

A STUDY OF THE IMPACT OF COMPUTER-ASSISTED INSTRUCTION ON
TEST SCORES OF MEDICAL LABORATORY TECHNICIAN STUDENTS

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ABSTRACT

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Computer-Assisted Instruction (CAI) may be employed within a health sciences program to provide a supplemental instructional strategy for educators. This study investigated the differences in test scores between those Medical Laboratory Technician (MLT) students who participated in computer-assisted instruction and those MLT students who did not participate in computer-assisted instruction. The study was designed to make comparisons in the test scores of MLT students in order to determine the effectiveness of CAI as a supplemental instructional strategy. MLT students at two community colleges participated in the study. The Medicomp test was administered to the two groups of students as a pretest and posttest. The two groups then followed a prescribed plan of intervention. Descriptive statistics and inferential statistics were then used to analyze the test scores of the two groups. Among this sample of students, there was no difference in the test scores between the two groups. In conclusion, computer-assisted instruction did not make a difference in the test scores of the MLT students.

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CHAPTER 1

Computer-assisted instruction (CAI) may be employed within a health sciences program to provide a supplemental instructional strategy for educators. The number of Medical Laboratory Technician (MLT) students in medical technology programs has increased as a result of a decrease in the number of available programs (Castleberry, Kuby, & Nielson, 1991). Although MLT programs have more students, there has been no significant increase in the number of educators. Consequently, there has arisen the need for a more effective means of instruction (Umiker & Yohe, 1984).

Although there are limited statistics available to document the use of CAI in the medical technology classroom, its increasingly widespread use in other health-related disciplines may be an indication of its value as an instructional aide. The objective nature of the laboratory curriculum lends itself to the use of CAI as an educational tool. As the number of medical advances continues to rise, there exists a multitude of applications possible with CAI (Turgeon, 1985). CAI may profit educators by decreasing their workload and providing them a supplemental teaching strategy. CAI also helps to facilitate the development of student decision-making skills (Keenan & Brown, 1985).

Computer-assisted instruction presents a supplemental strategy for teachers to deal with the high cost of education, the special needs of an increasingly diverse student population, and the lack of instructional time (Bolton, 1984).

Studies indicate that CAI is being utilized in an increasing number of programs (Hebda, 1988). Educators are realizing the benefits of CAI in the areas of problem-solving skills and clinical simulations, and as a result are incorporating CAI into their clinical programs.

Statement of the Problem

This study investigated the differences in test scores between those MLT students who participated in computer-assisted instruction and those MLT students who did not participate in computer-assisted instruction.

Statement of the Purpose

Due to the lack of educators in Medical Technology programs, there has arisen the need for a more effective means of instruction (Umiker & Yohe, 1984). In addition, there are now greater amounts of material, more diverse populations, and a need for increased problem-solving skills. This study was designed to make comparisons in the test scores of MLT students in order to determine the effectiveness of CAI as a supplemental instructional strategy.

Hypothesis

The following hypothesis was tested:

There is no statistically significant difference between the Medicomp posttest scores of Medical Laboratory Technician students who have and those who have not participated in computer-assisted instruction.

Definitions

For the purpose of this study, the definitions described below apply.

1. Test score. The number of correct answers the student obtains on the Medicomp test.
2. Medical Laboratory Technician (MLT) students. Those students who are enrolled in a MLT school, accredited by the Committee on Allied Health Education Agency. The two-year program prepares the student to take the national registry.
3. Participant. An individual who has utilized the computer-assisted program disk at least once in addition to the traditional methods of learning.
4. Nonparticipant. An individual who has not utilized any of the computer-assisted program disks.
5. Computer-Assisted Instruction (CAI). The use of a computer program as a learning tool for students in addition to the traditional methods of learning.

Limitations

For the purpose of this study, the following limitations apply:

1. A sample of convenience was used.
2. A bias might have been incorporated into the study because more than one professor was teaching the MLT students.
3. Frequency of CAI use was not addressed.

Assumptions

For the purpose of this study the results depended on the following assumptions:

1. The MLT students have a similar knowledge base prior to administration of the pretest.
2. The Medcomp test is reliable.
3. The CAI program is ergonomic.

Significance of the Study

Computer-assisted instruction (CAI) is an effective teaching technique that has existed for almost two decades (Frenzel, 1980). CAI offers an interesting and valid method of introducing students to the use of microcomputer. With the advent of new technology, the cost of computers is not as high as it was when computing was first introduced making CAI an affordable option.

The primary advantage of CAI over traditional methods of instruction is the personalized interaction and immediate

availability it offers to students. Another advantage of CAI is that the user has control of the learning process. CAI programs are self-paced and very individualized. Students can proceed through the program as quickly or as slowly as they deem appropriate. The use of CAI may result in a substantial reduction in the time that students spend learning subject material because the students receive immediate feedback concerning their responses (Gaston, 1988). Students using CAI may actually retain more information due to increased exposure to clinical situations which may not occur on a daily basis (Green, Heuer, & Hill, 1988). In a study conducted by faculty at Erie Community College in New York, students who used computer-assisted instruction had a significantly greater increase in achievement on tests that measured application of knowledge than students who did not participate in CAI.

All of these advantages allow the teacher to develop creative and more efficient teaching styles. By utilizing other methods of instruction, the teacher is freed to assist those students who require more one on one instruction. CAI can also provide extra time for the teacher to find and improve teaching materials.

Chapter 2

The use of the computer in the classroom as an instructional tool has gradually become a necessity due to greater amounts of material which must be assimilated by the MLT student. Even though MLT programs have more students, there has been no significant increase in the number of educators. Consequently, there has arisen the need for a more effective means of instruction (Umiker & Yohe, 1984). Although there are limited statistics available to document the role of the computer in the medical technology classroom, its increasingly widespread use in other health-related disciplines is an indication of its value as an instructional aide. The laboratory setting lends itself to CAI because of its objective nature. This chapter will review literature related to the computer-assisted learning process, the advantages and disadvantages of computer-assisted instruction, and using computer-assisted instruction with medical technology students.

According to Burson (1982), CAI is an interactive learning environment in which the computer generates, facilitates, and implements the final information presented, based on communication from the learner. CAI causes the student to receive and react to instructional material which

is presented to the learner by the computer. The computer provides learners with individualized learning environments, in which students may work at their own pace. There are various levels of CAI, all of which are appropriate to different educational settings.

Clinical simulations are perhaps the most advanced level of CAI. CAI is able to provide the laboratory student with a real-life situation without the corresponding stressors inherent in the professional world of work. The student has the opportunity to learn from simulated errors without patient care being compromised. If wrong decisions are made or essential observations are missed by the learner, the opportunity to correct the error is provided. Other high levels of CAI are linear and branching tutorials which force a student into a distinct pattern of decision making. Based upon the learners response, the computer program can branch along different pathways toward the same final goal. Drill and practice and problem-solving are also other applications of microcomputers (Lassan, 1989).

Understanding the Teaching-learning Process

The computer may be utilized in a health science education program in order to provide another form of an interactive teaching-learning system. Because students learn differently, it is necessary for the teacher to assess students characteristics at the beginning of each new

semester to determine the most effective means of instruction. In order to understand how people learn, it is imperative that we first define "learning". According to Busteter (1991), learning is the active part of the process of teaching and learning. The critical part of the teaching-learning process is how the learner is aided to embark on this active experience we call learning. When the traditional approach to teaching is taken, this definition of learning is contradicted because there is no action in the teacher-learner relationship. The student's role is passive - simply to "soak up" the information that the instructor provides to them "like a sponge" (Busteter, 1991).

Teacher-centered instruction is one approach to teaching and learning. The instructor plans what specific behaviors the learner needs to possess, and then provides the appropriate stimuli to evoke the correct response from the student. Learning, then, is an accumulation of the repeated associations between various stimuli and the correct responses to them. The teacher-learner relationship lends itself to the lecture mode of instruction. Lectures are supplemented by the textbook readings and/or journal articles. Discussions can be utilized to elaborate and/or clarify the information presented in lecture, the texts, or in journal articles (Knopke & Diekelmann, 1978). If a

student is an auditory learner, the teacher-centered type of instruction is optimal. However, research shows that we retain only 10-15% of the information we hear and 15-20% of what we see and hear (Busteter, 1991).

Learner-centered instruction is a second approach to teaching and learning. Teacher activities are directed toward getting active student participation in the learning process - it focuses on student involvement. "The cognitive approach views learning as a purposeful, goal-directed activity involving the gaining or changing of knowledge, skills, or abilities. It is based on the assumption that learning takes place by individuals reacting to, organizing, and then going beyond the information immediately related to a problem situation in order to develop new meanings for themselves" (Knopke & Diekelmann, 1978).

A self-directed learning style indicates a student's interest in learning approaches that are relatively unstructured and informal, approaches that allow students to pursue their individual interests and set their own goals. These individuals prefer an independent study environment, where they are given a list of learning objectives, resources, and materials and independently determine how they will learn the subject material (Busteter, 1991).

Student-centered instruction is a highly individualistic and self-directed process. It requires that

each student examine a problem situation and organize information and experience according to a personal cognitive framework. Emphasis is placed on learning activities that encourage individual and personalized participation. Students often decide to use CAI because of its highly individual learning environment (Knopke & Diekelmann, 1978).

Advantages of Computer-Assisted Instruction

CAI has been compared to traditional teaching methods in several studies. These studies have cited several distinct advantages and educational benefits. Perhaps the most beneficial advantage to students is the personalization of learning. The learner is presented with an interesting and reinforcing mode of instruction while in direct contact with the computer. CAI allows the student flexibility in the scheduling of computer programs and the mode in which they will be presented to the learner. The student is also able to control the pace at which the learning proceeds while at the same time receiving immediate feedback concerning their responses. If the student is having difficulty with certain material, the computer guides the student to helpful educational material which explains the subject matter further. The immediate feedback also acts to motivate the student to continue learning (Turgeon, 1985). Educational programs using CAI can become more cost-effective due to decreased time spent instructing the

students. Also, the computer program can provide consistent presentations of information to individual students at their convenience (Thompson & Wescott, 1988). Even though CAI brings many advantages to the classroom it does present some definite limitations.

Disadvantages of Computer-assisted Instruction

Perhaps the greatest limitation of CAI is its design. Computer programs are developed to work with one student at a time, however, the instruction is highly individualized. Another limitation is the lack of direct interaction with other students and faculty. This lack of communication can become a serious deficit to those students who require a one-to-one interaction with the instructor. Due to the lack of graphics available to the health sciences, another limitation is heavy reliance on complete narrative texts to depict real life scenarios and various case studies in the clinical setting (Lassan, 1989). For some presentations, this instruction could be better enhanced by the use of graphics. The cost of graphics, however, can be more of a burden on the school than an aid. Another limitation is the amount of time and manpower required to develop quality computer programs (Lassan, 1989). The programs must be reviewed, pilot tested, and reviewed again before they are ready to be used as an instructional tool. For this reason, it is usually best to employ professionally developed

software. Even though it is more expensive initially, the benefits will be more cost-effective in the end (Lassan, 1989).

Traditional Learning versus CAI

A study examining the use of CAI versus traditional learning was conducted at a community college in New York (Green, Heuer, & Hill, 1988). This study examined the use of computers by MLT students. Faculty at the college developed computer programs for clinical laboratory courses that simulated "real" laboratory situations. Students were required to use the computer programs throughout the laboratory program and were evaluated based on satisfaction, knowledge, and retention. Time spent on the computer varied throughout the semester. By the end of the rotation, the students required less time on the computer because of improvement in keyboard technique and better organization of data contained on the computer report. The repetitive entry of reference ranges with patient results proved to be an effective learning aid. On written examinations, student recall of these reference ranges and recognition of abnormal values were greatly improved. The students were also required to enter quality control data which taught the responsibility of controlled results and reinforced what the students learned in lecture. The programs also assisted students in preparing for certification examinations. It was determined that

students who experience computer-based learning of laboratory techniques would be well-prepared to enter the professional clinical laboratory (Green, Heuer, & Hill, 1988).

A study examining the effectiveness of CAI was conducted at the University of Calgary in 1980 (Conklin, 1983). The sample consisted of thirty four nursing students enrolled in a third year required course. These students were randomly divided into one of three groups: CAI group, traditional group, and control group. Each of the subjects were administered the surgical nursing multiple choice test as a pretest. After pretesting, the CAI group was assigned to eight CAI sessions and given a reference-reading list. The traditional group was given only the reference-reading list, and the control group did not receive any surgical nursing instruction. After a period of six weeks, each of the students was administered the surgical nursing multiple choice test again. Adjustments were then made to the posttest means using the pretest score. The pretest was used as the covariate to control for initial differences between the three groups. After statistical analysis of the results was complete, the scores revealed that the CAI posttest mean was significantly greater than the posttest means of the other two groups. Furthermore, the improvement by the CAI group was significantly greater than the improvement by the other two groups. These results indicate

that CAI greatly enhanced the learning process. Therefore, CAI can be considered an effective teaching technique (Conklin, 1983).

CAI And Differences in Test Scores of Medical Laboratory Technician Students

At the University of Washington (Chang, Grech, Nyamathi, & Sherman), first year laboratory students were tested on blood cell morphology. Half of the class was instructed in the traditional manner (instructor and double-headed microscope) and the other half was given free access to a computer/video disc system on blood cell morphology. After a period of time, the students were tested on their ability to identify normal white blood cells. Both groups achieved an acceptable level of performance on the test, and there was no statistical difference between the groups. In this sample, the computer/video disk program was found to be just as effective as the traditional method of instruction in teaching cell morphology. Therefore, it may serve as a valuable tool in training programs for medical laboratory technician students.

Powerful interactive teaching systems may be developed because of the ability of the microcomputer to pose questions, evaluate answers, display appropriate text, and control the video display (Chang, Grech, Nyamathi, & Sherman, 1989). According to Chang, McNeely, & Mitchell (1985), the use of CAI has been found to be just as effective as lecture and

classroom methods in terms of skill and knowledge retention. The major benefit to the educational process has been the amount of time saved. Some studies have also shown that CAI can induce positive feelings and attitudes on the part of the student. By using CAI, the problem of too much to learn in too little time may be lessened. CAI as an instructional strategy has substantial potential for enhancing the student-teacher ratio and improving the quality of education by utilizing reinforcement (Chang, McNeely, & Mitchell, 1985).

Computer-assisted instruction can be an effective educational tool to instruct students about difficult concepts which are not easily learned and retained. A CAI lesson in immunohematology was developed by Rudmann and Paranto in 1989 for this purpose. A sample of 22 students was used in a pilot test of the computer lesson. Before using the CAI program, the students were pretested regarding the material they would encounter. The mean score on the pretest was 68.18% with only nine students achieving 80% or above. On the posttest, the mean score was 80.91%, with sixteen participants scoring 80% or above. This change in scores was a statistically significant result, and indicates that CAI can be a valuable learning experience (Paranto & Rudmann, 1989).

By monitoring the success of medical laboratory students through changes in scores, the effectiveness of CAI can be evaluated. Although many variables can affect the interaction

between student and computer, it has been shown that CAI can be an instructional strategy worth the investment. For CAI to be effective in enhancing student achievement, however, the unit of instruction must be free of programming errors and the content must be consistent with course objectives and student learning needs. To make the most effective use of CAI, educators should know which types of CAI are most appropriate for meeting different learning objectives or are most suited to certain students (Belfry & Winne, 1988).

CHAPTER 3

METHODOLOGY

This descriptive study investigated the differences in test scores on the Medcomp test in order to determine the effectiveness of computer-assisted instruction (CAI) as an instructional strategy for educators. Medical Laboratory Technician (MLT) students at two community colleges participated in the research study. The samples were non-randomized. The Medcomp test was administered to the two groups of students as a pretest and a posttest. Descriptive statistics and inferential statistics were used to analyze the adjusted Medcomp posttest scores. Comparisons were made between the adjusted Medcomp posttest scores of the MLT students who did and did not participate in CAI to see if there was a significant difference between the two groups.

Setting

Grayson County College and El Centro Community College are two year community colleges located in north central Texas. Both schools offer a broad scope of both academic and vocational programs--one of which is the Medical Laboratory Technology Associate Degree (MLT-AD) program. Upon completion of the two year program, the student

receives an Associate Degree in Applied Science. The student is then eligible to write the Medical Laboratory Technician certification examination for the Board of Registry of the American Society of Clinical Pathologists (ASCP).

Subjects

Medical Laboratory Technician (MLT) students at the two community colleges participated in this descriptive study. The students were all freshmen who were enrolled in the MLT-AD program during the 1991 spring semester. Participation in the study was a requirement of the class, however the test results had no bearing on the students' final grades. The students were divided into two groups: participants and nonparticipants. The participants, MLT students at Grayson County College, utilized the computer-assisted program disk at least once in addition to the traditional methods of learning. At the beginning of the semester, the instructor presented a brief orientation to the computer and CAI programs. The majority of the students were already familiar with the use of the computer. Specific class sessions were incorporated into the class curriculum for the students to utilize the computer-assisted program. The nonparticipants, MLT students at El Centro Community College, did not utilize any of the computer-assisted program disks. The sample was non-randomized.

Individual student's names were not used in the report. Only group data was used. To assure anonymity, a letter and number code was arbitrarily assigned to the students. Letter A indicates participants and Letter B indicates nonparticipants. For example, a code A125 indicates a MLT student who was a participant.

Data Collection

Instrumentation

The Medicomp test (see Appendix B), a multiple choice test developed by the Shiesl Corporation, was administered as a pretest and posttest to the two groups of students. The test consisted of four sections covering the following subjects: Basic Chemistry, Basic Serology, Immunohematology, and Advanced Immunology. To determine the reliability of the Medicomp test, Shiesl Corporation conducted a pilot study at a community college in New Jersey. Using the test-retest method, the reliability was determined to be $r=0.80$ (Shiesl Corporation).

Methods

Permission was obtained from the two institutions to use group data obtained from the pretest and posttest scores. The permission forms may be found in Appendix C. Collection of the data was begun after approval of the proposal by the thesis committee.

To begin the study, a short orientation on data

collection was given to the professors at each of the community colleges. At the beginning of the semester, both groups of MLT students were administered the Medicomp test as a pretest. The participants in the study took the test using the computer program. A written form of the Medicomp test was developed and administered to the nonparticipants in the study. Approximate time of administration for each section was forty five minutes.

Throughout the spring semester, each of the two groups followed a prescribed plan of intervention. The participants in the study utilized the Medicomp computer-assisted program disk at least once in addition to the traditional methods of learning. The nonparticipants did not utilize any of the computer-assisted program disks. They participated only in the traditional methods of learning. At the conclusion of the semester, the two groups of MLT students were administered the Medicomp test as a posttest. These pretest/posttest scores were then analyzed statistically according to the following procedures.

Treatment of the Data

The following methods were used for analysis of the data collected for this study. Descriptive statistics (mean and percentage) were used to profile the pretest/posttest scores and demographic data. The pretest scores of the MLT students in both groups were then used to determine the

Medicomp posttest scores. An inferential statistic (F-test) was then used to analyze the Medicomp posttest scores. Comparisons were made between the Medicomp posttest scores of the MLT students who did and did not participate in CAI to see if there was a significant difference between the two groups. The acceptable level of statistical significance for all analyses was 0.05.

CHAPTER 4

FINDINGS

Data analysis for this study was conducted on an IBM PC using the BMDP statistical software package (BMDP Statistical Software, Inc.). A level of significance of $p < 0.05$ was determined acceptable for rejection of the null hypothesis. The population for this study consisted of freshman MLT students at two community colleges in North central Texas. A sample of convenience was used to obtain an adequate number of data points. Of the 89 people who were enrolled in the two MLT programs, 82 completed the study. The final sample of 82 people was divided into two groups: participants and nonparticipants. Table 1 and Table 2 illustrate how this sample was further divided with regards to gender and ethnic origin.

Table 1 demonstrates that there were 30 participants and 52 nonparticipants in this study. Of the 30 participants, 13 were male (43.3%) and 17 were female (56.7%). The number of nonparticipants was equally divided between male and female.

Table 2 demonstrates the various ethnic groups that were included in the research study. Of the 30 participants, there were 29 white students (96.7%) and one

black student (3.3%). Of the 52 nonparticipants, there were 31 white students (59.6%), seven black students (13.5%), six

Table 1

Descriptive Statistics for Gender

<u>Group</u>	<u>Frequency</u>	<u>%</u>
<u>Participants</u>		
Male	13	43.3
Female	17	56.7
<u>Nonparticipants</u>		
Male	26	50.0
Female	26	50.0

hispanic students (11.5%), and eight asian students (15.4%).

As part of the descriptive statistics generated for the final sample of 30 participants and 52 nonparticipants, the range of scores, mean, and standard deviation were calculated for the two groups for the pretest and posttest results. These results are found in Table 3.

Table 3 illustrates that the mean scores for each group were significantly different on the pretest. The mean score

for the participants was higher than the mean score for the nonparticipants. However, the mean scores for each group did not vary greatly on the posttest. There was only a one point difference between the two groups with the nonparticipants group obtaining the higher mean score.

Table 2

Descriptive Statistics for Ethnic Classification

<u>Group</u>	<u>Frequency</u>	<u>%</u>
<u>Participants</u>		
White	29	96.7
Black	1	3.3
Hispanic	0	0
Asian	0	0
<u>Nonparticipants</u>		
White	31	59.6
Black	7	13.5
Hispanic	6	11.5
Asian	8	15.4

To determine if an analysis of covariance could be performed on the posttest mean scores, three assumptions of

covariance were tested. These assumptions included linearity, homoscedasticity, and correlation between the pretest and posttest scores. A value of r greater than or equal to 0.40 must be obtained in order to perform an analysis of covariance on the posttest scores. The correlation factor was not greater than or equal to 0.40.

Table 3

Descriptive Statistics of Pretest / Posttest

Group	Range	<u>M</u>	<u>SD</u>
Participant			
Pretest	43	45.13	11.76
Posttest	38	52.41	10.12
Nonparticipant			
Pretest	43	39.52	10.70
Posttest	49	53.48	12.64

As a result, a t test or analysis of variance (ANOVA) must be performed on the posttest scores. An analysis of variance was performed on the posttest scores, and the results are illustrated in Table 4.

Table 4 illustrates that there was no significant

difference between the mean scores on the posttest for each group. The mean score on the posttest for participant group was 52.41. The mean score on the posttest for the nonparticipant group was 53.48. A F-test value with significance of $p=0.6978$ was found for the summed groups. This value is not less than or equal to 0.05. Thus, the null hypothesis was supported.

Table 4

Analysis of Variance Table for Mean Posttest Scores

Source	df	<u>SS</u>	<u>MS</u>	<u>F</u>	Tail
Group	1	21.19	21.19	0.15	0.6978
Error	79	11026.02	139.56		

CHAPTER 5

SUMMARY

This descriptive study investigated the differences in test scores on the Medicomp test in order to determine the effectiveness of computer-assisted instruction (CAI) as an instructional strategy for educators. Medical Laboratory Technician (MLT) students at two community colleges participated in the study. The students were divided into two groups: participants and nonparticipants. Each group of students was administered the Medicomp test as a pretest. The participants in the study utilized the computer-assisted program disk at least once in addition to the traditional methods of learning. The nonparticipants utilized only the traditional methods of learning. The sample was non-randomized. The students were administered the Medicomp test again as a posttest. Descriptive statistics (mean and percentage) were used to profile the pretest/posttest scores on the Medicomp test and demographic data. An Analysis of Variance [(1,79)F=0.15, p=.6978] was used to analyze the Medicomp posttest scores. Comparisons were made between the Medicomp posttest scores of the MLT students who did and did not participate in CAI to see if there was a significant difference between the two groups. The level of statistical significance used for rejection of the null hypothesis was

$p=0.05$.

Conclusions

For this study, the Medicomp test was chosen because of its relationship to the courses being taught during the study. The hypothesis states that there is no statistical difference between the Medicomp posttest scores of Medical Laboratory Technician students who have and have not participated in computer-assisted instruction. Statistical significance of $p=0.6978$ was derived from the ANOVA. The hypothesis was therefore accepted. Among this sample of freshman MLT students, there was no difference in the adjusted Medicomp posttest scores between the two groups. In conclusion, based upon this study, computer-assisted instruction did not make a difference in the MLT score.

Discussion

This study was undertaken to examine the effectiveness of CAI as a supplemental instructional tool. Although there were few studies available which examined the effectiveness of CAI in MLT programs, those studies did indicate a significant difference in the results of those groups using CAI. The results of this descriptive were not similar to those from other studies, showing conflicting evidence in the effectiveness of CAI in MLT studies.

Just because there was no statistical difference between the two groups, does not mean that CAI is not an effective instructional strategy. The sample used in this study was small and non-randomized. Also, more than one instructor taught the

students, which might have introduced a bias into the study.

The similarities in the posttest scores may suggest that the use of CAI can be as effective as traditional methods of teaching. The posttest mean for participant group was 52.41, while the posttest mean for the nonparticipant group was 53.48.

It is difficult to justify the need to purchase software for CAI use when few studies that examine the effectiveness of CAI exist, and when the results of these studies are conflicting. According to national survey conducted by Medical Laboratory Observer (1991), only six percent of laboratories now frequently use CAI. However, ten percent of the 58% respondents plan to begin using PCs to assist in teaching laboratory procedures (Jahn, 1991). CAI is simply an area which has not been thoroughly researched to date.

Another area of concern within this descriptive study was the use of a "test" to gather data. When students are administered a test, there is a degree of apprehension the students experiences. Even though the test score did not apply to the students' final grades, it is probable that this tension still may have been a factor in the final results.

The length of the Medicomp test may have been a contributing factor in the results obtained. The long length of the test seemed to be a area of concern to those who took the written form of the Medicomp test. Without the computer interaction, the test was long and tedious.

Recommendations

The recommendations for further research emphasize two major areas: sample selection and use of the research instrument. A larger, randomized sample would be advantageous to any further research, and the results obtained would be more "usable" in establishing the effectiveness of CAI as an instructional strategy. An amended research instrument, shorter in length, would help alleviate the tedious nature of the test.

Specifically, recommendations for further research are:

1. Replication of this study using an amended instrument.
2. Replication of this study using Medical Technology (MT) students.
3. A study examining the differences in test scores between MLT and MT students using CAI.
4. A study that specifies the frequency of CAI usage.

By utilizing a larger sample and by amending the research instrument, the major concerns encountered in this study would be addressed. Using a sample composed of MT students would enable the researcher to study the sample for a longer period of time which would increase the reliability and validity of the research study. Also, MT students might be more responsible with their answers on the research instrument. By controlling the frequency of CAI use by the students, the source of error contributed due to

memorization would be eliminated.

By conducting a study comparing the two groups of students using CAI, the validity and reliability of previous studies would be increased. Also, any biases that were incorporated into the previous studies due to differences between the two groups, would be compensated for by the comparison.

The decision to employ the use of CAI in the clinical classroom should be the decision of the instructor. Computer-assisted instruction can be beneficial to students because CAI programs are self-paced and very individualized. If the classroom situation deems the use of CAI appropriate, then the instructor should feel confident in using any CAI software that has been thoroughly tested. However, CAI should be used to supplement traditional teaching methods , not replace them.

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APPENDIXES

APPENDIX A

MEDICOMP TEST
BASIC CHEMISTRY
DOROTHY I. GOOD M.S. M.T. (ASCP)

Directions: Circle the correct answer on the following multiple choice questions. There is only one correct response.

1. A micro chemistry is ordered on a newborn, and capillary blood must be drawn. You should not:
 - a. wipe away the first drop of blood.
 - b. sterilize the skin at site of puncture with alcohol.
 - c. use a lancet which may stick deeper than 0.01 ml.
 - d. squeeze the skin hard to make the blood flow faster.
2. Leaving the serum on the clot for 4 hours will have what effect on the glucose? It will be:
 - a. decreased.
 - b. increased.
 - c. remain the same.
 - d. twice the original value.
3. A venous blood, collected at 8 A.M., had a value of 110 mg/dl. An arterial blood, drawn at 12 noon was 115 mg/dl. Both tests were done on the plasma. How do they compare?
 - a. Venous plasma is always higher.
 - b. Arterial plasma is always higher.
 - c. Arterial plasma is always lower.
 - d. It makes no difference.
4. In drawing blood for a CO₂ test, what precaution must be taken?
 - a. The patient must be fasting.
 - b. The plasma must be removed from the cells within 5 minutes.

- c. Fluoride must be used as an anticoagulant.
 - d. The tube must be filled to capacity.
5. Prolonged stasis of blood from leaving the tourniquet on too long will cause elevations in the:
- a. potassium.
 - b. bilirubin.
 - c. lactic acid.
 - d. All of the above.
6. Hemolysis of blood must be avoided since it invalidates certain determinations. The test which would be least affected is:
- a. Plasma hemoglobin.
 - b. Whole blood hemoglobin.
 - c. LDH.
 - d. Acid Phosphatase.
7. An amniotic fluid is collected for bilirubin analysis. What precautions must be taken?
- a. The entire tube must be filled.
 - b. The tube must be kept in ice until the specimen is tested.
 - c. The tube must be protected from light.
 - d. The fluid must be stoppered until tested.
8. A fasting specimen was drawn from a patient. The serum supernatant was very turbid. Of the following, which test would be least affected by the turbidity?
- a. Kinetic CPK by UV.
 - b. Kinetic GOP by UV.
 - c. Thymol turbidity.
 - d. Somogyi method glucose.

9. The best anticoagulant to use when collecting blood for a glucose is:
 - a. Sodium fluoride.
 - b. Sodium oxalate.
 - c. Sodium citrate.
 - d. EDTA.
10. The best anticoagulant to use when collecting blood for sodium and potassium is:
 - a. Sodium citrate.
 - b. Potassium oxalate.
 - c. EDTA.
 - d. Lithium heparin.
11. Blood collected about an hour after the patient has eaten a heavy meal often has elevated:
 - a. chylomicrons.
 - b. globulin.
 - c. thymol turbidity.
 - d. calcium.
12. The serum of a freshly drawn blood is slightly turbid. This is probably due to:
 - a. Triglycerides only are increased.
 - b. Cholesterol only is increased.
 - c. Both are increased.
 - d. Either is increased.
13. A patient had a cholesterol of 350 mg/dl and a triglyceride level of 135 mg/dl. The serum would appear:
 - a. with a layer of cream atop a clear serum.
 - b. very turbid throughout.
 - c. with medium turbidity.

- d. clear.
- 14. Which of the following tests should be done on plasma rather than serum?
 - a. CPK.
 - b. Uric acid.
 - c. Potassium.
 - d. Bilirubin.
- 15. A blood barbiturate analysis was reported inaccurately on the patient's chart. A correct report is entered after erasing the first report.
 - a. This is legal if they can read the report.
 - b. This is unacceptable and could get the person sued.
 - c. This is acceptable if the pathologist agrees.
 - d. This is acceptable if the patient's physician agrees.
- 16. Chemistry screening profiles are usually done by automated methods. The results are:
 - a. more accurate than manual tests.
 - b. more diagnostic if the patients fast.
 - c. far less accurate than manual methods.
 - d. good enough for research.
- 17. Patients having a urine quantitative serotonin (5-HIAA) test should be given the following instructions:
 - a. Use HCL as a preservative; special diet.
 - b. Use NaOH as a preservative; special diet.
 - c. Use NaOH as a preservative; no special diet.
 - d. Use HCL as a preservative; no special diet.
- 18. The prefix "cardio" refers to:
 - a. the "cardio".
 - b. the heart.

- c. the kidney.
 - d. the spleen.
19. The term "lipid" means:
- a. liver.
 - b. ligament.
 - c. lung.
 - d. fat.
20. The suffix "ose" denotes:
- a. bone-forming.
 - b. of the ear.
 - c. carbohydrates.
 - d. weakness.
21. The type of fire extinguisher to use on electrical equipment fires is:
- a. A.
 - b. B.
 - c. C.
 - d. D.
22. Which solution may be safely pipeted by mouth?
- a. Cerebrospinal fluid.
 - b. Serum.
 - c. Saline.
 - d. None.
23. Which procedure will insure type I water?
- a. Absorption.
 - b. Distillation.
 - c. Deionization.

d. Filtering.

24. Proper storage of chemicals is essential. Which of the following is the most important?
- a. Alphabetical order makes the chemicals easier to find.
 - b. Volatile liquids must be stored in small containers in an explosion-proof refrigerator.
 - c. A fume hood should be used to store all flammables.
 - d. All flammables should be kept together, regardless of content.
25. In operating an autoclave, the following precautions MUST be taken:
- a. Caps on containers must be tightened to assure sterilization.
 - b. Only glass items can be autoclaved.
 - c. If the timing is going to be halved, the pressure must be doubled.
 - d. The temperature and pressure must be down to safe levels before the door is opened.
26. When a pH-sensitive glass electrode is not being used, it should be submerged in:
- a. normal saline.
 - b. deionized or distilled water.
 - c. a buffer slightly acid.
 - d. a buffer slightly alkaline.
27. Fluorometry has an advantage over spectrometry in that with the analysis there is:
- a. increased sensitivity and decreased specificity.
 - b. decreased sensitivity and decreased specificity.
 - c. decreased sensitivity and increased specificity.
 - d. increased sensitivity and increased specificity.

28. The purpose of a centrifugal analyzer is to:
- a. mix the sample and reagents.
 - b. separate lipids into fractions.
 - c. fractionate proteins.
 - d. aspiration of various fractions.
29. For the best levels of sensitivity and specificity, a gas chromatograph may be coupled to which detector system?
- a. Dual lens.
 - b. Mass spectrometer.
 - c. UV spectrometer.
 - d. Fluorescent spectrometer.
30. Which of the following elution technics may be used in HPLC?
- a. Isotonia.
 - b. Isoelectric.
 - c. Isocratic.
 - d. Amphoteric.
31. Which of the following MUST a flame photometer have?
- a. Dual beam.
 - b. Cuvets.
 - c. Atomizer.
 - d. Didynium filter.
32. The accuracy of the spectrophotometer wavelength may be checked with:
- a. a deuterium lamp.
 - b. a nickel sulfate solution.
 - c. a didynium glass filter.
 - d. Any of the above.

33. Nephelometry measures light that is:
- a. produced by a double-beam.
 - b. absorbed by particles that are suspended.
 - c. scattered by suspended particles.
 - d. passed through a dual lens.
34. It is essential to recheck the standardization of a flame photometer when:
- a. the lithium balance is varied.
 - b. the potassium range is changed.
 - c. a new batch of lithium diluent is introduced.
 - d. Any of the above.
35. Which of the following will cause a falsely elevated result in the quantitation of chloride by a coulometric-amperometric system.
- a. Calcium.
 - b. Cromide.
 - c. Hydrogen.
 - d. Oxalate.
36. The total of all the values in a set of numbers divided by the number of values in the set is calculated to arrive at the:
- a. geometric mean.
 - b. arithmetic mean.
 - c. medium.
 - d. most frequent value.
37. The formula for the correlation of variation (CV) is:
- a. $CV = \text{mean divided by standard deviation times } 100\%$.
 - b. $CV = 100\% \text{ divided by standard deviation times mean}$.
 - c. $CV = \text{standard deviation divided by mean times } 100\%$.

- d. $CV = \text{mean divided by standard deviation times } 100\%$.
38. An analyst observes that the value of the control sample in a QC program has been drifting downward for 5 weeks. This is probably caused by:
- a. control contamination.
 - b. exposure to cool temperature.
 - c. control sample improperly diluted.
 - d. reagent deteriorating.
39. A complete laboratory QC program includes:
- a. specimen collection with proper identification.
 - b. calibrating laboratory glassware.
 - c. analyzing for both accuracy and precision.
 - d. All of the above.
40. What % of values of normal test population is EXCLUDED from the acceptable range when the range is set by taking the mean value \pm or $- 2$ S.D.:
- a. 1%.
 - b. 2.5%.
 - c. 5.0%.
 - d. 10%.
41. Good precision in automated chemistry analysis will be attained if:
- a. the temperature of dialysis is constant, with NO variable analyzed.
 - b. patient specimens, controls and standards are analyzed in an exact procedure.
 - c. all reactions are carried to completion.
 - d. All of the above.

42. Which error would go unnoticed if control serum was analyzed with each patient?
- a. Using wrong pipet for control.
 - b. Mixup of patient specimens.
 - c. Using wrong reagents.
 - d. Using wrong wavelength.
43. The daily controls fall within 1 S.D. of the values originally analyzed for these controls. How do you evaluate this?
- a. The precision is good and the CV is small.
 - b. The precision is good and the CV is large.
 - c. The accuracy is good and the CV is large.
 - d. The accuracy is good the CV is small.
44. It is essential for a good primary standard to be:
- a. inexpensive; cost is important since it is used every day.
 - b. available in crude form.
 - c. available in a pure stabile form.
 - d. open to room air to ascertain hydration.
45. Glucose is stored in the liver and muscles as:
- a. a monosaccharide.
 - b. glycogen.
 - c. fat.
 - d. starch.

46. Diabetes mellitus is indicated by the following glucose tolerance levels:
- a. Plasma values at 1 hr = 100 mg/dl, at 1 1/2 hrs = 140 mg/dl, at 2 hrs = 110 mg/dl.
 - b. Plasma values at 1 hr = 160 mg/dl, at 1 1/2 hrs = 130 mg/dl, at 2 hrs = 120 mg/dl.
 - c. Plasma values at 1 hr = 140 mg/dl, at 1 1/2 hrs = 150 mg/dl, at 2 hrs = 130 mg/dl.
 - d. Plasma values at 1 hr = 185 mg/dl, at 1 1/2 hrs = 160 mg/dl, at 2 hrs = 140 mg/dl.
47. A patient is given a glucose load orally to test his glucose tolerance. He vomits the glucose 30 minutes later. What should you do?
- a. Continue. In 30 minutes, the glucose should be absorbed.
 - b. Discontinue. He obviously can't tolerate glucose.
 - c. Discontinue. At a later date give a venous glucose tolerance test.
 - d. Discontinue and tell the doctor he doesn't need it.
48. It is essential to run standards for glucose tests when:
- a. each batch of tests is run.
 - b. new reagents are used.
 - c. your lab is due for inspection.
 - d. daily.
49. A BUN and glucose are being analyzed by a dual-channel automated instrument. The BUN shows a good baseline, but the glucose does not. What is the probable problem?
- a. Proportioning pump.
 - b. Colorimeter.
 - c. Dialyzer.
 - d. Reagents.

50. Plasma or serum is preferred to whole blood in testing for glucose. Why?
- Convenience.
 - Glucose is more stable in plasma or serum.
 - Sensitivity is greater.
 - No filtrate is needed.
51. Bile salts are bile acids conjugated with:
- proteins.
 - carbohydrates.
 - enzymes.
 - amino acids.
52. Which lipoprotein functions are labile and inaccurate upon freezing the serum:
- Chylomicrons and HDL.
 - Chylomicrons and VLDL.
 - VLDL and LDL.
 - Chylomicrons and LDL.
53. Ketones are formed by excessive breakdown of fatty acids. Ketones are a group which includes:
- acetone.
 - diacetic acid.
 - betahydroxybutyric acid.
 - All of the above.
54. The stains commonly used to differentiate between the lipoprotein fractions are:
- fat red 7B and Oil red O.
 - Ponceau S and fat red 7B.
 - Oil red O methylene blue.

- d. Oil red O and ponceau S.
- 55. Hydrolysis of serum triglycerides into fatty acid and glycerol may be done with any of the following EXCEPT;
 - a. enzymes.
 - b. chloroform.
 - c. strong alkalis.
 - d. strong acids.
- 56. Steatorrhea is a malabsorption problem covered by an abnormal accumulation of which of the following in the feces?
 - a. Amino acids.
 - b. Enzymes.
 - c. Lipids.
 - d. Starches.
- 57. The chemical that differentiates proteins from carbohydrates and lipids is:
 - a. sulfur.
 - b. carbon.
 - c. oxygen.
 - d. nitrogen.
- 58. In order to use the biuret method for quantitating total protein, one must first remove the globulins by:
 - a. salt precipitation with sodium sulfate.
 - b. salt precipitation with potassium tartrate.
 - c. filtering after NaOH precipitation.
 - d. filtering after acid precipitation with sulfuric acid.
- 59. The intensity of the color of the biuret reaction for measurement of total serum proteins is dependent on:
 - a. the pH of the medium.
 - b. the strength of the buffer.

- c. the protein's molecular weight.
 - d. the number of peptide bonds.
60. Multiple myeloma has an elevated:
- a. alpha globulin.
 - b. gamma globulin.
 - c. beta globulin.
 - d. delta globulin.
61. A copper transport protein, migrating as an alpha-2-globulin is:
- a. albumin.
 - b. alpha-1-globulin.
 - c. alpha-2-globulin.
 - d. ceruloplasmin.
62. Bence-Jones protein is used to identify multiple myeloma, although a negative test does not rule out this disease. The thermal method of precipitation/redissolving reacts at what temperature?
- a. 37 - 40 degrees Centigrade / 85 - 100 degrees Centigrade.
 - b. 56 - 60 degrees Centigrade / 70 - 85 degrees Centigrade.
 - c. 40 - 60 degrees Centigrade / 85 - 100 degrees Centigrade.
 - d. 70 - 80 degrees Centigrade / 85 - 100 degrees Centigrade.
63. One property that differentiates albumin from globulin is:
- a. solubility in water.
 - b. solubility in hydrochloric acid.
 - c. solubility in nitric acid.
 - d. solubility in trichloroacetic acid.
64. A A/G ratio is ordered. The results are: total protein = 7.9 gm/dl; albumin = 2.8 gm/dl. How do you evaluate this?
- a. There was a mixup of specimens.

- b. This is normal.
 - c. This is an inverted A/G ratio and should be reported.
 - d. With a normal total protein, the albumin should be higher.
65. Of those compounds in human serum that are non-protein and contain nitrogen, which one is found in the greatest quantity?
- a. Amino acids.
 - b. Creatine.
 - c. Creatinine.
 - d. Urea.
66. Creatinine clearance is a measure of:
- a. tubular filtration rate.
 - b. glomerular secretion rate.
 - c. tubular secretion rate.
 - d. the glomerular filtration rate.
67. A buffered enzyme at an alkaline pH and serum are reactants for this test of a non-protein nitrogen. Is read with UV light at 293 nm. What substance is being analyzed?
- a. BUN.
 - b. Uric acid.
 - c. Creatine.
 - d. Creatinine.
68. A blood ammonia is ordered. The blood was collected in EDTA, and caution was taken to avoid hemolysis. The tube was filled completely and placed on ice. What caused the false increase?
- a. Cells lysing.
 - b. Wrong anticoagulant.
 - c. Blood became warm.
 - d. The patient was a chain-smoker.

69. Sodium, the primary cation found in plasma, is excreted in urine. The renal threshold is approximately:
- a. 110-130 mmol/L.
 - b. 950-1100 mmol/L.
 - c. 40-50 mmol/L.
 - d. 10-18 mmol/L.
70. A patient with Addison's disease has decreased secretion of both aldosterone and cortisol. His serum sodium and potassium results would show:
- a. high potassium, high sodium.
 - b. high potassium, low sodium.
 - c. low potassium, low sodium.
 - d. low potassium, high sodium.
71. Transferrin is usually elevated in:
- a. iron-deficiency anemias.
 - b. chronic diarrhea.
 - c. chronic blood loss.
 - d. hemochromatosis.
72. Which of the following statements about chloride are true?
- a. It can be assayed by a saccharogenic method.
 - b. It can move from extracellular plasma to intracellular fluid of RBC.
 - c. Urease is important in its assay.
 - d. It can be titrated with magnesium chloride.
73. The normal range for serum chloride in mEq/L is:
- a. 30-34.
 - b. 60-70.
 - c. 95-106.

- d. 100-140.
74. Calcium and phosphorus tend to maintain an equilibrium in the blood. A patient has a calcium level of 12.5 mg/dl in serum. What is the probable cause?
- a. Tetany.
 - b. Pregnancy.
 - c. Osteomalacea.
 - d. Polycythemia vera.
75. In the Clark-Collip method of quantitating calcium:
- a. cal-red is the indicator.
 - b. sulfuric acid converts the calcium oxalate to sulfur oxalate.
 - c. the end-point is titrated with potassium permanganate.
 - d. the calcium is precipitated as calcium citrate.
76. In order to maintain a normal pH of 7.4 in plasma, it is essential to keep a:
- a. 5:1 ratio of bicarbonate to dissolved CO₂.
 - b. 10:1 ratio of bicarbonate to dissolved CO₂.
 - c. 20:1 ratio of bicarbonate to dissolved CO₂.
 - d. 30:1 ratio of bicarbonate to dissolved CO₂.
77. A blood gas arterial specimen sealed and heparinized, was left at room temperature for 3 hours. What changes occur?
- a. PO₂ increase - PCO₂ decrease - pH increase.
 - b. PO₂ decrease - PCO₂ decrease - pH increase.
 - c. PO₂ decrease - PCO₂ increase - pH decrease.
 - d. PO₂ increase - PCO₂ increase - pH decrease.

78. A diabetic patient suddenly went out of control and ate a pound of chocolates at one time. What values would you expect in her FASTING blood?
- a. pH increased; glucose 600 mg/dl; ketones present.
 - b. pH decreased; glucose 600 mg/dl; ketones present.
 - c. pH decreased; glucose 95 mg/dl; ketones present.
 - d. pH increased; glucose 600 mg/dl; no ketones present.
79. What specimen is BEST to analyze acid-base disturbances involving pulmonary dysfunction?
- a. Arterial blood.
 - b. Capillary blood.
 - c. Venous blood.
 - d. None of the above.
80. Which anticoagulant is best for specimens for blood gas analysis?
- a. Sodium fluoride.
 - b. Sodium oxalate.
 - c. Sodium citrate.
 - d. Sodium heparin.
81. Which of the following methods for quantitating amylase is based on the measurement of the quantity of reducing substances formed?
- a. Amyloclastic.
 - b. Mercurimetric.
 - c. Saccharogenic.
 - d. Amylometric.

82. Which of the following statements about creatine kinase is (are) true?
- a. It needs magnesium for activity.
 - b. It is found primarily in cardiac and skeletal muscle and brain tissue.
 - c. It rises early after myocardial infarction.
 - d. All of the above.
83. Elevation of creatine kinase (previously called creatine phosphokinase) may be caused by:
- a. vigorous exercise.
 - b. appendicitis.
 - c. herpes simplex.
 - d. thyroid fever.
84. Lactic dehydrogenase (LD) has 5 isoenzymes. An increase of LD4 and LD5 suggest disease of what organ?
- a. Lungs.
 - b. Liver.
 - c. Spleen.
 - d. Kidneys.
85. Which enzyme is found elevated in acute pancreatic disease, and occasionally in kidney disease, obstruction of the intestines, and duodenal ulcers?
- a. Leucine amino peptidase.
 - b. Aldolase.
 - c. Lipase.
 - d. GOT.

86. To convert milligrams/100 ml (mg%) to milliequivalents per liter (mEq/L) use the following formula:
- a. $(\text{mg.} / 100 \text{ ml}) \times 10 = (\text{mEq/L}) / \text{equivalent weight of substance.}$
 - b. $\text{mg.} / 100 \text{ ml} = (\text{mEq/L} \times 10) / \text{equivalent weight of substance.}$
 - c. $\text{mEq/L} \times 10 = (\text{mg.} / 100 \text{ ml}) / \text{equivalent weight of substance.}$
 - d. $\text{mEq/L} = (\text{mg\%} \times 10) / \text{equivalent weight of substance.}$
87. A serum sodium is 460 ml/100 ml. The equivalent weight is 23. Calculate the mEq/L, using the formula $\{\text{mEq/L} = (\text{mg.\%} \times 10) / \text{equivalent weight of substance}\}$. What is the mEq/L of sodium?
- a. 100.
 - b. 200.
 - c. 300.
 - d. 400.
88. To convert vol.% CO₂ to mEq/L, the following formula should be used:
- a. $\text{vol.\% CO}_2 \times 0.45 = \text{mEq/L CO}_2.$
 - b. $\text{vol.\% CO}_2 / 10 \times 0.45 = \text{mEq/L CO}_2.$
 - c. $\text{vol.\% CO}_2 \times 10 \times 2.22 = \text{mEq/L CO}_2.$
 - d. $\text{vol.\% CO}_2 \times 10 \times 0.45 = \text{mEq/L CO}_2.$
89. The formula for converting Fahrenheit to Centigrade is:
- a. $\text{Fahrenheit} - 32 / 0.555 = \text{Centigrade.}$
 - b. $\text{Fahrenheit} + 32 / 0.555 = \text{Centigrade.}$
 - c. $\text{Fahrenheit} \times 0.555 - 32 = \text{Centigrade.}$
 - d. $\text{Fahrenheit} - 32 \times 0.555 = \text{Centigrade.}$

90. The basic unit used when measuring pressure is:
- a. microgram or 10 to the minus 6 power.
 - b. mole (mol.).
 - c. the Newton per square meter ($N / (m \text{ times } m)$)
 - d. the Kelvin (K.)
91. The function of the placenta is to secrete numerous hormones both steroid and protein. Of the following hormones, which is NOT secreted by the placenta?
- a. Progesterone.
 - b. Estrogen.
 - c. Luteinizing hormone.
 - d. Human chorionic gonadotropin.
92. Probably the most frequent cause of error in performing pregnancy tests by the hemagglutination method is:
- a. specimen too old, and hormone level has decreased.
 - b. outdated reagents.
 - c. specimen collected so soon after fertilization of egg.
 - d. temperature of test is too low.
93. A patient in a toxic state was admitted to the hospital. The physician ordered whole blood to be tested to determine the toxicity. Exposure to what agent was being tested?
- a. Aspirin.
 - b. Morphine.
 - c. Carbon monoxide.
 - d. Mercury.

94. Scurvy is found in the U.S., usually in children between 7 months and 2 years of age. This disease is a deficiency of:
- a. Vitamin A.
 - b. Vitamin B.
 - c. Vitamin C.
 - d. a mixture of all vitamins.
95. A valuable test in testing feces for steatorrhea is:
- a. Vitamin B12.
 - b. carotenoids.
 - c. folic acid.
 - d. total protein.
96. Vitamin B12 and which of the following are associated?
- a. Pernicious anemia and the Schilling test.
 - b. Solubility in water.
 - c. Intrinsic factor.
 - d. All of the above.
97. A blood alcohol (ethanol) test was ordered on a patient who had a car accident. The phlebotomist in error used isopropyl alcohol to sterilize the skin. What method, if any, could be used to quantitate the blood alcohol?
- a. Alcohol dehydrogenase.
 - b. Conway diffusion with dichromate reaction.
 - c. Gas-liquid chromatography.
 - d. None of the above.
98. The level of free red cell protoporphyrin is a useful screening test for what substance?
- a. Arsenic.
 - b. Cyanide.
 - c. Lead.

d. Barbiturates.

99. The 17-hydroxycorticosteroids tests, mainly evaluate:

- a. adrenal deficiency.
- b. thyroid deficiency.
- c. ovarian deficiency.
- d. testicular deficiency.

100. SD refers to:

- a. slow decrease.
- b. standard deviation.
- c. standard decrease.
- d. slow deviation.

MEDICOMP TEST
IMMUNOHEMATOLOGY
DOROTHY I. GOOD M.S. M.T. (ASCP)

Directions: Circle the correct answer on the following multiple choice questions. There is only one correct response.

1. The principle behind blood grouping is:
 - a. the red cells, having antibodies, will clump in the presence of agglutinins.
 - b. the serum, having antibodies, will clump in the presence of agglutinins.
 - c. red cells, having antigens, will clump in the presence of antibody directed toward that antigen.
 - d. the red cells, having agglutinins, will clump in the presence of antibody directed toward that agglutinin.
2. Genotype refers to characteristics of an individual as determined by:
 - a. direct observation.
 - b. heredity.
 - c. measurement.
 - d. chemical or serologic testing.
3. The patient is suspected of having a very weak subgroup of the A antigen, Ax. Of the following which is the best way to identify this?
 - a. Incubate the blood at 37 degrees C for 30 minutes.
 - b. Wait until the blood gets older, then retest it.
 - c. Wash the cells 3 times with saline, then test them.
 - d. Use monoclonal antibody testing serum.

4. A patient is being blood grouped. The following reactions occur when the blood cells are mixed with the antiserum: Anti-A antiserum - no agglutination ; Anti-B antiserum - agglutination; The blood group is:
 - a. A.
 - b. B.
 - c. AB
 - d. O.
5. In order to do "reverse grouping", the patient specimen needed is:
 - a. red blood cells, heparinized.
 - b. red blood cells, citrated.
 - c. red blood cells, sequestrinized.
 - d. fresh serum or fresh plasma.
6. Antigens of the ABO system in the red cells are:
 - a. fully developed in embryos 5 to 6 weeks old.
 - b. fully developed at birth.
 - c. fully developed in an individual 2-4 years old.
 - d. do not develop until puberty.
7. In order to differentiate between A1 and A2, you must use:
 - a. only human anti-A1 to agglutinate A1 cells.
 - b. only lectin anti-A1 (made from *Dolichos biflorus*) to agglutinate A1 cells.
 - c. neither human anti-A1 nor lectin anti-A1 to agglutinate A1 cells.
 - d. both human anti-A and lectin anti-A1 to agglutinate A1 cells.

8. In determination of the secretor property, it is necessary to:
 - a. freeze the saliva before testing.
 - b. read the test reaction microscopically.
 - c. place stoppered tube of saliva in a boiling water bath for 10 minutes to inactivate enzymes.
 - d. use antiglobulin serum.
9. In routine testing for ABO grouping, which of the following is NOT true?
 - a. both red cell and serum testing should be included.
 - b. incubation should be at room temperature or lower.
 - c. incubation should be performed at 37 degrees C., using a viewbox.
 - d. agglutination should be recorded only after viewing against a well-lighted background.
10. Extracts from the seeds of the plant *Dolichos biflorus* contain a lectin which reacts with human red cells of phenotype(s):
 - a. B and A3.
 - b. O.
 - c. A1B and A2.
 - d. Anti A1.
11. ABO phenotypes may be affected by:
 - a. Polycythemia.
 - b. Malaria.
 - c. Acute leukemia.
 - d. Mongolism.

12. Optimum temperature for testing antibodies of the ABO system is:
 - a. 22 degrees C.
 - b. 37 degrees C.
 - c. 40 degrees C.
 - d. 56 degrees C.
13. Antibodies in the ABO system:
 - a. never show dosage effect.
 - b. are difficult to detect, and must have an antiglobulin test.
 - c. are usually IgG antibodies.
 - d. are usually hemolysins IN VIVO.
14. A person who is blood group B has what type of antigens on his/her red blood cells?
 - a. A.
 - b. B.
 - c. AB.
 - d. O.
15. A patient is blood group AB. What antibody(s) would he/she have in his/her serum?
 - a. Anti-A.
 - b. Anti-B.
 - c. Both anti-A and anti-B.
 - d. Neither anti-A or anti-B.
16. What percentage of the United States population has blood group B, Rh negative blood.
 - a. 1.5%.
 - b. 5%.
 - c. 10%.

- d. 15%.
17. The expression of the A and B genes appears to be dependent on the action of the H gene. Which of the following statements is NOT true?
- a. A precursor mucopolysaccharide substance is converted by the gene H to H substance.
 - b. Most people are heterozygous Hh.
 - c. The H substance is partly converted by the A or B genes into A or B antigen.
 - d. The O gene, being amorphic, affects no conversion of H substance.
18. Agglutination occurs with anti-C, anti-c, and anti-e. NO agglutination occurs with anti-D and anti-E. What is the donor's genotype?
- a. cde/cde.
 - b. cDe/cDe.
 - c. cDE/cDe.
 - d. Cde/cde.
19. A person has a genotype CDe/cde. Which antibody can he produce?
- a. Anti-c.
 - b. Anti-C.
 - c. Anti-D.
 - d. Anti-E.
20. A patient's RBC agglutinate with anti-A typing serum, but not with anti-B typing serum. The patient's serum is then mixed with A cells, B cells, and O cells. Which of the following are the expected reactions:
- a. A cells RBC = no agglutination B cells RBC = agglutination
O cells RBC = agglutination.
 - b. A cells RBC = agglutination B cells RBC = no agglutination
O cells RBC = agglutination.
 - c. A cells RBC = no agglutination B cells RBC = no

agglutination O cells RBC = agglutination.

d. A cells RBC = no agglutination B cells RBC = agglutination
O cells RBC = no agglutination.

21. After D, the order of immunogenicity of the other Rh antigens appears to be:
 - a. $e > c > E > C$.
 - b. $C > E > c > e$.
 - c. $E > e > C > e$.
 - d. $c > E > C > e$.
22. Which of the following antibodies is it possible for a cDE/cde person to produce?
 - a. Anti-C.
 - b. Anti-c.
 - c. Anti-D.
 - d. Anti-e.
23. Four units of whole blood gave the following results with ABO testing. Which one of the answers below are correct for the ABO test?
 - a. Patient cells: Anti-A - Anti-B - Patient serum: A cells + B cells - Reported results: AB.
 - b. Patient cells: Anti-A + Anti-B + Patient serum: A cells - B cells + Reported results: A.
 - c. Patient cells: Anti-A - Anti-B + Patient serum: A cells + B cells - Reported results: B.
 - d. Patient cells: Anti-A - Anti-B - Patient serum: A cells - B cells + Reported results: O.
24. The major advantage of using anti-D Bio Clone grouping reagent is:
 - a. The blend of IgA monoclonal anti-D is specific.
 - b. The consistently strong reaction with Rh positive cells, regardless of method used.
 - c. The blend of IgE monoclonal anti-D is specific.

- d. The mixture of IgA monoclonal and IgD polyclonal gives a strong reaction.
25. The Rh immune antibody is of the immunoglobulin class:
- a. IgA.
 - b. IgD.
 - c. IgM.
 - d. IgG.
26. A blood bank worker used a 10% red cell suspension in doing a cell grouping test. What would most likely happen?
- a. False positive due to antigen excess.
 - b. False negative due to antigen excess.
 - c. False negative due to antibody excess.
 - d. False negative due to rouleaux formation.
27. Individuals who have the "Bombay" phenotype:
- a. Have red cells having A, B and H antigens.
 - b. Have red cells devoid of A, B, or H antigens.
 - c. Have red cells that are agglutinated with anti-A and anti-B.
 - d. Have serum that does not react with group O red blood cells.
28. Oh individuals completely lack the H antigen. Therefore:
- a. Anti-H is absent in the serum.
 - b. This antibody binds complement and causes hemolysis.
 - c. Oh patients can be transfused with any blood.
 - d. All are true.
29. You would be most likely to find the "I" antigens on:
- a. adult RBC.
 - b. newborns.

- c. adult WBC.
 - d. any washed cells.
30. Persons with which blood group resist malaria?
- a. H.
 - b. Lutheran.
 - c. Kell.
 - d. Duffy.
31. The Lewis blood group system differs because it:
- a. lyses red cells.
 - b. is not found in patients in warm climates.
 - c. is a system of antigens manufactured by tissue cells rather than erythrocytic antigens.
 - d. agglutinates both red and white cells.
32. Hemolysis in vitro is noted while doing an antibody screening test. Of the following, what is the most probable cause?
- a. Anti-A.
 - b. Anti-D.
 - c. Anti-Fy-a.
 - d. Anti-Le-a.
33. The antibody which is the most commonly encountered in reverse grouping and may cause a problem in serum testing is:
- a. anti-P.
 - b. anti-M.
 - c. anti-K.
 - d. anti-I.
34. A person having "Bombay" blood has the following characteristics of phenotypes:
- a. Absence of A or B enzymes in serum and red cells.

- b. Dominant mode of inheritance.
 - c. Presence of anti-A, anti-B, anti-AB, and a potent wide thermal range anti-H in the serum.
 - d. Agglutination with anti-A, anti-B, anti-AB or anti-H.
35. A child needing a transfusion has his blood cells typed as group "O". The reverse grouping shows no antibodies. How do you explain this?
- a. The specimens were mislabeled.
 - b. The child may be a "Bombay" type.
 - c. The test was done at room temperature.
 - d. The cells tested were over 6 hours old.
36. In performing an antibody screen on a pre-operative patient, one of the screening cells was positive at 22 degrees C only. What antibody would this probably be?
- a. Anti-M.
 - b. Anti-Jk-a.
 - c. Anti-Duffy.
 - d. Anti-Jk-b.
37. A blood IN VITRO exhibits hemolysis in its serum after storage for a short time. It probably is:
- a. Duffy-positive.
 - b. Kidd-positive.
 - c. Lewis-positive.
 - d. Lutheran-positive.
38. The antibody MOST likely to cause dosage effect is:
- a. anti-E.
 - b. anti-Kell.
 - c. anti-Lewis.
 - d. anti-M.

39. When drawing a donor, the blood flow must remain fairly brisk. If it takes more than minutes to collect a unit of blood, what may happen?
- a. The donor may lose consciousness.
 - b. The donor may become agitated because his/her time is important.
 - c. The unit may not be suitable for preparation of platelet concentrates, fresh frozen plasma or cryoprecipitate.
 - d. The blood may hemolyze.
40. During thrombocytapheresis, a donor's:
- a. platelet count decreases about 30%.
 - b. platelet count decreased about 50%.
 - c. platelet count decreases about 75%.
 - d. platelet count stays the same.
41. The following should be deferred from thrombacytapheresis or granulocytapheresis:
- a. Those who have taken aspirin within the last 3 days.
 - b. Those who have hypertension or diabetes.
 - c. Those who have ulcers and/or symptoms.
 - d. All of the above.
42. Which of the following should be deferred from donating?
- a. A patient who has had minor skin cancer.
 - b. A patient who has had febrile convulsions as a child.
 - c. A patient who bleeds a lot after having a tooth pulled.
 - d. A patient who has been vaccinated for smallpox 3 months ago.

43. To draw 450 +/- 45 ml. of blood from a donor (+30 ml for processing), the donor must weigh 110 lbs. If less, less blood may be drawn if some of the anticoagulant is expressed from the bag. The amount of anticoagulant to remove is:
- a. 63 ml minus donor's weight divided by 110 lb times 63 ml.
 - b. 110 lb minus donor's weight divided by 63 ml times 45 ml.
 - c. 63 ml minus donor's weight divided by 110 lb divided by 63 ml.
 - d. 50 kg times 110 lb minus donor's weight divided by 63 ml.
44. Which of the following viral infections is screened for by surrogate testing?
- a. Cytomegalic virus.
 - b. Hepatitis B virus.
 - c. Hepatitis delta virus.
 - d. Non-A, non-B hepatitis viruses.
45. The American Association of Blood Banks has established the criteria for donors giving blood. Which of the following groups can be excepted from some of these requirements.
- a. Men between the ages of 25-40.
 - b. Professional donors.
 - c. Donors who gave within the last months without any problem.
 - d. Autologous donors.
46. A donor unit showed a positive antibody screen. This unit may be used for:
- a. a whole blood unit.
 - b. packed red blood cells.
 - c. a single unit liquid plasma.
 - d. a single unit fresh frozen plasma.

47. A unit of blood tested positive by RIA for hepatitis B surface antigen (HBsAG). This blood may be used for:
- a. any compatible patient.
 - b. no patient - it must be discarded.
 - c. any compatible patient with a terminal disease.
 - d. only as an autologous transfusion.
48. One of the following donors should be rejected indefinitely. Which one?
- a. Pregnant one year before donating.
 - b. Tooth extraction 3 months before donating.
 - c. German measles vaccination 2 months before donating.
 - d. Human pituitary growth hormone give 2 months before donating.
49. A donor's history revealed he experienced night sweats; weight loss; lumps in armpits, neck, and groin; discolored areas of skin; cough and diarrhea. He was feeling fine today. Defer his donation indefinitely because he might have:
- a. Hepatitis.
 - b. AIDS or ARC.
 - c. Tuberculosis.
 - d. An intestinal parasite.
50. Autologous donations are preferred to receiving blood from another person because:
- a. Your own blood is the safest possible transfusion.
 - b. There is no risk of disease transmission.
 - c. There is no risk of alloimmunization to red cells, white cells or platelets.
 - d. All of the above.

51. The most severe reaction a DONOR may suffer from is (are):
- a. convulsions.
 - b. hyperventilation.
 - c. nausea and vomiting.
 - d. pallor sweating.
52. A group of donors were being tested pre-donation. Which temperature would exclude a donor?
- a. 99.9 degrees F.
 - b. 98.6 degrees F.
 - c. 98.0 degrees F.
 - d. 97.6 degrees F.
53. A donor hemoglobin for a female should be at least:
- a. 10.5 g/dl.
 - b. 11.5 g/ dl.
 - c. 12.5 g/dl.
 - d. 13.5 g/dl.
54. A donor has a history of viral hepatitis at age 13. He must be rejected as a donor:
- a. for 6 weeks.
 - b. for 6 months.
 - c. for 1 year.
 - d. forever.
55. A potential blood donor lived for one year in an area endemic for malaria. How long must he wait, after returning to the U.S., before he can donate blood?
- a. 1 year.
 - b. 3 years.
 - c. 6 months.

- d. forever.
56. Blood donor records must be kept for:
- a. 1 month.
 - b. 48 hours after the blood is transfused.
 - c. 1 year.
 - d. 5 years or longer, depending on local statutes.
57. After plasmapheresis, what length of time must elapse before whole blood donation?
- a. at least 8 hours.
 - b. at least 24 hours.
 - c. at least 48 hours.
 - d. at least 1 week.
58. Which of the following would rule out a donor permanently?
- a. A patient who has been exposed to malaria within the past 6 months.
 - b. A person who has had a positive test for HBsAg.
 - c. Oral hypoglycemic agents in well-controlled diabetics.
 - d. Blood pressure medications.
59. After an apheresis donation, the donor must wait how long before donating whole blood?
- a. 48 hours.
 - b. 1 week.
 - c. 3 weeks.
 - d. 6 weeks.
60. Individuals who have received blood or blood components cannot donate blood for a period of:
- a. 6 weeks.
 - b. 2 months.

- c. 3 months.
 - d. 6 months.
61. The primary anticoagulant in CPDA-1 is:
- a. citric acid.
 - b. dextrose.
 - c. phosphate.
 - d. sodium citrate.
62. A donor unit screened positive twice for the HIV antibody, using an enzyme-linked immunosorbant assay (ELISA) approved by the FDA. What should be done?
- a. Hold the unit for 6 days, after which it is safe to use.
 - b. The ELISA test SHOULD be positive, so it is safe to transfuse this blood.
 - c. Discard the unit and perform a confirmation Western Blot test.
 - d. Transfuse the blood only to patients having HIV antibody.
63. What is the ideal temperature range for refrigerators used to store blood for transfusion?
- a. 3-5 degrees C.
 - b. 1-8 degrees C.
 - c. 1-10 degrees C.
 - d. 5-10 degrees C.
64. Storing blood causes a "shift to the left", meaning:
- a. Hemoglobin oxygen affinity increases due to a decrease in 2,3-DPG.
 - b. Hemoglobin oxygen affinity decreases due to a decrease in 2,3-DPG.
 - c. Hemoglobin oxygen affinity increases due to an increase in 2,3-DPG.
 - d. Hemoglobin oxygen affinity decreases due to an increase in 2,3-DPG.

65. Blood collected in CPDA-1 and prepared in a closed system may be used for a maximum of:
- a. 15 days.
 - b. 21 days.
 - c. 35 days.
 - d. 45 days.
66. The optimum storage temperature for platelets is:
- a. 4 degrees C.
 - b. 22 degrees C.
 - c. 32 degrees C.
 - d. 37 degrees C.
67. Which of the following is true for leukocyte-poor red blood cells:
- a. They should be stored at 1-6 degrees C.
 - b. There should be greater than 70% RBC's and less than 30% of residual WBC.
 - c. They must be ABO/Rh compatible to be used for transfusion.
 - d. All of the above.
68. Which of the following does not have to be Rh compatible in order to be transfused safely?
- a. Leukocyte-poor red blood cells.
 - b. Single donor plasma.
 - c. Washed red blood cells.
 - d. Single donor platelets.
69. In treating hemophilia, the most effective blood component is:
- a. packed red blood cells.
 - b. whole blood, freshly drawn.
 - c. leukocyte-poor red cells.

- d. cryoprecipitated AHF.
70. Cryoprecipitate is used primarily for:
- a. multiple myeloma.
 - b. severe burns.
 - c. pernicious anemia.
 - d. treatment of factor VIII deficiency.
71. A thirty-year male with a severe nose bleed and hemoglobin of 8.0 gm/dl was admitted to the hospital. He was diagnosed as having von Willebrand's disease. The blood component best for treating this is:
- a. whole blood.
 - b. cryoprecipitate.
 - c. leukocyte-poor blood.
 - d. stored plasma.
72. Which of the following patients should receive RhoGAM?
- a. A patient whose red cells do not react with anti-D directly or in the test for Du.
 - b. A patient whose red cells do not react with anti-D directly but did react when converted to the antiglobulin test.
 - c. A patient whose red cells react in the Du test, with a negative Du control.
 - d. All patients should receive RhoGAM, regardless of Du test results.
73. RhoGAM should NOT be given when:
- a. the father is Rh positive.
 - b. the baby is Rh positive.
 - c. The mother is Rh negative.
 - d. the father is Rh negative.

74. Of the following, which cannot transmit hepatitis through transfusion?
- a. Single donor platelets.
 - b. Normal serum albumin.
 - c. Cryoprecipitate.
 - d. Packed RBC.
75. What is the maximum time after blood collection one has to prepare platelet concentrates from whole blood?
- a. 1 hour.
 - b. 6 hours.
 - c. 12 hours.
 - d. 24 hours.
76. Which blood component can be infused as a single unit, ignoring the ABO compatibility?
- a. Leukocyte-poor platelets.
 - b. Leuko-poor red cells.
 - c. Packed red cells.
 - d. Cryoprecipitated AHF.
77. In pooling platelets, which can be safely pooled with 5 units of O Rh pos platelets if most bags contain 0.5 ml RBC?
- a. AB Rh neg platelets.
 - b. A Rh neg platelets.
 - c. B Rh neg platelets.
 - d. O Rh neg platelets.

78. Which blood component is the best source of coagulation factors for transfusing a patient with a deficiency of labile factors?
- a. Whole blood.
 - b. Leukocyte-poor blood.
 - c. Fresh frozen plasma.
 - d. Single unit platelets.
79. Methods to prepare leukocyte-poor platelets include:
- a. filtering.
 - b. centrifugation.
 - c. use of a specially designed platelet pooling bag.
 - d. All of the above.
80. In order NOT to delay transfusions, the following crossmatch is recommended:
- a. Patient serum + donor washed cells + 22% bovine albumin + antiglobulin.
 - b. Donor serum + patient washed cells + 22% bovine albumin + antiglobulin.
 - c. Donor serum + patient washed cells + 22% bovine albumin + IgG sensitized RBC.
 - d. Patient serum + donor washed cells + 22% bovine albumin + IgG sensitized RBC.
81. Antigen-antibody reactions during compatibility testing may be enhanced by:
- a. incubating at 37 degrees C after adding albumin.
 - b. adding low-ionic strength solution (LISS).
 - c. performing the antihuman globulin test.
 - d. All of the above.

82. In crossmatching, after centrifugation, the supernatant showed hemolysis. This must be interpreted as:
- a. doubtful compatibility; recheck the test.
 - b. positive.
 - c. negative.
 - d. safe to donate.
83. One of the following could NOT cause positive results in a crossmatch. Which one?
- a. An alloantibody in patient's serum reacting with corresponding antigen on donor RBC.
 - b. An antibody in patient's serum reacting with corresponding antigen on donor RBC.
 - c. Incorrect ABO grouping of patient or donor.
 - d. Absence of autoantibody in the patient's serum.
84. Rapid transfusion of large volumes of cold blood may cause the patient to have:
- a. an allergic reaction.
 - b. a febrile reaction.
 - c. a hemolytic reaction.
 - d. hypothermia.
85. A pint of blood was dispensed for therapy to a patient. Even though the major crossmatches were compatible, the patient had a severe hemolytic reaction. Which of the following would you suspect?
- a. Anti-Le-a.
 - b. Anti-M.
 - c. Anti-N.
 - d. Anti-AB.

86. The American Association of Blood Banks Standards prohibits the use of most devices used to warm blood prior to transfusions. Which one is permitted?
- a. In-line blood warmers.
 - b. Microwave blood warmers.
 - c. Incubators.
 - d. Water baths.
87. The antibodies that most often cause DELAYED hemolytic reactions are those of the:
- a. Kidd system, anti-E, anti-C, and anti-Fya.
 - b. Kell, anti-C, anti-e, and Lutheran.
 - c. Lutheran, anti-c, anti-e, and Kidd.
 - d. Lewis, anti-c, anti-e, and Kell.
88. One of the problems encountered in the MAJOR compatibility testing is:
- a. an antibody in the donor plasma reacting with the corresponding antigen on the patient's red cells.
 - b. fibrin clots in the donor serum.
 - c. prior coating of the patients red cells with protein.
 - d. imbalance of the normal ratio of albumin and gamma globulin.
89. An O, Rh-negative patient receives whole blood from a B, Rh positive donor. The immediate reaction is:
- a. Rh sensitization.
 - b. circulatory overload.
 - c. a hemolytic reaction.
 - d. None of the above.

90. In an emergency, fresh-frozen plasma from group AB donors may be given to patients who are:
- a. group AB only.
 - b. group O only.
 - c. groups A & B only.
 - d. groups A, B, O, or AB.
91. A patient is suspected of having a hemolytic transfusion reaction. The tests which would be most valuable in confirming this are:
- a. ABO grouping and Rh typing.
 - b. bilirubin, free hemoglobin, visual examination for hemolysis, DAT, and urinalysis.
 - c. hemoglobin and differential.
 - d. RBC, platelet count and differential.
92. A patient was transfused with 1 unit of whole blood. A febrile reaction occurred. Upon checking, there was no red cell incompatibility. The reaction was probably due to:
- a. contaminated blood.
 - b. an allergy.
 - c. alloimmunization.
 - d. leukoagglutinins.
93. ABO blood group incompatibility is usually implicated in what type of reaction?
- a. Anaphylactic.
 - b. Bacterial.
 - c. Febrile.
 - d. Hemolytic.

94. A frequent autoimmune "cold" antibody is:
- a. anti-M.
 - b. anti-A.
 - c. anti-I.
 - d. anti-K.
95. Most urticarial reactions are thought to be due to:
- a. Anti-IgA in the recipient reacting with the IgA in the donor.
 - b. Anti-IgE in the recipient reacting with IgE in the donor.
 - c. Anti-IgG in the recipient reacting with the IgG in the donor.
 - d. Anti-IgM in the recipient reacting with the IgM in the donor.
96. The most common cause of hemolytic transfusion reaction is:
- a. presence of IgM antibodies.
 - b. due to bacteriogenic reactions.
 - c. administration of wrong blood due to wrong patient identification and clerical error.
 - d. due to alloimmunozation.
97. Urticarial reactions is characteristic of what type of response?
- a. Bacterial.
 - b. Allergic.
 - c. Febrile.
 - d. Hemolytic.

98. A STAT blood typing, drawn by a nurse, is received in the laboratory. There is no label. It is essential to:
- a. label the tube yourself, to make sure it is done right.
 - b. take it back to the floor nurse, and refuse to do it.
 - c. have the nurse redraw the blood, label it properly and bring it to the laboratory.
 - d. ignore the situation until the doctor reorders it.
99. A patient received one-half pint of blood when chills, fever and shortness of breath started. Direct antiglobulin test = positive, haptoglobin = 32 mg/dl and urine contained free hemoglobin. What is the probable cause of the reaction?
- a. Anaphylactic.
 - b. Urticarial.
 - c. Hemolytic.
 - d. Febrile.
100. Which type of transfusion reaction has the least risk by transfusing RBC ONLY?
- a. Hemolytic.
 - b. Circulatory overload.
 - c. Anaphylactic.
 - d. None of the above.
101. EDTA should not be used in blood collected for tests for antibody screen and/or compatibility testing because:
- a. EDTA negates detection of significant antibodies.
 - b. It takes longer for the test to react.
 - c. EDTA prevents the detection of complement-dependent antibodies.
 - d. EDTA causes rouleaux.

102. The hospital doing a compatibility testing on a unit of whole blood or packed RBC must confirm the unit's ABO group. They must also confirm the:
- a. Australian antigen-syphilis tests.
 - b. Rh group on Rh negative units only.
 - c. antibody screen and VDRL.
 - d. antibody screen and Australian antigen test.
103. A couple had four children, each with a different ABO phenotype; i.e., A, B, AB, & O. The phenotypes of the parents had to be:
- a. AB & O.
 - b. AB & AB.
 - c. A & B.
 - d. A & AB.
104. Two group A people mate and have a group O child. This explained by:
- a. the laboratory made an error in typing the child.
 - b. the father was really not the father.
 - c. the mother was really not the mother.
 - d. both parents were heterozygous-group AO.
105. Ms. Flit had baby out of wedlock and has accused Mr. G. of fathering the child. Ms. Flit's blood genotype is BB. The genotype of the purported father is AO. What phenotype(s) would include Mr. G. as the baby's possible father?
- a. AB, B.
 - b. A.
 - c. O.
 - d. Any of the above.

106. The mother of a baby is cde/cde. The father is Rh positive. The baby is cde/cde. One could conclude that:
- an error was made in the baby's Rh type.
 - the father is homozygous Rh positive.
 - the father is heterozygous Rh positive.
 - somebody was unfaithful.
107. Both parents are genotyped CDE/cde. About 1/4 of their children can be expected to be:
- Rh positive.
 - Rh negative.
 - heterozygous.
 - Du positive.
108. Rouleaux formation resembling agglutination, may be caused by:
- diluting the cells with 50% saline.
 - low immunoglobulin levels.
 - elderly person whose antibody level has decreased severely.
 - high concentrations of fibrinogen or abnormal proteins.
109. Cold autoagglutinins are generally what type immunoglobulin?
- IgA.
 - IgE.
 - IgM.
 - IgG.
110. Cell-to-cell contact is enhanced by reduction of the zeta potential. This may be accomplished by exposing red cells to:
- 0.85% saline.
 - antiglobulin.
 - distilled water.
 - certain proteolytic enzymes.

111. Cold agglutinins:

- a. can exhibit a wide thermal amplitude over a range of 4-37 degrees C.
- b. are usually of the IgG variety.
- c. always react at 37 degrees C.
- d. None of the above.

MEDICOMP TEST
ADVANCED IMMUNOLOGY
DOROTHY I. GOOD M.A. A.S.S. (ASPS)

Directions: Circle the correct answer on the following multiple choice questions. There is only one response.

1. A reactive Fluorescent Treponemal Antibody (FTA) absorption test:
 - a. indicates the stage of infection.
 - b. is indicated when a red fluorescence is observed.
 - c. confirms the presence of treponemal antibodies in serum.
 - d. can be read only after 24 hours.
2. RPR tests were drawn 7/1/88 - run on 7/3/88. The room temperature was 32 degrees C. After checking the results of the 48 test specimens - the supervisor did not report them. Why?
 - a. The RPR test must be run within 8 hours after specimen collection.
 - b. The temperature was too high - increasing the reactivity.
 - c. The temperature was too low - decreasing the reactivity.
 - d. None of the above.
3. Cross-reactivity may result in false positive serologic reactions when:
 - a. No electrolyte is in the test serum.
 - b. The complement has been inactivated.
 - c. The diluent is contaminated.
 - d. Closely-related organisms share common antigens.

4. VDRL antigen is made from purified cardiolipin and beef heart lecithin. Cholesterol is added to increase the antigen's effective reacting surface. What happens when serum from a syphilitic patient is tested with this antigen?
 - a. Reagin produces dispersion of the antigen - observed as visible flocculation.
 - b. Sedimentation occurs.
 - c. A true turbidimetric test results.
 - d. Flocculation is dispersed within 10 minutes.
5. Which immunoglobulin class(es) appear(s) most effective in fixing complement by way of the classic pathway(s)?
 - a. IgA
 - b. IgA IgG
 - c. IgM IgG
 - d. IgM IgE
6. Which of the following disorders would not be likely to cause a biologic false positive test with VDRL testing?
 - a. Atypical pneumonia.
 - b. Myelogenous leukemia.
 - c. Infectious mononucleosis.
 - d. Systemic lupus erythematosus.
7. Tests for syphilis using treponemal antigens should be used when testing serum from patients:
 - a. routinely.
 - b. who have diagnostic problems.
 - c. with chancres.
 - d. who are having pre-marital tests.

8. A physical on a patient revealed - a reactive Rapid Plasma Reagin (RPR) - a non-reactive FTA-ABS - and a non-reactive spinal fluid VDRL. Explain this.
 - a. the patient had syphilis in the primary stage.
 - b. The patient had syphilis in the secondary stage.
 - c. The patient had syphilis in the tertiary stage.
 - d. The RPR was a biological false positive.
9. A "Prozone reaction" occurs when:
 - a. the serum has been inadequately inactivated.
 - b. the serum has lost its complement.
 - c. the antibody content is so high that the antigen is insufficient to give a clear-cut reaction.
10. The fluorescent treponemal antibody absorption (FTA-ABS) test for syphilis is:
 - a. highly specific and sensitive.
 - b. always less sensitive than the Treponema Immobilization Test (TPI).
 - c. less sensitive than the VDRL.
 - d. affected greatly by the storage temperature.
11. In doing the Fluorescent Treponemal Antibody-Absorption Test - you note a beaded pattern of fluorescence along the treponeme. This indicates:
 - a. a false-positive reaction.
 - b. a definitive diagnosis of *T. pallidum*.
 - c. a false-negative reaction.
 - d. presence of an antibody that is non-treponemal.

12. Needles used for adding antigen suspensions to slide tests for syphilis should be checked how often to determine how many drops/ml are being delivered?
 - a. Each time a new needle is used.
 - b. If the QC is not within limits.
 - c. Each time the test is performed.
 - d. When a new lot of antigen is used.
13. A rotator is used in the performance of a VDRL test. The speed of the rotator should be:
 - a. 100 rpm.
 - b. 140 rpm.
 - c. 160 rpm.
 - d. 180 rpm.
14. Slide agglutination tests are practical only when the clumping of particles occurs within:
 - a. one-two minutes.
 - b. ten minutes.
 - c. one hour.
 - d. four hours.
15. Which of the following tests is relatively easy to perform - dependable to read - and can be used as a confirmatory test for the diagnosis of secondary or late-stage syphilis?
 - a. RPR
 - b. FTA-ABS.
 - c. TPI.
 - d. MHA-TP.

16. A physician orders a serological test for syphilis on a cerebrospinal fluid. Probably the best test to determine syphilis in CSF is:
 - a. FTA-ABS.
 - b. TPI.
 - c. VDRL.
 - d. RPR.
17. To diagnose infectious syphilis - *Treponema pallidum* can be demonstrated directly from appropriate clinical material with:
 - a. culture on special agar media.
 - b. fluorescent-antibody dark-field technic.
 - c. the FTA-ABS test.
 - d. staining with Gram stain.
18. In the FTA_ABS test - the antigen used is a suspension of:
 - a. cholesterol-beef-heart.
 - b. lecithin-beef-heart.
 - c. *T. pallidum* (Nichols strain) from rabbit testicle.
 - d. Reiter's treponeme.
19. Flocculation tests for syphilis use antigen of:
 - a. cardiolipin-cholesterol-lecithin.
 - b. *T. Pallidum* (Nichol's strain).
 - c. Reiter's treponeme.
 - d. None of the above.

20. Acquired (adaptive) immunity is that which is conferred:
- a. by actual infection or inoculation that causes the production of specific protective antibodies (active immunity).
 - b. by artificial transmission of antibodies - which afford temporary protection against invading antigen (passive immunity).
 - c. both (1) and (2).
 - d. neither (1) or (2).
21. C-reactive protein:
- a. is specific for rheumatoid arthritis.
 - b. rules out bacterial infection.
 - c. remains long after an inflammatory disease subsides.
 - d. is found in rheumatoid arthritis - TB viral infections - and many malignant diseases.
22. Human CRP is a(n):
- a. alpha globulin.
 - b. beta globulin.
 - c. gamma globulin.
 - d. fibrinogen.
23. In interpreting agglutination tests for febrile diseases - the most important thing to look for is:
- a. history of vaccination.
 - b. the strength of reaction in the first test.
 - c. naturally-occurring antibodies to which the patient may have been exposed.
 - d. the rise in titer of the patient's serum antibodies.

24. C-reactive protein measurement is:
- a. undetectable when the inflammation is gone.
 - b. a normally undetectable serum protein derived from liver.
 - c. analyzed by latex agglutination - immunoprecipitation - immunonephelometry - or "rocket electrophoresis".
 - d. all of the above.
25. The latex agglutination titer deemed the lower limit of positivity for a diagnosis of rheumatoid arthritis is:
- a. 1 to 2
 - b. 1 to 16.
 - c. 1 to 40.
 - d. 1 to 160.
26. Antiserum used in the C-reactive protein test:
- a. is obtained from lab animals sensitized with C-mucopolysaccharide of Pneumococcus.
 - b. is the same as anti-HCG serum.
 - c. is a suspension of 3 strains of Proteins.
 - d. is a Strep-A extract.
27. Which is false about the following statements regarding C-reactive protein determinations?
- a. The serum must be inactivated for 30 minutes at 56 degrees.
 - b. The highest serum dilution showing visible flocculation is taken as the C-reactive protein titer.
 - c. A prozone reaction may occur in patients with excessive amounts of antigen.
 - d. The latex slide test for CRP are less sensitive than the capillary precipitin tests.

28. The classical autoantibody found in rheumatoid arthritis is:
- a. IgA.
 - b. IgE.
 - c. IgG.
 - d. IgM.
29. In lupus erythematosus (SLE):
- a. the patient produces autoantibody against his/her antigen.
 - b. the LE factor reacts with T cell nuclei.
 - c. the Le factor is an alpha-globulin.
 - d. the LE factor is very unstable because it is an anti-RNA antibody.
30. The LE cell is:
- a. a monocytic leukocyte that has ingested a homogeneous globular mass of altered nuclear material.
 - b. a lymphocytic leukocyte that has ingested a homogeneous globular mass of altered nuclear material.
 - c. a neutrophilic leukocyte that has ingested a homogeneous globular mass of altered nuclear material.
 - d. a macrocyte that has ingested a homogeneous globular mass of altered nuclear material.
31. In lupus erythematosus - the serum factor responsible for cellular changes of immunologic origin is:
- a. antideoxyribonucleoprotein of the IgA type.
 - b. antideoxyribonucleoprotein of the IgE type.
 - c. antideoxyribonucleoprotein of the IgG type.
 - d. antideoxyribonucleoprotein of the IgM type.

32. SLE patients frequently have which of the following?
- a. Decreased serum immunoglobulin levels.
 - b. "Onion-skin" appearance of arteriolar wall of spleen.
 - c. Increased titers of DNA antibody.
 - d. Inhibition of activation of the complement system.
33. Which of the following would NOT point to lupus erythematosus?
- a. Thrombocytosis.
 - b. Leukopenia.
 - c. Thrombocytopenia.
 - d. Mild anemia.
34. An electrophoretic pattern of patients with disseminated lupus erythematosus would show:
- a. decrease in albumin - alpha-1-globulin - alpha-2-globulin - beta-globulin - and gamma-globulin.
 - b. increase in albumin - alpha-1-globulin - alpha-2-globulin - beta-globulin - and gamma-globulin.
 - c. increase in albumin - alpha-1-globulin - alpha-2-globulin - with a decrease in beta-globulin and gamma-globulin.
 - d. decrease in albumin - alpha-1-globulin - alpha-2-globulin - with an increase in beta-globulin and gamma-globulin.
35. Certain drugs have been found to have lupus-inducing or lupus-activating potential. Among these are:
- a. hydralazine hydrochloride and procainamide hydrochloride.
 - b. anticonvulsant drugs - such as dilantin and primidone.
 - c. antibiotics - such as sulfonamides - penicillin - and streptomycin.
 - d. all of the above.

36. Active SLE patients frequently have:
- a. decrease in only C3.
 - b. decrease in only C1q.
 - c. decrease in only C4.
 - d. decrease in serum CH50.
37. Which antinuclear antibody immunofluorescent pattern would most likely be associated with anti-extractable nuclear antigen?
- a. Diffuse.
 - b. rim.
 - c. Speckled.
 - d. Nucleolar.
38. The LE factor is found in what percentage of normal individuals?
- a. Less than 4%.
 - b. 8%.
 - c. 10%.
 - d. 15%.
39. In the indirect antinuclear antibody test - a smooth homogeneous pattern indicates the presence of antibody to:
- a. mud fever.
 - b. cryoglobulin.
 - c. DNA.
 - d. RNA.
40. The target cells of HIV are principally the:
- a. CD4 lymphocyte (T4 + helper/inducer lymphocytes).
 - b. granulocytes in immature forms.
 - c. platelets.

d. basophilic normoblasts.

41. The high morbidity and mortality of AIDS patients is due mostly to opportunistic infections (OI). Many of these are caused by:
- a. pneumocystis carinii protozoa.
 - b. E. histolytica and G. lamblia amoeba and flagellatis.
 - c. cryptosporidium.
 - d. all of the above.
42. Patients with AIDS usually have:
- a. leukocytosis - with a shift to the left.
 - b. absolute lymphocytopenia - with suppression of the T-H lymphocytes.
 - c. eosinophilia - denoting an allergic response.
 - d. lymphocytosis - with an increase in T4 cells.
43. All patients with AIDS have an increased level of:
- a. IgA.
 - b. IgE.
 - c. IgG.
 - d. IgM.
44. Pneumonitis caused by cytomegalovirus is often the terminal complication in an AIDS patient. This VIRUS IS BEST ISOLATED from a culture of:
- a. blood serum.
 - b. whole blood.
 - c. cerebrospinal fluid.
 - d. urine and throat washings.

45. Tests for the HIV antibodies are based mainly on detection of antibodies developed against surface glycoproteins. Procedures used to DETECT THESE ANTIBODIES include all except:
- a. ELISA.
 - b. immunofluorescence.
 - c. ultracentrifugation.
 - d. Western blotting.
46. For reactivity - WHICH COMPLEMENT COMPONENT must be present?
- a. C1.
 - b. C2.
 - c. C3.
 - d. C4.
47. The technologist does a COMPLEMENT FIXATION TEST. The control tubes give the correct reaction - but both serum control and the unknown test fail to hemolyze. What is the probable cause?
- a. The complement was contaminated.
 - b. The serum had anticomplementary activity.
 - c. the serum contained reagin.
 - d. Outdated sheep cells.
48. Which of the following statements about the COMPLEMENT FIXATION test is correct?
- a. Horse red blood cells are usually used.
 - b. The test reactants are usually incubated for 30 minutes at 22 degrees C.
 - c. Guinea pig serum is never used.
 - d. The unit of hemolysis is the lowest dilution that gives complete hemolysis.

49. The COMPONENTS OF COMPLEMENT are:
- a. triglycerides.
 - b. lipopolysaccarides.
 - c. carbohydrates.
 - d. proteins.
50. GUINEA PIG SERUM is used in complement fixation tests because:
- a. it is readily available.
 - b. it is inexpensive.
 - c. it gets better with age.
 - d. it combines with most antigen-antibody complexes.
51. In the DAVIDSOHN DIFFERENTIAL TEST FOR INFECTIOUS MONONUCLEOSIS - the heterophil antibodies:
- a. will not be absorbed by guinea pig kidneys and will be absorbed by beef erythrocytes.
 - b. will be absorbed by both guinea pig kidneys and beef erythrocytes.
 - c. will not be absorbed by either guinea pig kidneys or beef erythrocytes.
 - d. will be absorbed by guinea pig kidneys but not by beef erythrocytes.
52. In the Monospot test - the indicator cells are:
- a. formalized sheep erythrocytes.
 - b. formalized horse erythrocytes.
 - c. formalized guinea pig erythrocytes.
 - d. formalized beef erythrocytes.

53. A MILD TO MODERATE FORM OF HEPATITIS is always associated with infectious mononucleosis. Abnormal tests would include:
- a. LDH.
 - b. SGOT or AST.
 - c. SGPT or ALT.
 - d. all of the above.
54. A positive heterophil antibody test is:
- a. specific for infectious mononucleosis and Epstein-Barr virus.
 - b. specific for infectious mononucleosis only.
 - c. specific for Epstein-Barr virus only.
 - d. not specific for either infectious mononucleosis or Epstein-Barr virus.
55. The Paul Bunnell test for infectious mononucleosis may use:
- a. human red cells.
 - b. mouse cells.
 - c. ox cells.
 - d. chicken cells.
56. An 18-year old male with infectious mononucleosis has a COLD AGGLUTININ TITER OF 1 TO 2000. A consideration of this antibody's clinical importance is the:
- a. sensitivity.
 - b. specificity.
 - c. titer at 4 degrees C.
 - d. thermal range.

57. A cold agglutinin titer indicating positive in the 1 to 40 dilution:
- a. should be ignored.
 - b. is suggestive of atypical pneumonia.
 - c. has probably passed its peak.
 - d. is specific for lupus erythematosus.
58. IN READING COLD AGGLUTININS - the titer is read as:
- a. the reciprocal of the lowest dilution exhibiting any agglutination.
 - b. the reciprocal of the highest dilution exhibiting any agglutination.
 - c. 4+ agglutination in the last tube.
 - d. no agglutination in any tube.
59. Patients RECOVERING FROM PRIMARY ATYPICAL PNEUMONIA often develop agglutinins that react with a nonhemolytic strain - streptococcus MG. What percent of patients with primary atypical pneumonia develop the streptococcus MG reactions?
- a. About 5%.
 - b. About 20%.
 - c. About 45%.
 - d. About 80%.
60. One of the MAJOR DIFFERENCES BETWEEN VIRAL HEPATITIS A AND VIRAL HEPATITIS B is:
- a. viral hepatitis A has a short incubation time.
 - b. viral hepatitis A has a long incubation time.
 - c. viral hepatitis A is known as infectious hepatitis.
 - d. viral hepatitis B is known as infectious jaundice.

61. The most sensitive tests now available for detecting HBsAg and anti-HBs is/are:
- a. agar gel diffusion (Ouchterlony).
 - b. counter electrophoresis.
 - c. Electrophoresis and complement fixation.
 - d. RIA and reversed passive hemagglutination.
62. Of the 4 MAJOR SUBTYPES OF HBsAg DETECTABLE WITH SUBTYPE-SPECIFIC SERA prepared by hyperimmunization of rabbits and guinea pigs with purified HBsAg - the most common in most parts of the world are:
- a. adr and adw.
 - b. adw and ayw.
 - c. adr and ayr.
 - d. ayr and adw.
63. In using AGAR GEL DIFFUSION (OR OUCHTERLONY METHOD) for determination of HBsAg - you have the following advantage:
- a. it is more sensitive than other methods.
 - b. it is a rapid method - requiring only 2 hours.
 - c. it demonstrates specificity by the formation of lines of identity between HBsAg in test samples and positive control sera.
 - d. it cannot distinguish the subtype of HBsAg by lines of partial identity.
64. Which of the following statements is NOT true about counter electrophoresis?
- a. The reagents move in opposite directions so there is a lesser degree of sensitivity.
 - b. It is possible to have CEP reaction in 30-90 minutes.
 - c. HBsAg and its antibody - anti-HBs - have differing electrophoretic mobilities in an electric field.
 - d. The reagents move in one direction rather than diffusing radially from the wells - so there is a greater degree of

sensitivity.

65. HEPATITIS B VIRUS:

- A. may be transmitted by transfusion.
- b. cannot be transmitted by transfusion.
- c. cannot be transmitted by IV drugs.
- d. contains no Dane particles in the plasma.

66. In doing the RIA test for HBsAg - plastic beads coated with guinea pig antibody are placed in tubes - the patient's serum is added and incubated. Antibody tagged with iodine-125 is added.

- a. The antibody-antigen-tagged antibody is then checked for fluorescence.
- b. The HBsAg rinses off the beads - leaving them free of antibody.
- c. The HBsAg is measured spectrophotometrically.
- d. A gamma scintillation counter detects the antibody-antigen-tagged antibody.

67. What would you look for as evidence of RECENT HEPATITIS A INFECTION?

- a. HBV antibody.
- b. HAV antibody - IgM type.
- c. HAV antibody - IgG type.
- d. HAV antibody - IGA type.

68. The ELISA (enzyme-linked immunosorbent assay) technic for the detection of HBsAg:

- a. requires a stool specimen for testing.
- b. requires radiolabeled Cla.
- c. used anti-HBs linked to horseradish peroxidase.
- d. is measured by its fluorescence.

69. Non-A non-B hepatitis differs from hepatitis A hepatitis B.
- The former has highly stable incubation period.
 - The former cannot cause post-transfusion hepatitis.
 - The former is frequently connected with icteric hepatitis.
 - The former is frequently connected with those who are chronic carriers.
70. In performing AN ANTISTREPTOLYSIN O TITER - one Todd unit is that of antibody that completely neutralizes:
- 1 minimal hemolytic dose of streptolysin O.
 - 5 minimal hemolytic doses of streptolysin O.
 - 2 1/2 minimal hemolytic doses of streptolysin O.
 - 10 minimal hemolytic doses of streptolysin O.
71. In an ASO test - the HEMOLYSIS CONTROL TUBE shows partial lysis. How will this affect the test results?
- The results will be falsely high because of decreased hemolysis.
 - The results will be falsely high because of increased hemolysis.
 - The results will be falsely low because of increased hemolysis.
 - The results will be falsely low because of decreased hemolysis.
72. The test of choice for serologic determination STREPTOCOCCAL PYODERMA is:
- AHT.
 - ADN-B.
 - RA.
 - LE.

73. TESTS FOR RHEUMATOID ARTHRITIS were performed with an outdated RA kit. What should be done?
- a. Report the results - since the controls came out right.
 - b. Draw fresh blood from the patients and repeat tests.
 - c. Repeat the positive tests only - using a kit that had not expired.
 - d. Repeat the positive and negative tests- using a kit that had not expired.
74. The SLIDE TEST FOR RHEUMATOID ARTHRITIS involves:
- a. use of sheep RBCs sensitized by a rabbit anti-sheep erythrocyte serum.
 - b. use of inert particles coated with a gamma globulin fraction (FII) of human serum.
 - c. agglutination by turkey cells after incubation at 37 degrees for 15 minutes.
 - d. none of the above.
75. The CATABOLISM OF WHICH IMMUNOGLOBULIN is accelerated in rheumatoid arthritis patients:
- a. IgA.
 - b. IgD.
 - c. IgE.
 - d. IgG.
76. The MOST COMMONLY USED PROCEDURE FOR DETECTION OF ELEVATED C-REACTIVE PROTEIN in the lab is:
- a. Gel-immunodiffusion.
 - b. Immunoelectrophoresis.
 - c. Latex agglutination.
 - d. Radial diffusion.

77. NORMAL VALUES FOR C-REACTIVE PROTEIN vary with age. Which of the following is correct for the radioelectroimmunoprecipitation method assay?
- a. Newborn nl value = 470 ng CRP/ml.
 - b. Infant nl value = 470 ng CRP/ml.
 - c. Ages 8-12 nl value = 470 ng CRP/ml.
 - d. Ages 18-60 nl value = 470 ng CRP/ml.
78. An INCREASED C-REACTIVE PROTEIN in the blood is an indication of:
- a. an inflammatory phase or early tissue injury.
 - b. benign tumors.
 - c. plantar's warts.
 - d. lupus erythematosus.
79. The C-reactive protein analysis is:
- a. a normally undetectable liver-derived serum protein.
 - b. a sensitive measure of the quantity of tissue injury.
 - c. analyzed using latex agglutination - immunonephelometry - immunoprecipitation - or electrophoresis.
 - d. All of the above.
80. A student was performing a C-reactive protein test - using a rapid slide latex test. She forgot to inactivate the test serum for 30 minutes at 56 degrees C. How would this affect the test?
- a. The test would exhibit a false-positive.
 - b. The test would exhibit a false-negative.
 - c. The test would appear "doubtful".
 - d. None of the above.

81. The first immune response following fetal infection with rubella is the production of which antibody?
- a. IgA.
 - b. IgE.
 - c. IgG.
 - d. IgM.
82. WHICH SEROLOGIC TEST FOR RUBELLA is most likely to produce a false-positive result because nonspecific serum inhibitors are present?
- a. Complement-fixation.
 - b. Hemagglutination inhibition.
 - c. Hemolysis in gel.
 - d. None of the above.
83. In order TO DETECT HUMAN CHORIONIC GONADOTROPIN - using the rapid latex slide immunoassay test - the level of HCG needed for a positive is:
- a. less than 0.1 International Unit/ml.
 - b. 1.0 International Unit/ml.
 - c. 1.5-2.5 International Unit/ml.
 - d. 5.0-6.0 International Unit/ml.
84. One of the major sources of error that cause a FALSE-NEGATIVE INDIRECT LATEX SLIDE TEST for HCG is:
- a. specific gravity less than 1.010.
 - b. blood in the urine.
 - c. multiple pregnancies.
 - d. smoking marijuana.

85. One of the major sources of error that causes a FALSE-POSITIVE INDIRECT LATEX SLIDE TEST for HCG is:
- a. specific gravity less than 1.010.
 - b. high proteinuria.
 - c. aspirin.
 - d. None of the above.
86. In the AGGLUTINATION INHIBITION TEST FOR HUMAN CHORIONIC GONADOTROPIN:
- a. the HCG unites with the antibodies in the antiserum - neutralizing them and preventing agglutination.
 - b. a positive test is indicated by a smooth - milky appearance.
 - c. a false-positive may be caused by the presence of follicle-stimulating hormones or luteinizing hormones.
 - d. All of the above.
87. Failure to recognize a "PROZONE REACTION" will lead to a report that is:
- a. abnormally high.
 - b. a false-negative.
 - c. a false-positive.
 - d. None of the above.
88. Which of the following does NOT cause increased susceptibility to infection?
- a. Agranulocytosis.
 - b. Alymphocytosis.
 - c. C-3 deficiency.
 - d. C-reactive protein deficiency.

89. The ENZYME IN AN EOSINOPHIL capable of mediating killing of *Candida* is:
- a. arylsulfatase B.
 - b. histaminase.
 - c. lysophospholipase.
 - d. peroxidase.
90. PRECIPITATION IS SIMILAR TO AGGLUTINATION except that in agglutination:
- a. the union of antibody occurs with soluble antigens.
 - b. the union of antibody occurs with suspended particulate antigens.
 - c. always needs heat to react.
 - d. None of the above.
91. Of the MAJOR CLASSES OF IMMUNOGLOBULIN - about 85% of it is:
- a. IgA.
 - b. IgD.
 - c. IgG.
 - d. IgM.
92. The major immunoglobulin found in body secretion (tears - saliva - etc.) is:
- a. IgA.
 - b. IgD.
 - c. IgE.
 - d. IgM.
93. Immunoglobulins are produced by plasmacytes which are:
- a. normocytes.
 - b. monocytes.
 - c. transformed B-lymphocytes.

d. transformed T-lymphocytes.

94. The SLIDE BENTONITE FLOCCULATION TEST may be used to confirm a diagnosis of:
- a. Echinococcus.
 - b. Filariasis.
 - c. Trichinosis.
 - d. All of the above.
95. An ANTIGEN in an individual which - under certain circumstances - can induce an antibody against itself - and an antigen used in the production of antisera are of which type?
- a. Autologous - heterophile.
 - b. Autologous - homologous.
 - c. Heterologous - homologous.
 - d. Heterologous - autologous.
96. WHICH OF THESE IS NOT INVOLVED in the manufacturing of human immunoglobulins?
- a. Bone marrow.
 - b. Bursa of Fabricius.
 - c. Lymph nodes.
 - d. Spleen and thymus.
97. Of the tests listed - THE MOST SENSITIVE METHOD for the detection of antibodies is:
- a. Agglutination.
 - b. Complement fixation.
 - c. gel diffusion.
 - d. Passive hemagglutination.

98. The VISIBLE RESULT OF A SEROLOGIC REACTION between certain motile organisms acting as antigens and their antisera - in the presence of complement - is:
- a. Agglutination.
 - b. Hemolysis.
 - c. Precipitation.
 - d. Immobilization.
99. The KVEIM REACTION is used in testing for:
- a. Sarcoidosis.
 - b. Aspergillitis.
 - c. Infectious mononucleosis.
 - d. Hemolytic disease of the newborn.
100. In Bruton's disease:
- a. it is found only in females over 50 years old.
 - b. the circulating B cells are normal in number.
 - c. concentration of immunoglobulins are decreased or absent.
 - d. None of the above.
101. The SERUM HEMOLYTIC COMPLEMENT LEVEL CH50 is:
- a. a measure of total complement activity.
 - b. a measure of complement fixation.
 - c. a measure of serum factor B level.
 - d. All of the above.
102. The ANTIBODY ALLOTYPE is determined by:
- a. constant region of light chains.
 - b. constant region of heavy chains and light chains.
 - c. variable region of heavy chains and light chains.
 - d. variable region of heavy chains only.

103. The patient had a HIGH TITER OF ANTI-MITOCHONDRIAL ANTIBODIES. This could point to:
- a. vasoconstriction.
 - b. biliary cirrhosis.
 - c. thyroid cancer.
 - d. chronic hepatitis.
104. BENCE-JONES PROTEIN consists of:
- a. a constant region of heavy chains.
 - b. a variable region of heavy chains.
 - c. both heavy and light chains.
 - d. monoclonal light chains synthesized DE NOVO.
105. Which of the following is excessively INCREASED IN WALDENSTROM'S MACROGLOBULINEMIA?
- a. IgA.
 - b. IgD.
 - c. IgE.
 - d. IgM.
106. CHARCOT-LEYDEN CRYSTALS are considered to be breakdown products of which cell?
- a. Basophils.
 - b. Eosinophils.
 - c. Lymphocytes.
 - d. Megakaryocytes.
107. WHICH T CELL MALIGNANCY may retain "helper activity" concerning immunoglobulin synthesis by B cells?
- a. Acute lymphocytic leukemia.
 - b. Chronic lymphocytic leukemia.
 - c. Lymphoma.

d. Sezary syndrome.

108. Cells from a patient with HAIRY CELL LEUKEMIA has immunologic and functional features of:

a. B lymphocytes and monocytes.

b. B lymphocytes and granulocytes.

c. monocytes and granulocytes.

d. megakaryocytes and granulocytes.

109. A child has acute LYMPHOBLASTIC LEUKEMIA. Her blast cells are probably:

a. B-lymphocytes.

b. T-lymphocytes.

c. monocytes.

d. null cells.

110. Serum alpha-fetoprotein levels may be increase in patents with:

a. chronic active hepatitis.

b. liver carcinoma.

c. viral hepatitis.

d. All of the above.

111. Titer is the QUANTITATIVE MEASURE OF THE ANTIBODY present in serum. Which of the following is correct?

a. the serum is always diluted with distilled water.

b. The antigen is always diluted with saline.

c. Titer increases with the onset of infection.

d. Titer decreases with the onset of infection.

112. Antigenic substances having A MOLECULAR WEIGHT OF LESS THAN 5000 RARELY stimulate the production of antibodies. These substances are called:
- a. active antigens.
 - b. haptens.
 - c. specific antigens.
 - d. None of the above.
113. The IMMUNOGLOBULIN most frequently produced when gram-negative bacteria is present is:
- a. IgA.
 - b. IgE.
 - c. IgG.
 - d. IgM.
114. It is routine for which immunoglobulin to transfer through the placenta?
- a. IgA.
 - b. IgE.
 - c. IgM.
 - d. IgG.
115. The class of 19s immunoglobulins includes:
- a. IgA.
 - b. IgE.
 - c. IgM.
 - d. IgG.

4. The STRUCTURE of the IMMUNOGLOBULIN consists of:
 - a. two heavy and two light chains linked by disulfide bonds.
 - b. four heavy chains linked by disulfide bonds.
 - c. four light chains linked by disulfide bonds.
 - d. two pairs of heavy and two pairs of light chains linked by disulfide bonds.
5. IMMUNOGLOBULIN-G when treated with PAPAIN splits into three fragments. These are known as:
 - a. two Fab fragments - one Fc fragment.
 - b. three Fab fragments.
 - c. three Fc fragments.
 - d. one Fab fragment - one Fc fragment.
6. A FLARED WHEAL reaction in SKIN ALLERGY TESTS indicate:
 - a. anergy.
 - b. late hypersensitivity.
 - c. necrotic lesions.
 - d. immediate hypersensitivity.
7. ANERGY may be defined as:
 - a. diminished antigen reaction with subsequent hypersensitivity.
 - b. diminished antigen reactivity with delayed and/or diminished hypersensitivity.
 - c. a physical quantity in heat and calories.
 - d. kinetic force due to motion.

8. ACTIVE IMMUNITY is:
- a. always caused by clinical or subclinical infection.
 - b. always caused by an injection of live or killed microorganisms or their antigens.
 - c. a temporary immunity induced by injection of antibodies from another host.
 - d. the state of resistance developed by an individual following specific contact with foreign microorganisms or their products.
9. The Sm ANTIGEN can be defined as:
- a. a non-histone - nuclear protein devoid of nucleic acids.
 - b. a nuclear ribonucleoprotein.
 - c. deoxyribonucleic acid.
 - d. histones.
10. ARTHUS REACTION is:
- a. an inflammatory lesion due to the action of precipitins.
 - b. a graft-vs-host reaction.
 - c. Herxheimer's reaction.
 - d. quellung reaction.

11. OPSONIZATION is defined as:
- a. chemotaxis.
 - b. the process by which bacteria is sensitized that they are readily phagocytosed.
 - c. the process where cells move a certain direction in response to a chemical stimuli.
 - d. the histamine release which increase vascular permeability - flow of serum antibody - and complement to affected area.
12. C-REACTIVE PROTEIN IS:
- a. a betaglobulin - MW 120000 - 140000.
 - b. a gamma globulin - MW 60000 - 80000.
 - c. an alpha globulin - MW 120000 - 140000.
 - d. a gamma globulin - MW 120000 - 140000.
13. ANTIGENS of MOLECULAR WEIGHT LESS THAN 5000 rarely stimulate the production of antibodies. These substances are called:
- a. innate antigens.
 - b. natural antigens.
 - c. haptens.
 - d. molecular antigens.
14. Which of the following statements is true of NEPHELOMETRY?
- a. Light that is scattered by the small particles is measured at right angles of the beam incident to the cuvette.
 - b. The longer the wave length the greater the degree of dispersion.
 - c. The light blocked by particulate matter is measured as light passes through the cuvette.

- d. Cannot be used for rapid detection of antibody-antigen complex.
15. The OUTER FILAMENTOUS structures of HEPATITIS B VIRUS composed of 20 NM spheres are:
- a. circulating aggregates of HBcAg.
 - b. circulating aggregates of HBsAg.
 - c. circulating aggregates of HBsAg.
 - d. infections.
16. RHEUMATOID FACTOR may be defined as:
- a. IgG or IgM autoantibody.
 - b. antigen in rheumatoid arthritis.
 - c. immune complex formed when IgA antibody is present.
 - d. immune complex formed only when IgE type antibody is present.
17. ANTISTREPTOLYSIN O may be defined as:
- a. an antibody produced in response to streptolysin O.
 - b. an antigen produced by streptococcus pyogenes.
 - c. a toxin produced by streptococcus pyogenes.
 - d. a nonspecific antibody.
18. The term "HIV" is best defined as:
- a. Epstein-Barr virus.
 - b. T-Helper cells.
 - c. human immunodeficiency virus.
 - d. lymphadenopathy associated virus.

19. MITOGENS are substances that stimulate a non-specific lymphocyte response which is not dependent on a previous exposure. The following act as mitogens EXCEPT:
- a. pokeweed mitogen (PWM).
 - b. phytohemagglutinin (PHA).
 - c. staphylococcus aureus cowan (SAC).
 - d. siliconized glass beads.
20. COMPLEMENT FIXATION may be defined as:
- a. complement binding in an antigen-antibody reaction.
 - b. an immunoglobulin bound to a fluorescent dye.
 - c. protein released from an infected cell which protects other cells from infection.
 - d. an antibody found in colostrum - mucus - and saliva tests.
21. In HEPATOCELLULAR CARCINOMA you often find:
- a. high levels of alpha-fetoprotein.
 - b. low levels of alpha-fetoprotein.
 - c. high serum haptoglobin.
 - d. high albumin.
22. Which of the statements apply to BRUTON'S AGAMMAGLOBULINEMIA?
- a. B-lymphocytes are normal.
 - b. condition is limited to females.
 - c. immunoglobulins are absent or decreased.
 - d. genetical makeup is autosomal recessive.

23. Selective IMMUNOGLOBULIN A DEFICIENCY is:
- a. associated with no allergic manifestation.
 - b. associated with autoimmune disease.
 - c. found in one out of every 100 persons.
 - d. found increased IgA in the saliva secretory component.
24. The EPSTEIN-BARR VIRUS causes ANTIBODY formation in:
- a. infectious mononucleosis.
 - b. nasopharyngeal carcinoma.
 - c. Burkitt's lymphoma.
 - d. All of the above.
25. POLYCLONAL HYPERIMMUNOGLOBULINEMIA can be seen in:
- a. biliary cirrhosis.
 - b. chronic infections.
 - c. systemic lupus erythematosus.
 - d. All of the above.
26. SOME CHRONIC HEPATITIS B infections are associated with high-risk patients with ANTIBODY TITERS to the:
- a. e antigen.
 - b. hepatitis surface antigen.
 - d. delta antigen.
 - d. core antigen.
27. HEPATITIS B may be contracted by the following MODES:
- a. parenteral exposure to blood or blood products.
 - b. insect bites - mosquitoes - bed bugs.
 - c. sexual transmission.

- d. All of the above.
28. The presence of the following would indicate a PAST INFECTION by the HEPATITIS A VIRUS:
- a. Escherichia Coli protein.
 - b. staphylococcal protein.
 - c. HAV antibody - IgG type.
 - d. HAV antibody - IgM type.
29. The presence of the following would indicate a PRESENT INFECTION by HEPATITIS A VIRUS:
- a. Escherichia Coli protein.
 - b. HAV antibody - IgA type.
 - c. HAV antibody - IgG type.
 - d. HAV antibody - IgM type.
30. 90 PERCENT OF POST-TRANSFUSION HEPATITIS may be due to:
- a. hepatitis A virus.
 - b. hepatitis B virus.
 - c. non-A - non-B hepatitis.
 - d. cytomegalovirus.
31. The following have been linked with HEPATITIS A EXCEPT for:
- a. blood transfusions.
 - b. poisonous mushrooms.
 - c. Epstein-Barr virus.
 - d. contaminated water.

32. C-REACTIVE PROTEIN is:
- a. able to activate the complement pathway.
 - b. an acute inflammatory phase protein able to bind the C-polysaccharide of the pneumococcus.
 - c. elevated up to a thousand times in response to inflammation.
 - d. All of the above.
33. A HEPATITIS B VIRUS CARRIER:
- a. is not infectious.
 - b. is a safe virus carrier.
 - c. always carries the hepatitis B virus.
 - d. has chronic hepatitis signs.
34. HEPATITIS NON-A - NON-B:
- a. is always acute and severe.
 - b. is implicated with a high percentage of post-transfusion hepatitis.
 - c. is associated with icteric hepatitis.
 - d. is never implicated in post-transfusion hepatitis.
35. An INCREASED ANTISTREPTOLYSIN O TITER may be found in all of the following EXCEPT:
- a. scarlet fever.
 - b. gonorrhea.
 - c. pneumococcal pneumonia.
 - d. nephrotic syndrome.

36. INVIVO STREPTOLYSIN O PRODUCTION may be INHIBITED by all of the following EXCEPT:
- a. phenylbutazone.
 - b. penicillin.
 - c. cortisone.
 - d. antibiotics.
37. The HUMAN IMMUNODEFICIENCY VIRUS may be contracted by all the following EXCEPT:
- a. heterosexual and homosexual contact.
 - b. intravenous drug abuse.
 - c. in utero.
 - d. insect vectors.
38. The NATURALLY ACQUIRED PASSIVE IMMUNITY ANTIBODIES which have TRANSPLACENTAL passage from mother to unborn child in the latter part of pregnancy are usually of which type?
- a. IgA.
 - b. IgD.
 - c. IgG.
 - d. IgM.
39. ALL of the following are involved in HOST RESPONSE to antigens EXCEPT for:
- a. IgG.
 - b. IgM.
 - c. C-reactive protein.
 - d. albumin.

40. C-REACTIVE PROTEIN is a trace constituent of serum that appears in response to a variety of TISSUE NECROSIS and INFLAMMATORY CONDITIONS. CRP usually appears:
- a. within 10 to 14 days.
 - b. within 5 to 7 days.
 - c. within 2 to 10 hours.
 - d. within 14 to 26 hours.
41. The SITES for a B-LYMPHOCYTE to produce IMMUNOGLOBULINS are:
- a. bone marrow.
 - b. lymphoid tissue of appendix - cecum - and Peyer's patches.
 - c. liver and spleen.
 - d. All of the above.
42. In the PRIMARY IMMUNE RESPONSE the B-LYMPHOCYTES undergo differentiation and clones - to BECOME:
- a. T-lymphocytes.
 - b. memory cells and plasma cells.
 - c. lymphokines.
 - d. a blastogenic factor.
43. SUSCEPTIBILITY to infections may be caused by ALL THE FOLLOWING DEFICIENCIES EXCEPT:
- a. C1q.
 - b. C3.
 - c. C-reactive protein.
 - d. agranulocytosis.

44. HEPATITIS A VIRAL INFECTION will elicit a typical antibody response sequence of:
- a. increase of IgG only.
 - b. increase of IgM only.
 - c. IgM increase followed by IgM decrease and IgG increase.
 - d. IgM decrease followed by IgG and IgM increase.
45. INFECTIVITY OF HEPATITIS B is closely associated with:
- a. HBsAg.
 - b. HBcAg.
 - c. HBeAg.
 - d. HBvAg.
46. The following ANTIGENS are used for IMMUNIZATION in man EXCEPT:
- a. virulent bacteria.
 - b. attenuated organisms.
 - c. toxoid.
 - d. killed organisms.

47. ALL of the following may be associated with STREPTOLYSIN O EXCEPT:
- a. streptolysin O is called so - because of its oxygen lability.
 - b. streptolysin O is hemolytically inactive in its oxidized form.
 - c. streptolysin O is a protein which in a reduced state causes lysis of red cells and white cells.
 - d. streptolysin O is antigenic eliciting the formation of more antigens that neutralize the hemolytic reaction.
48. LYMPHOCYTES which recognize foreign MACROPHAGED ANTIGENS are called:
- a. T-cytotoxic cells.
 - b. B-cytotoxic cells.
 - c. T-helper cells.
 - d. B-cells.
49. T-HELPER CELLS have a STRUCTURE on the cell SURFACE called:
- a. CD4 molecule.
 - b. CD8 molecule.
 - c. CD3 molecule.
 - d. T and B molecules.
50. T4-POSITIVE T-CELLS or CD4 positive T-cells may initiate the production of B-cells which are antigen-specific. These B LYMPHOCYTE CELLS are converted to:
- a. T-cytotoxic cells.
 - b. T4-positive T cells.
 - c. plasma cells.
 - d. CD4 positive cells.

51. T-helper cells may release INTERLEUKIN-2 - GAMMA-INTERFERON - and MACROPHAGE ACTIVATING FACTOR. This group is called:
- a. enzymes.
 - b. hormones.
 - c. lymphokines.
 - d. haptens.
52. The following are IMMUNOLOGIC ABNORMALITIES found in acquired immunodeficiency syndrome patients EXCEPT:
- a. normal lymphokine production.
 - b. reversal of T4/T8 ratio.
 - c. T4 T-cell depletion.
 - d. decreased lymphokine production.
53. KILLER (K) CELLS and NATURAL KILLERS (NK) CELLS are circulating lymphocytes which are classifies as:
- a. non T-cells.
 - b. non B-cells.
 - c. non B - non T-cells.
 - d. T-cells and B-cells.
54. The presence of a DETECTABLE TITER in the ABSENCE OF A RUBELLA INFECTION may indicate:
- a. a need to be vaccinated.
 - b. the patient should be in isolation.
 - c. a false anamnestic response.
 - d. a previous infection and present immunity to reinfection.
55. Which TEST is often used to detect IgE?
- a. RAST.

- b. RA.
 - c. ANA.
 - d. HTLV.
56. The test for RHEUMATOID FACTOR which uses SHEEP RED CELL SENSITIZED with RABBIT IgG is:
- a. Feulgen test.
 - b. Rose-Waaler test.
 - c. antinuclear antibody test.
 - d. Black's test.
57. The COMPLEMENT FIXATION TEST is based on:
- a. complement is unfixed in an antigen-antibody complex.
 - b. complement is fixed in an antigen-antibody complex.
 - c. latex suspensions in agglutination tests.
 - d. the immunofluorescent reaction.
58. Which HCG SUBUNIT is used in the RADIOIMMUNOASSAY test for SERUM HCG?
- a. alpha.
 - b. beta.
 - c. gamma.
 - d. delta.
59. A POSITIVE PREGNANCY TEST for HCG requires a minimum human chorionic gonadotropin level of:
- a. 0.1 - 0.5 IU/ml.
 - b. 0.5 - 1.0 IU/ml.
 - c. 1.0 - 1.5 IU/ml.
 - d. 1.5 - 2.5 IU/ml.

60. LUTEINIZING HORMONE (LH) may cause a FALSE-POSITIVE result in the standard tube test for HCG because of:
- a. HCG level of 0.1 IU/ml.
 - b. cross-reactivity of HCG and luteinizing hormone.
 - c. increase in the latex particles adsorptivity.
 - d. All of the above.
61. FALSE-NEGATIVE results in the INDIRECT LATEX SLIDE TEST may occur with:
- a. early pregnancy.
 - b. ectopic pregnancy.
 - c. HCG levels of less than 0.5 IU/ml.
 - d. All of the above.
62. HUMAN CHORIONIC GONADOTROPIN TESTING based on HCG or luteinizing hormone (LH) binding to a PROTEIN RECEPTOR MEMBRANE is:
- a. radioimmunoassay (RIA).
 - b. radioreceptor assay test (RRA).
 - c. hemagglutination inhibition (HAI).
 - d. direct latex particle agglutination (DAP).
63. A NEGATIVE RHEUMATOID FACTOR determination may occur with rheumatoid arthritis in all of the following EXCEPT:
- a. when rheumatoid factor titers are low.
 - b. in juvenile rheumatoid arthritis.
 - c. in psoriatic arthritis.
 - d. in typical rheumatoid arthritis.

64. Testing for SERUM BETA-HUMAN CHORIONIC GONADOTROPIN is important in:
- a. detecting low-titer human chorionic gonadotropin.
 - b. detecting an early pregnancy.
 - c. monitoring phases of embryo development.
 - d. All of the above.
65. CHOLESTEROL is added to the antigen in the RAPID PLASMA REAGIN test because:
- a. it increases the sensitivity.
 - b. it increases the specificity.
 - c. it increases the rate of reaction.
 - d. it decreases the sensitivity.
66. In the COLD AGGLUTININ TEST the patient's blood SHOULD NOT BE REFRIGERATED before separating the serum because:
- a. the cold agglutinins will be adsorbed by the red cells and removed with the clot.
 - b. it speeds the rate of coagulation rendering the test invalid.
 - c. it slows the rate of coagulation rendering the test invalid.
 - d. the cold agglutinins will be hemolyzed the red cells.
67. If the patient's serum has HIGH or INCREASING concentrations of ANTISTREPTOLYSIN TITER - it would mean:
- a. a recent infection with alpha strep.
 - b. a recent infection with group A hemolytic strep.
 - c. a recent infection with gamma strep.
 - d. systemic lupus erythematosus.

68. NORMAL ANTISTREPTOLYSIN O TITER in adults can go up to:
- a. 5 TODD units.
 - b. 125 TODD units.
 - c. 500 TODD units.
 - d. 1000 TODD units.
69. The ANTISTREPTOLYSIN TITRATION test is a QUANTITATIVE analysis of ANTIBODY against a FIXED amount of STREPTOLYSIN O. This FIXED AMOUNT is:
- a. 0.05 ml.
 - b. 0.5 ml.
 - c. 1.0 ml.
 - d. 5.0 ml.
70. The term T4/T8 RATIO refers to:
- a. T-cytotoxic to T-helper cells.
 - b. T-suppressor to T-helper cells.
 - c. T-helper to T-suppressor-cytotoxic cells.
 - d. T-suppressor to T-cytotoxic cells.
71. The T4 T-CELL LEVEL is a immunologic marker for:
- a. measuring T8 activity.
 - b. classification of HIV infection.
 - c. determining the severity of the immunodeficiency in AIDS.
 - d. interferon (IFN).

72. OKT-3 refers to:
- a. monoclonal antibody to T4 surface marker.
 - b. monoclonal antibody to T8 surface marker.
 - c. monoclonal antibody to T-cell surface marker.
 - d. polyclonal antibodies.
73. The T-CELL ROSETTE METHOD can:
- a. differentiate Th from Ts cells.
 - b. differentiate T from B cells.
 - c. differentiate T from non-T cells.
 - d. differentiate T from non-T - non-B cells.
74. IMMUNOGLOBULIN LEVELS may be assayed by all of the following methods EXCEPT:
- a. radioimmunoassay (RIA).
 - b. radial immunodiffusion (RID).
 - c. enzyme linked immunosorbent assay (ELISA).
 - d. Kleinhauer-Betke test (KB).
75. The RADIOALLERGOSORBENT TEST (RAST) measure ANTIGEN SPECIFIC IgE in a radioimmunoassay method THE LIGAND IS:
- a. a labelled anti-IgG antibody.
 - b. a labelled anti-IgM antibody.
 - c. a labelled anti-IgE antibody.
 - d. an unlabelled anti-IgE antibody.

76. In the ENZYME-LINKED IMMUNOABSORBENT ASSAY (ELISA) the LIGAND IS:
- a. a molecule covalently bound to an enzyme which can detect the test antibody.
 - b. a colorless indicator which when acted upon by an enzyme changes to purple.
 - c. an enzyme.
 - d. an antibody.
77. INADEQUATE CONCENTRATION OF THE COMPLEMENT system may be due to:
- a. genetic conditions.
 - b. a defective structure.
 - c. hypercatabolism.
 - d. All of the above.
78. The following DISEASE STATE is associated with an INCREASED SERUM COMPLEMENT:
- a. liver cirrhosis.
 - b. acute glomerulonephritis.
 - c. systemic lupus erythematosus.
 - d. thyroiditis.
79. The COMPLEMENT COMPONENT DEFICIENCY associated with SEX-LINKED AGAMMAGLOBULINEMIA is:
- a. C1q.
 - b. C5 and C6.
 - c. C2.
 - d. C4.

80. The COMPLEMENT COMPONENT DEFICIENCY associated with HLA haplotype A10 - B18 is:
- a. C1q.
 - b. C2.
 - c. C6 and C9.
 - d. C4.
81. The COMPLEMENT COMPONENT DEFICIENCY associated with an increased susceptibility to NEISSERIA INFECTIONS is:
- a. C1q.
 - b. C2.
 - c. C4.
 - d. C6.
82. The COMPLEMENT DEFICIENCY associated with HEREDITARY ANGIONEUROTIC EDEMA is:
- a. C1q.
 - b. C1s INH.
 - c. C1s.
 - d. C2.
83. The COMPLEMENT DEFICIENCY associated with a LOSS OF PHAGOCYTIC ACTIVITY IS:
- a. C1q.
 - b. C1s.
 - c. C1r.
 - d. C5.

84. A COMPLEMENT COMPONENT DEFICIENCY associated as an AUTOSOMAL RECESSIVE in GUINEA PIGS is:
- a. C1q.
 - b. C2.
 - c. C3.
 - d. C4
85. A COMPLEMENT COMPONENT DEFICIENCY associated with a LOSS OF B and T LYMPHOCYTES is:
- a. C1q.
 - b. C2.
 - c. C3.
 - d. C4.
86. The FIRST MOLECULE activated in the ALTERNATIVE PATHWAY of complement activation is:
- a. C1.
 - b. C2.
 - c. C3.
 - d.C4.
87. In the CLASSICAL PATHWAY OF COMPLEMENT ACTIVATION the first SEQUENCE of complement component activation is:
- a. C3 - C3b - C3a.
 - b. C1 - C4 - C2 - C3.
 - c. C1 - C2 - C3 - C4.
 - d. C4 - C5 - C6 - C9.

88. What indicates a POSITIVE test in the HEMAGGLUTINATION-INHIBITION test for RUBELLA?
- a. Titer of >8.
 - b. Titer of <8.
 - c. No increase in titers of specimens collected two weeks apart.
 - d. Complete hemolysis.
89. NO RASH development in patients exposed to rubella may still indicate a RUBELLA INFECTION when:
- a. acute sample titer is 1 to 3.
 - b. a serum specimen taken 14-28 days after exposure tests with a fourfold titer increase.
 - c. increased neutrophil and platelet count.
 - d. leukocytosis during high fever and leukopenia during rash.
90. A REACTIVE FLUORESCENT TREPONEMAL ANTIBODY ABSORPTION test is:
- a. indicative of the activity of infection.
 - b. confirmation of early syphilis.
 - c. indicated by a yellow-green fluorescence under the microscope under a dark field.
 - d. a simple screening test for syphilis.
91. The TREPONEMA PALLIDUM IMMOBILIZATION test for syphilis may be NON-REACTIVE in patients having syphilis during:
- a. early secondary stage.
 - b. early latent stage.
 - c. late latent stage.
 - d. tertiary stage.

92. The RAPID PLASMA REAGIN card test is a MODIFICATION of:
- a. the Kahn test.
 - b. the Kline test.
 - c. the Kolmer test.
 - d. the VDRL test.
93. For most accurate results - SLIDE FLOCCULATION tests for SYPHILIS should be performed with the TEMPERATURE range of:
- a. 56 degrees F.
 - b. 65-70 degrees F.
 - c. 73-85 degrees F.
 - d. 37 degrees C.
94. The AUTOMATED REAGIN TEST (ART) is a modification of:
- a. the Kahn test.
 - b. the Kline test.
 - c. the Kolmer test.
 - d. the VDRL test.
95. SEROLOGIC REACTIONS are influenced by:
- a. pH and ionic strength of the medium in which the reaction is being performed.
 - b. the presence of electrolytes.
 - c. the time and temperature at which the reaction is conducted.
 - d. All of the above.

96. A FALSE POSITIVE test for SYPHILIS may occur from:
- a. caffeine addiction.
 - b. infection with gonorrhea.
 - c. marijuana addiction.
 - d. heroin addiction.
97. A physician receives a "REACTIVE" report on a patient who had an RPR. The patient has NO CLINICAL SYMPTOMS. The physician should:
- a. start treatment anyway.
 - b. ignore the test results - since the patient has no symptoms.
 - c. retest the patient - using a different - more specific procedure.
 - d. consider it a biological false-positive and do nothing.
98. In the VDRL QUALITATIVE TEST. The size of the ANTIGEN DROP from the needle should be:
- a. 1/10 ml.
 - b. 1/20 ml.
 - c. 1/60 ml.
 - d. 1/100 ml.
99. A serologic test is reported "REACTIVE IN A 1 TO 16 DILUTION". The "1 TO 16" refers to:
- a. the dilution of the serum.
 - b. the dilution of the antigen.
 - c. the dilution of the saline.
 - d. None of the above.

100. RPR is a test for:

- a. syphilis
- b. gonorrhea
- c. trichomonas
- d. vaginitis.

APPENDIX B

TEXAS WOMAN'S UNIVERSITY
DEPARTMENT OF HEALTH STUDIES
DENTON, TEXAS 76204

AGENCY PERMISSION FOR CONDUCTING SURVEY

THE Technical Innovations - Shiesl Corporation

GRANTS TO Kelly Ann Brandon
a student enrolled in the master's degree program in Health
Sciences Instruction at Texas Woman's University, the
privilege of it's facilities/data in order to study the
following problem:

Differences in Test Scores of Medical Laboratory
Technician Students Using Computer-Assisted Instruction

The conditions mutually agreed upon are as follows:

1. The agency (may) (may not) be identified in the final report.
2. The names of consultative or administrative personnel in the agency (may) (may not) be identified in the final report.
3. The agency (wants) (does not want) a conference with the student when the report is completed.

4. Other The agency may use any results in a promotion of its products

Date: November 20, 1990

Rick Good
Signature of Agency Personnel

Kelly Brandon
Signature of Student

Susan Ward, RN, PhD
Thesis Committee Chairman

APPENDIX C

TEXAS WOMAN'S UNIVERSITY
DEPARTMENT OF HEALTH STUDIES
DENTON, TEXAS 76204

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THE Grayson County Community College

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Technician Students Using Computer-Assisted Instruction

The conditions mutually agreed upon are as follows:

1. The agency (may) (~~may not~~) be identified in the final report.
2. The names of consultative or administrative personnel in the agency (~~may~~) (may not) be identified in the final report.
3. The agency (wants) (~~does not want~~) a conference with the student when the report is completed.
4. Other _____

Date: November 20, 1990

Shirley Hagan
Signature of Agency Personnel

Kelly Brandon
Signature of Student

Laura Ward, R.N., Ph.D.
Thesis Committee Chairman

APPENDIX D

TEXAS WOMAN'S UNIVERSITY
DEPARTMENT OF HEALTH STUDIES
DENTON, TEXAS 76204

AGENCY PERMISSION FOR CONDUCTING SURVEY

THE El Centro Community College

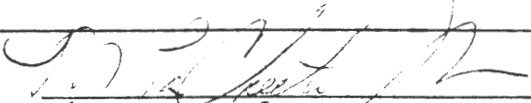
GRANTS TO Kelly Ann Brandon
a student enrolled in the master's degree program in Health Sciences Instruction at Texas Woman's University, the privilege of it's facilities/data in order to study the following problem:

Differences in Test Scores of Medical Laboratory Technician Students Using Computer-Assisted Instruction and Medical Laboratory Technician Students Not Using Computer-Assisted Instruction

The conditions mutually agreed upon are as follows:

1. The agency (may) (~~may not~~) be identified in the final report.
2. The names of consultative or administrative personnel in the agency (~~may~~) (may not) be identified in the final report.
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Date: November 20, 1990


Signature of Agency Personnel

Kelly Brandon
Signature of Student

Juan Ward, R.N., Ph.D.
Thesis Committee Chairman