C	35.	A
8.	D	22.	C	36.	D
9.	A	23.	E	37.	A
10.	C	24.	B	38.	B
11.	A	25.	E	39.	E
12.	E	26.	C	40.	C
13.	B	27.	B		
14.	E	28.	A		