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Centre Number

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COMMONWEALTH SECONDARY SCHOLARSHIPS  
 EXAMINATION FOR TWO-YEAR SCHOLARSHIP 1968-69

Morning Session  
 Thursday, 27th July

# QUANTITATIVE THINKING

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COMMONWEALTH SECONDARY SCHOLARSHIPS  
EXAMINATION FOR TWO-YEAR SCHOLARSHIP 1968-69

Centre Number

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## QUANTITATIVE THINKING

Morning Session, Thursday, 27th July, 1967

Time allowed : Two hours

**TEST BOOKLET. TO BE HANDED IN WITH YOUR ANSWER SHEET.**

### INSTRUCTIONS TO CANDIDATES

This is a test of your ability to use basic mathematical principles and ideas.

If a question involves terms or principles which you might not have met before, these will be explained in sufficient detail to enable you to answer the question concerned.

In addition, a selected list of symbols and simple formulae is printed at the foot of this page.

You are strongly advised to observe the following points :

1. Work carefully through the questions in the order in which they are given.
2. Do not waste too much time on any one question ; if necessary, go on to the next question and come back to the difficult ones later.
3. If you think you know an answer, mark it even if you are not certain that it is correct.
4. Make sure that you mark the letter you have chosen in the correct line on your answer sheet.

### ANSWERING

In each case you are required to select an answer from a number of choices and to indicate your answer by—

- (a) writing the appropriate letter in the box on your answer sheet ; and
- (b) putting a circle around the appropriate letter.

For example, if your answer is choice D you would mark your answer sheet as follows :

D	A	B	C	(D)	E
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If you wish to change an answer, put a cross through both the letter in the box, and the circle you have made previously. Then write your new answer in the box, and circle the letter which indicates your new answer.

<del>B</del>	A	(B)	C	( <del>D</del> )	E
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Now look through this examination paper but do not start writing until the supervisor tells you to do so.

#### SYMBOLS :

- = means "is equal to", and  $\neq$  means "is not equal to".
- > means "is greater than".
- < means "is less than".
- $\perp$  indicates that the angle between the two lines is a right angle.
- $\angle ABC$  means "angle ABC".

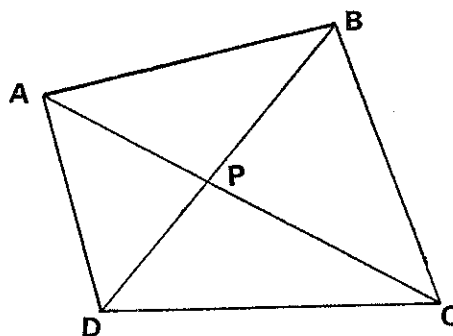
#### FORMULAE :

- Circumference of a circle =  $2\pi \times$  radius, i.e.  $C = 2\pi r$ .
- Area of a circle =  $\pi \times$  square of radius, i.e.  $A = \pi r^2$ .
- Area of rectangle = length  $\times$  breadth, i.e.  $A = l \times b$ .
- Area of triangle =  $\frac{1}{2} \times$  base  $\times$  height, i.e.  $A = \frac{1}{2}b \times h$ .

1. In the diagram, the diagonals  $AC$  and  $BD$  intersect at  $P$ .

The number of triangles illustrated by this diagram is

- A. 4  
B. 6  
C. 8  
D. 10  
E. 12



2. To build a fence a contractor charges \$1 per foot plus \$1 for each post. If the distance between the centres of adjacent posts is 9 feet, how much does he charge to build a straight fence 54 feet long?

- A. \$54  
B. \$59  
C. \$60  
D. \$61  
E. \$63

3. The statement  $84 \div 2 \times 6 - 5 = 2$  is only true when parentheses are inserted in the appropriate place. Which of the following is a true statement?

- A.  $(84 \div 2) \times (6 - 5) = 2$   
B.  $84 \div (2 \times 6 - 5) = 2$   
C.  $84 \div (2 \times 6) - 5 = 2$   
D.  $(84 \div 2) \times 6 - 5 = 2$

4. 15 miles per hour equals 22 feet per second. If an aircraft travels at 600 miles per hour, what is its approximate speed in feet per second?

- A. 300 feet per second.  
B. 600 feet per second.  
C. 900 feet per second.  
D. 1,200 feet per second.  
E. 1,500 feet per second.

5. A shopkeeper increased his original stock by 20 per cent. and then sold 20 per cent. of all his stock. When he checked his stock against the original stock, he would expect

- A. no difference  
B. 4 per cent. decrease  
C. 4 per cent. increase  
D. 5 per cent. decrease  
E. 5 per cent. increase

## Questions 6-9.

Number pairs, which are written  $(a, b)$  can be used in a way similar to ordinary single numbers. For example, number pairs can be added in the following way—

$$(a, b) + (c, d) = (a + c, b + d)$$

And number pairs can be multiplied in the following way—

$$(a, b) \cdot (c, d) = ac + bd$$

6.  $(3, -3) \cdot (-4, 4)$  equals

- A. -10
- B. 20
- C. 30

- D. -24
- E. None of these

7.  $(3, 4) + (2, 6) - (1, 3)$  equals

- A. (3, 5)
- B. (4, 6)
- C. (6, 13)

- D. (4, 7)
- E. None of these

The number pair  $(x, y)$  can be represented as a point on a graph, as shown in Fig. 1.

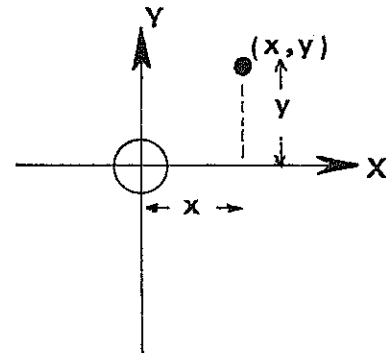


FIG. 1.

Fig. 2 shows such a plane in which the points A, B, C, D, E are marked.

8. Which point represents

$$(-5, 3) + (1, 0)?$$

9. Which point represents

$$(2, 3) + (-7, -6)?$$

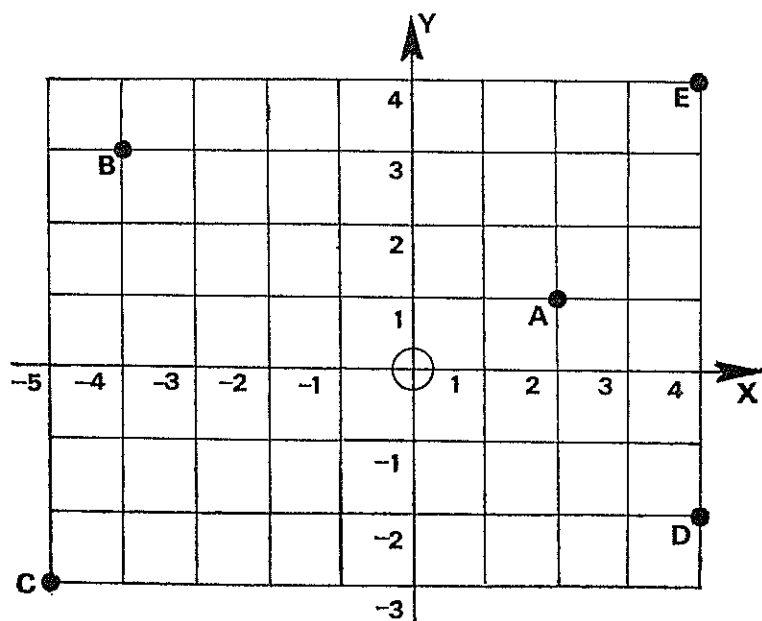


FIG. 2.

10. Which of the following can be divided without remainder by at least three of the numerals 11, 3, 5, 2? There is more than one answer.

A. 6,776  
 B. 495  
 C. 4,620  
 D. 9,955,033  
 E. 1,818  
 J. 4,920

Questions 11–14 refer to the following table and information.

The following statistics represent the results of an examination of 900 candidates. The examination comprised 12 questions, each of which was worth a maximum of two marks.

Question No.	1	2	3	4	5	6	7	8	9	10	11	12
<i>N</i>	897	688	705	722	820	692	600	693	703	796	467	402
<i>B</i>	562	328	172	45	335	154	60	54	543	348	82	8
<i>Z</i>	20	194	143	326	268	111	270	121	8	38	150	325

*N* is the number of candidates attempting a question.

*B* is the number of candidates achieving full marks on a question.

*Z* is the number of candidates achieving zero marks on a question.

11. What percentage of candidates attempted question 7?

A.  $33\frac{1}{3}$   
 B. 10  
 C. 55  
 D.  $66\frac{2}{3}$

12. What percentage of candidates who attempted question 7 obtained full marks?

A.  $6\frac{2}{3}$   
 B. 10  
 C. 15  
 D. 45

13. How many candidates obtained full marks on both question 7 and question 8?

A. 600  
 B. 693  
 C. 114  
 D. 14  
 E. There is not sufficient information to tell.

14. Which question was answered most successfully by those who did it?

A. 1  
 B. 2  
 C. 9  
 D. 12

Questions 15–18 refer to the following diagrams and information.

Ordinary numbers can be represented as points along a line  $OX$ , as shown in Fig. 1. The number line is always drawn in this direction.  $x$  is the symbol for any number on this line.

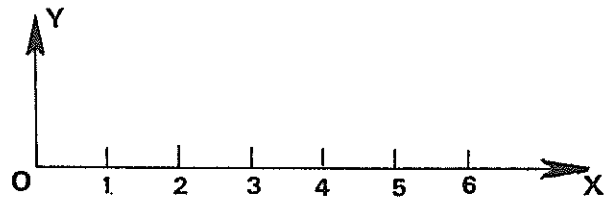


FIG. 1.

When the letter  $K$  is placed in front of a number, this means that the number line has been rotated about  $O$ , anti-clockwise through  $90^\circ$ . So the number  $K5$  would be located at point  $M$  in Fig. 2, as the number line has rotated anti-clockwise through  $90^\circ$  and is now in the direction  $OY$ .

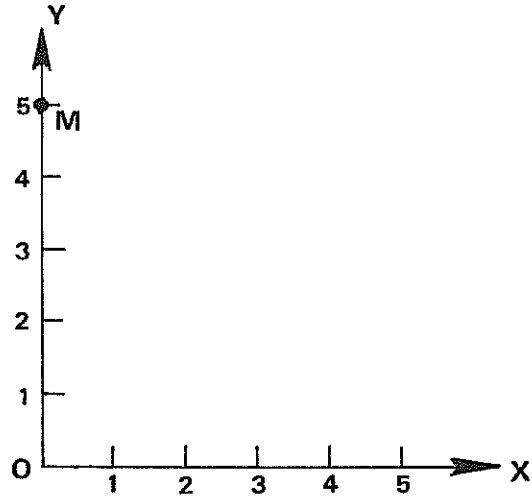


FIG. 2.

Fig. 3 shows a plane space in which points (or number pairs) may be located relative to the axes  $OX$  and  $OY$ .

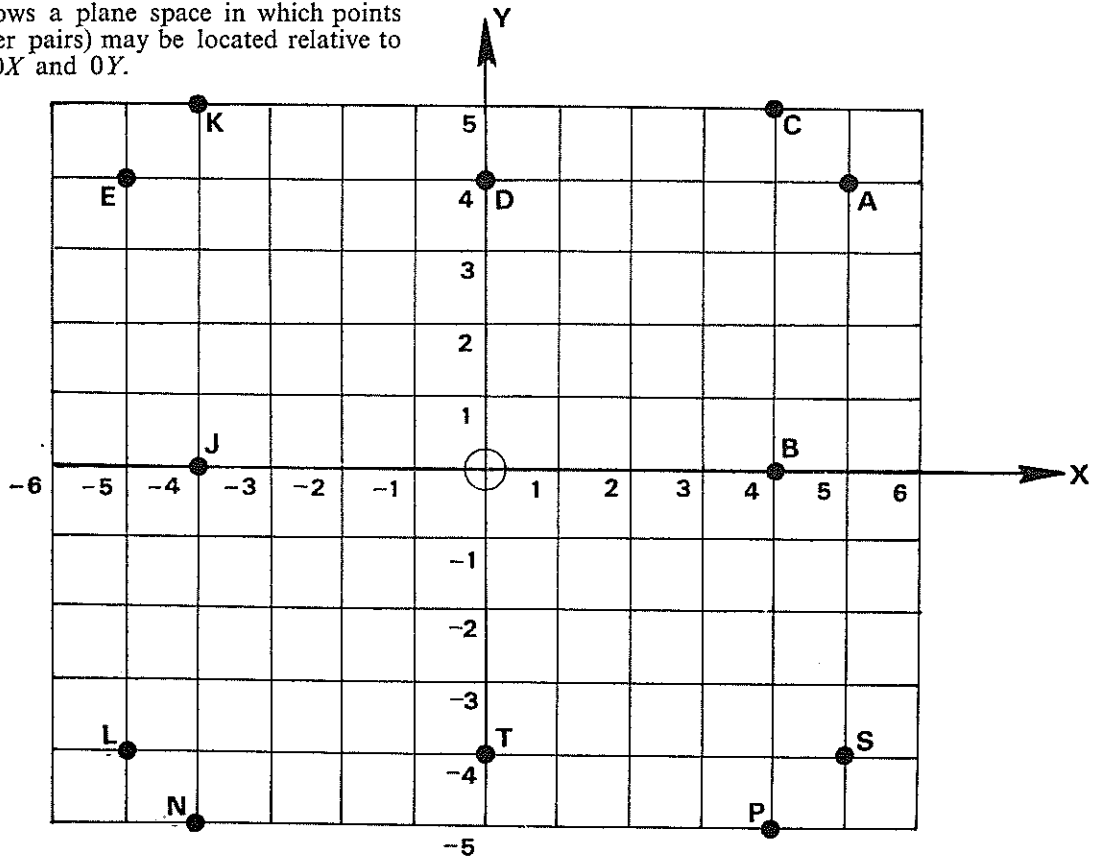


FIG. 3.

Name (by its appropriate letter) the point on this space which could represent the following numbers.

15.  $K4$ .
16.  $K(K4)$ .
17.  $-K4$ .
18.  $K5 + 4$ .



Questions 19, 20 refer to the following information.

It may easily be proved that  $\frac{1}{x} + \frac{1}{x} = \frac{1}{\frac{x}{2}}$

Use this relationship to answer the following questions.

19. Which one of the following is an expression equivalent to

$$\frac{1}{8 \cdot 4} + \frac{1}{8 \cdot 4}$$

A.  $\frac{1}{4 \cdot 2}$

B.  $\frac{1}{16 \cdot 8}$

C.  $\frac{2}{16 \cdot 8}$

D. None of the above.

20. Which of the following is an expression equivalent to

$$\frac{1}{12 \cdot 8} + \frac{1}{12 \cdot 8} + \frac{1}{6 \cdot 4} + \frac{1}{1 \cdot 6} + \frac{1}{3 \cdot 2}$$

A.  $\frac{1}{0 \cdot 8}$

B.  $\frac{5}{36 \cdot 8}$

C.  $\frac{15 \cdot 2}{12 \cdot 8}$

D. None of the above.

21. Two projectiles speed directly towards each other, one at 12,000 miles per hour and the other at 18,600 miles per hour.

They start 2,465 miles apart.

How far apart will they be, 1 minute before collision ?

A. 1,946 miles

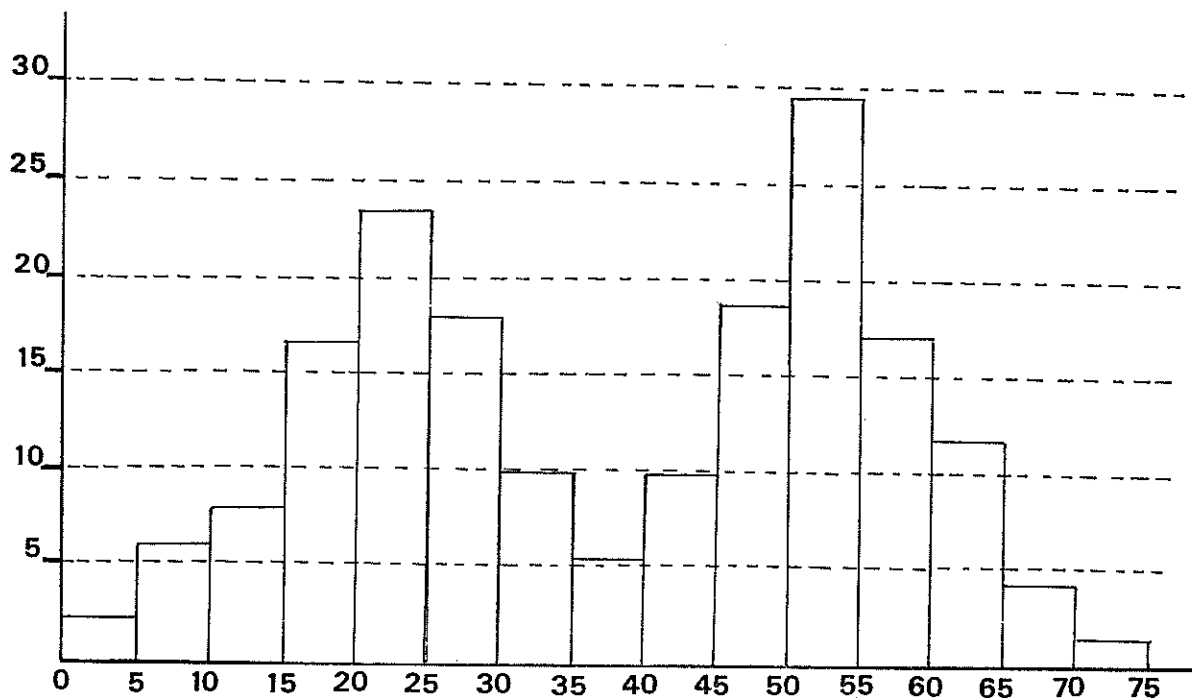
B. 110 miles

C. 255 miles

D. 510 miles

## Questions 22, 23.

The column graph shown represents the results obtained by 200 candidates in an examination consisting of 75 questions. One mark was allotted to each question and the pass mark was 40. The ranges represented in each column are 0-5, 6-10, 11-15, &c.



22. A candidate is selected at random. The chance that his score lies in the range 51-55 is about
- A. 1 in 2  
 B. 1 in 10  
 C. 1 in 15  
 D. 3 in 20  
 E. 7 in 100
23. All but one of the following statements are supported by the graph. Select the one that is *not* supported.
- A. Approximately half the candidates pass the examination.  
 B. The average score on the test lies in the range 30-45.  
 C. There are more candidates who passed by 10 marks or less than who failed by less than 10 marks.  
 D. Each question was answered correctly by about half the candidates.

Questions 24, 25 refer to the following diagram and information.



*A* and *B* represent identical carts.

Cart *A* rolls along a table at a speed of 12 centimetre per second. Cart *B* is initially at rest. As soon as the end of spring *S* (projecting in front of *A*) touches *B*, *B* starts to move. *B* moves in all a total distance of 6 centimetre from its initial position before the spring no longer touches it. At the instant this occurs the Cart *A* has become stationary, and remains so, and Cart *B* now has a speed of 12 centimetre per second.

24. The total time during which the spring contacted Cart *B* was 2 seconds. At what time after the initial contact was the spring probably most compressed?

- |               |                                     |
|---------------|-------------------------------------|
| A. 0.5 second | D. 2 second                         |
| B. 1 second   | E. At all times during the contact. |
| C. 1.5 second |                                     |

25. The carts had the same speed

- A. when cart *B* was 3 centimetre from its initial position.  
 B. at some point when cart *B* was less than 3 centimetre from its initial position.  
 C. at some point when cart *B* was more than 3 centimetre from its initial position.  
 D. at no stage during the collision.

26. In a population of 6,673,346, there are 8,200 doctors. Which gives the best approximation to the fraction of the population that are doctors?

- |           |           |
|-----------|-----------|
| A. 0.08   | D. 0.012  |
| B. 0.008  | E. 0.0012 |
| C. 0.0008 |           |

27.  $x^4 - 4x^3y + 6x^2y^2 - 4xy^3 + y^4$  is equal to one of the following. Select it.

- |                |                  |
|----------------|------------------|
| A. $(x - y)^4$ | D. $x^4 + y^4$   |
| B. $x^4 - y^4$ | E. $(2x - 2y)^4$ |
| C. $(x + y)^4$ |                  |

Questions 28–31 refer to the following diagram and information.

Fig. 1 shows a simplified flow chart for a computer. The flow chart consists of a series of steps. Each step is boxed separately. In other words, this is a list of instructions for the computer.

$N$  refers to the number of cases.

$X$  is the numerical value of each case.

$\Sigma$  means “the sum of”.

$\Sigma X$  means “the sum of all the numerical values of  $X$  already processed”.

$M$  is the mean (average) numerical value of  $N$  cases.

$K$  is the number of cases already processed.

The cases fed into the computer have the following numerical values, and are read by the computer in this order :

2, 7, 5, 7, 9, 12, 5, 9.

28. What is the value of  $N$  ?
- A. 2  
B. 3  
C. 7  
D. 8  
E. 56
29. What is the value of  $M$  ?
- A. 1  
B. 3  
C. 7  
D. 8  
E. 9
30. If  $K = 3$ , what is the numerical value of the datum ( $X$ ) which the computer will read next ?
- A. 3  
B. 4  
C. 5  
D. 7  
E. 9
31. One of the instruction boxes reads  $\Sigma X = \Sigma X + X$   
This instruction
- A. means  $X$  must equal zero.  
B. means add the value of the next case to the existing total.  
C. means the computer should add all values of  $X$  together.  
D. asks the computer whether all cases have been counted.

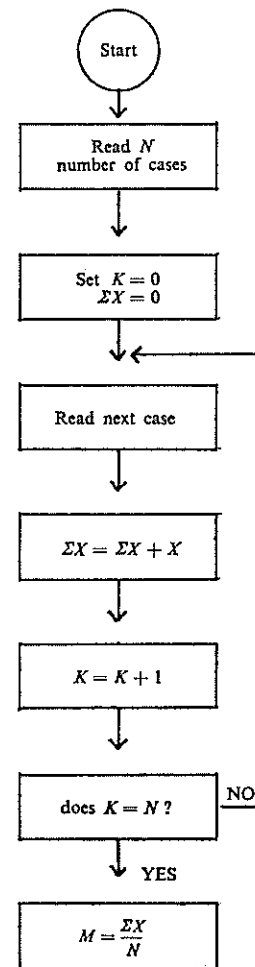
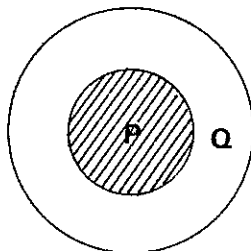


FIG. 1.

Questions 32, 33 refer to the following diagram and information.



Disc  $P$  lies on disc  $Q$ . The diameter of disc  $Q$  is twice the diameter of disc  $P$ . The diameter of disc  $P$  is  $x$ .

32. The area of disc  $P$  is

- A.  $x$
- B.  $2x$
- C.  $3x$

- D.  $4x$
- E. None of the above.

33. The fraction of the area of disc  $Q$  *not* covered by disc  $P$  is

- A.  $\frac{1}{2}$
- B.  $\frac{1}{4}$
- C.  $\frac{3}{4}$

- D.  $\frac{2}{3}$
- E. None of the above.

34. If  $P = \frac{R}{Q}$ , then  $Q$  is equal to

- A.  $PR$
- B.  $\frac{P}{R}$
- C.  $\frac{Q}{R}$

- D. either B or C depending on whether  $Q$  is greater or less than 1.
- E. None of these.

35. The story is told of a man who was cursed, and the curse was extended to his sons and their sons unto the seventh generation. Now he had ten sons, and they each had ten sons, and they each had ten sons, and so on unto the seventh generation. Assuming his sons are counted as the first generation, the total number of people cursed is approximately

- A. the population of Melbourne.
- B. the population of Australia.
- C. the population of the U.S.A.
- D. the population of Asia.
- E. the population of Hobart.
- J. 71.

*Questions 36–38.*

A factory has a production capacity of 100,000 articles.

Its production costs may be grouped into fixed costs and variable costs.

*Fixed costs* are incurred regardless of the volume of production.

*Variable costs* are proportional to the volume of production. That is, if the production is doubled, variable costs are doubled.

For full production (100,000 articles) the following costs are estimated.

Labour	..	..	..	..	..	\$50,000
Materials	..	..	..	..	..	\$40,000
Manufacturing fixed costs			..	..	..	\$10,000
Manufacturing variable costs			..	..	..	\$20,000
Administrative expense			..	..	..	\$20,000
Selling expenses	..	..	..	..	..	\$20,000

*Note that :*

- (i) Labour and materials should be considered as variable costs.
- (ii) The selling expense is 50 per cent. variable, 50 per cent. fixed.
- (iii) Administrative expense is fixed.
- (iv) The only revenue is from the sale of the articles.

36. For full production, what is the value of the fixed costs ?

- A. \$10,000
- B. \$30,000
- C. \$40,000
- D. \$160,000

37. For half production, what fraction of the total costs are variable costs ?

- A.  $\frac{1}{4}$
- B.  $\frac{3}{8}$
- C.  $\frac{3}{4}$
- D.  $\frac{1}{2}$

38. If 80,000 articles are produced and then sold at \$2 each, this would result in

- A. A profit of \$40,000.
- B. Neither a profit nor a loss
- C. A loss of \$20,000
- D. A profit of \$24,000
- E. A profit of more than \$40,000

Questions 39–41 refer to the following information.

The following list gives some examples of the use of star numbers :

$$*2 + *3 = *6$$

$$*4 + *5 = *20$$

$$*8 + *2 = *16$$

39. Complete the following :  $*3 + *4 =$

A.  $*7$

B.  $7$

C.  $*12$

D.  $12$

40. Complete the following :  $*12 - *6 =$

A.  $*6$

B.  $6$

C.  $*2$

D.  $2$

E.  $-72$

J.  $*-72$

41. Complete the following :  $*\left(\frac{p}{q}\right) =$

A.  $*p + *q$

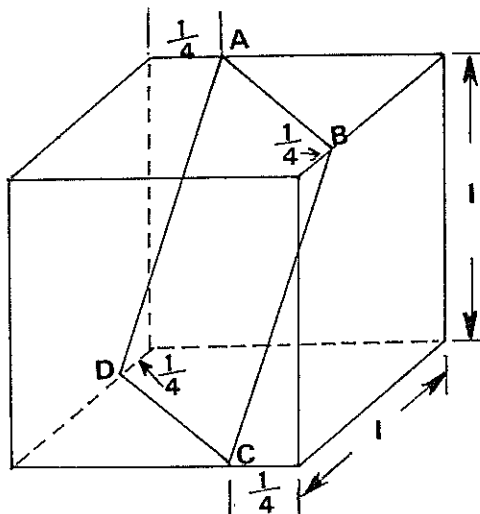
B.  $*p - *q$

C.  $*p \div *q$

D.  $*p \times *q$

Questions 42, 43.

A plane quadrilateral is fitted into a unit cube as shown.



42. It is possible to infer, without calculation, that

A.  $AB = BC$

B.  $AB = CD$

C.  $AB < BC$

D.  $AB < CD$

E.  $AB > BC$

J.  $AB > CD$

43. The length of  $AB$  is

A.  $\sqrt{\frac{2}{3}}$

B.  $\sqrt{\frac{1}{2}}$

C.  $\sqrt{\frac{2}{3}}$

D.  $\sqrt{3}$

## Questions 44-46.

The daily requirement of vitamins is not the same for every person. It depends on the weight, age and sex of the person and on his state of health. The figures given in the following table therefore apply to a fictitious person, and refer to only five of the vitamins.

Vitamin	Daily Requirement in Milligrams	Number of Milligrams in a Serving								
		Milk	Cheese	Celery	Water-melon	Banana	Wheat-germ	Tuna	Egg	Liver
A	5	0.3	0.8	0.3	0.6	0.2	..	..	0.3	2.6
B <sub>1</sub>	1.1	0.1	0.02	0.04	0.05	0.04	0.5	0.05	0.05	0.2
B <sub>2</sub>	1.5	0.5	0.4	0.1	0.05	0.05	0.2	0.1	0.15	3
C	100	3.0	..	8.0	6.0	10.0	..	..	..	..
Niacin	17	0.3	..	0.2	0.2	0.7	1.3	12	0.05	14

44. If as many as ten serves of the foods listed could be given each day, how many, by themselves, could provide the daily requirements for all of the 5 vitamins listed ?
- A. none  
B. one  
C. two  
D. three  
E. four
45. On one day a single serving of each of the foods listed is eaten. This would provide
- A. The daily requirement for at least three of the listed vitamins.  
B. The daily requirement of just two of the listed vitamins.  
C. At least half of the daily requirements of all the listed vitamins.  
D. All the daily requirements of all the listed vitamins.
46. Which of the following could provide the daily requirement of at least three of the listed vitamins ? There may be more than one answer.
- A. 3 serves of liver.  
B. An egg and a serve of wheat-germ.  
C. 3 serves each of celery and cheese.  
D. 1 serve of liver and 3 serves of watermelon.  
E. 3 serves each of banana, celery, and wheat-germ.



Questions 47–51 refer to the following information.

The expression  $(a \triangle b)$  means the product of the number  $a$  and the number  $(b + 1)$ ;  $a$  or  $b$  may have any value including zero.

$$\text{Thus } 3 \triangle 4 = 15$$

For questions 47 and 48 write

- A. if the statement is always true.
- B. if the statement is sometimes true.
- C. if the statement is never true.
- and D. if there is insufficient information to decide the truth or falsity of the statement.

47.  $0 \triangle b = 0$ , where 0 means zero.

48.  $1 \triangle b = b$

49. What is the value of  $(-4) \triangle (-3)$ ?

- A. 6
- B. 8
- C. 15
- D. 16

50. If  $3 \triangle x = -3$ , then

- A.  $x = -1$
- B.  $x = -3$
- C.  $x = 0$
- D. the value of  $x$  can be calculated, but it is not listed above.
- E. there is no value of  $x$  which fits.

51. If  $a \triangle b$  is equal to 0 and  $a \neq 0$ , then

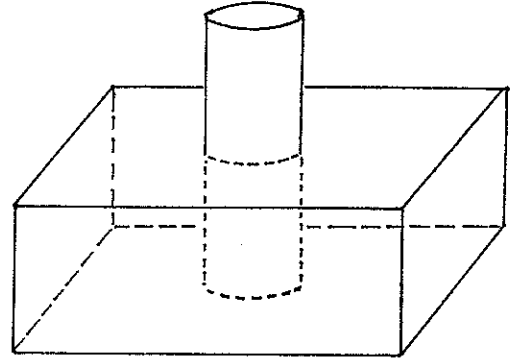
- A.  $b = 0$
- B.  $b = 1$
- C.  $b = -1$
- D. No conclusion can be drawn about the value of  $b$ .

Questions 52, 53 refer to the following information.

When a cylinder floats vertically in a liquid, as shown in the diagram, a certain fraction ( $f$ ) of the block is in the liquid. If  $d_B$  is the density of the block, and  $d_L$  is the density of the liquid, then it is known that

$$f = \frac{d_B}{d_L}$$

The density of any object is calculated by dividing its mass by its volume.



Below are a list of facts about various liquids, and a cylinder.

Density of water = 62 pound per cubic foot

Density of kerosene = 50 pound per cubic foot

Volume of cylinder = 2 cubic foot

Area of cross-section of cylinder = 2 square foot

Height of cylinder = 1 foot

Mass of cylinder = 80 pound

52. Of the six facts given in the list, what is the *least* number needed to determine the fraction of the cylinder which is above the liquid level when the cylinder floats in kerosene?

A. 1

C. 3

B. 2

D. 4

53. What fraction of the cylinder is below the surface when the cylinder floats in water?

A.  $\frac{2}{3}$

D.  $\frac{4}{5}$

B.  $\frac{2}{5}$

E.  $\frac{20}{31}$

C.  $\frac{1}{2}$

54. Study the following sequence of steps. It is possible that in some of the steps the left-hand side of the statement does not equal the right-hand side. Give the letter corresponding to the first line on which this occurs. If there is no such line write N.

Given  $x = 3$

line A.  $\therefore (x - 3) = 0$

line B.  $\therefore (x - 3)x = (x - 3)4$

line C.  $\therefore x^2 - 3x = 4x - 12$

line D.  $\therefore x^2 - 7x + 12 = 0$

line E.  $\therefore (x - 3)(x - 4) = 0$

line J.  $\therefore x - 4 = 0$

line K.  $\therefore x = 4$

line L.  $\therefore$  as  $x = 3$  and  $x = 4$ , therefore  $3 = 4$

Questions 55–59 refer to the following information.

The decimal system is the normal system of counting in tens.

The tertiary system is a system of counting in threes.

The octal system is a system of counting in eights.

The table below shows some equivalent numbers expressed in each of the three systems.

<i>Decimal</i>	<i>Tertiary</i>	<i>Octal</i>
0	0	0
1	1	1
2	2	2
3	10	3
4	11	4
5	12	5
6	20	6
7	21	7
8	22	10
9	100	11
10	101	12

55. Write the *decimal number* 15 in the tertiary system.

- A. 5  
 B. 120  
 C. 122  
 D. 113  
 E. 300

56. Write the *decimal number* 16 in the octal system.

- A. 2  
 B. 18  
 C. 24  
 D. 20  
 E. 121

57. Write the *tertiary number* 222 in the decimal system.

- A. 26  
 B. 22  
 C. 20  
 D. 74  
 E. 222

58. Write the *tertiary number* 201 in the octal system.

- A. 15  
 B. 20  
 C. 201  
 D. 209  
 E. 23

59. Write the *octal number* 17 in the decimal system.

- A. 13  
 B. 15  
 C. 17  
 D. 19  
 E. 21

*Questions 60, 61.*

This year, Easter Day fell on March 26th, which is early ; but it is not as early as possible, for unless world-wide agreement to the contrary occurs, Easter Day is and will be the first Sunday after the full moon which happens upon or next after the twenty-first day of March. And if the full moon happens upon a Sunday, Easter Day is the Sunday after.

Now the average time from one full moon to the next is 29 days, 12 hours and about 44 minutes, but the time may vary by as much as about 6 hours.

60. When is the earliest that Easter Day can occur ?

- |             |             |
|-------------|-------------|
| A. March 21 | D. March 24 |
| B. March 22 | E. March 25 |
| C. March 23 |             |

61. What is the latest day in April on which Easter Day could fall ?

- A. 30th
- B. Anzac Day (25th)
- C. 1st
- D. The Sunday following the second Saturday.
- E. None of these.