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# QUANTITATIVE THINKING

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|    |   |   |   |   |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|---|---|---|---|
| 1  | A | B | C | D | E |   |   |   |   |   |   |
| 2  | F | G | H | I | J |   |   |   |   |   |   |
| 3  | A | B | C | D | E |   |   |   |   |   |   |
| 4  | F | G | H | I | J |   |   |   |   |   |   |
| 5  | A | B | C | D |   |   |   |   |   |   |   |
| 6  | F | G | H | I |   |   |   |   |   |   |   |
| 7  | A | B | C | D |   |   |   |   |   |   |   |
| 8  | F | G | H | I | J |   |   |   |   |   |   |
| 9  | A | B | C | D | E |   |   |   |   |   |   |
| 10 | F | G | H | I |   |   |   |   |   |   |   |
| 11 | K | L | M |   |   |   |   |   |   |   |   |
| 12 | K | L | M |   |   |   |   |   |   |   |   |
| 13 | K | L | M |   |   |   |   |   |   |   |   |
| 14 | A | B | C | D | E |   |   |   |   |   |   |
| 15 | F | G | H | I | J |   |   |   |   |   |   |
| 16 | A | B | C | D | E |   |   |   |   |   |   |
| 17 | F | G | H | I |   |   |   |   |   |   |   |
| 18 | A | B | C | D | E |   |   |   |   |   |   |
| 19 | F | G | H | I |   |   |   |   |   |   |   |
| 20 | A | B | C | D | E |   |   |   |   |   |   |
| 21 | F | G | H | I | J |   |   |   |   |   |   |
| 22 | A | B | C | D | E |   |   |   |   |   |   |
| 23 | F | G | H | I | J |   |   |   |   |   |   |
| 24 | A | B | C | D |   |   |   |   |   |   |   |
| 25 | F | G | H | I | J |   |   |   |   |   |   |
| 26 | K | L | M | N | O | P | Q | R | S | T | U |
| 27 | K | L | M | N | O | P | Q | R | S | T | U |
| 28 | K | L | M | N | O | P | Q | R | S | T | U |
| 29 | K | L | M | N | O | P | Q | R | S | T | U |

|    |   |   |   |   |   |
|----|---|---|---|---|---|
| 30 | A | B | C | D | E |
| 31 | F | G | H | I | J |
| 32 | A | B | C | D | E |
| 33 | F | G | H | I | J |
| 34 | A | B | C | D | E |
| 35 | F | G | H | I |   |
| 36 | A | B | C | D | E |
| 37 | F | G | H | I | J |
| 38 | A | B | C | D |   |
| 39 | F | G | H | I | J |
| 40 | A | B | C | D | E |
| 41 | F | G | H | I | J |
| 42 | A | B | C | D | E |
| 43 | F | G | H | I | J |
| 44 | A | B | C | D | E |
| 45 | F | G | H | I | J |
| 46 | A | B | C | D | E |
| 47 | F | G | H | I | J |
| 48 | A | B | C | D | E |
| 49 | F | G | H | I | J |
| 50 | A | B | C | D | E |
| 51 | F | G | H | I | J |
| 52 | A | B | C | D |   |
| 53 | K | L | M | N | O |
| 54 | K | L | M | N | O |
| 55 | K | L | M | N | O |
| 56 | K | L | M | N | O |
| 57 | K | L | M | N | O |
| 58 | F | G | H | I |   |
| 59 | A | B | C | D | E |
| 60 | F | G | H | I | J |

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COMMONWEALTH SECONDARY SCHOLARSHIPS  
EXAMINATION FOR TWO-YEAR SCHOLARSHIP 1966-67

## QUANTITATIVE THINKING

Morning Session, Thursday, 29th July, 1965

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 circle the letter you have chosen in the correct line on your answer sheet.

### ANSWERING

In each case you are required to select one answer from four or five or more choices and to indicate your answer by putting a circle around the appropriate letter (A, B, C, &c.) on your answer sheet. For example, if your answer was choice D you would mark your answer sheet as follows :

A   B   C   **(D)**   E

If you wish to change an answer, put a cross through the circle that you have made and draw a circle around the letter which indicates your new answer, e.g.,

**(A)**   B   C   ~~(D)~~   E

Should you wish to indicate a letter that you have already crossed out, write this letter at the end of the line and circle it, e.g.,

~~(A)~~   B   C   ~~(D)~~   E   **(D)**

Make any notes or calculations on this examination paper. Do not make notes or calculations on your answer sheet.

Now look through this examination paper but do not start writing until the supervisor tells you to do so.

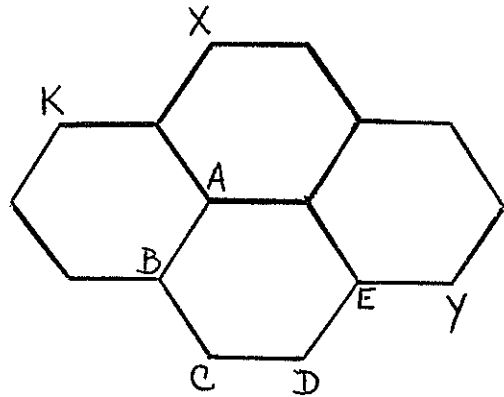
#### SYMBOLS :

- = means "is equal to".
- > means "is greater than".
- < means "is less than".
- ⊥ indicates that the angle between the two lines is a right angle.
- ∠ABC means "angle ABC".

#### FORMULAE :

- Circumference of a circle =  $2\pi \times \text{radius } (2\pi r)$ .
- Area of a circle =  $\pi \times \text{square of radius } (\pi r^2)$ .
- Area of rectangle =  $\text{length} \times \text{breadth } (l \times b)$ .
- Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height } (\frac{1}{2} b \times h)$ .

1. The diagram shows four regular hexagons. A line is drawn through  $K$  parallel to  $XY$ . Through which of the points  $A, B, C, D, E$  will this line pass?



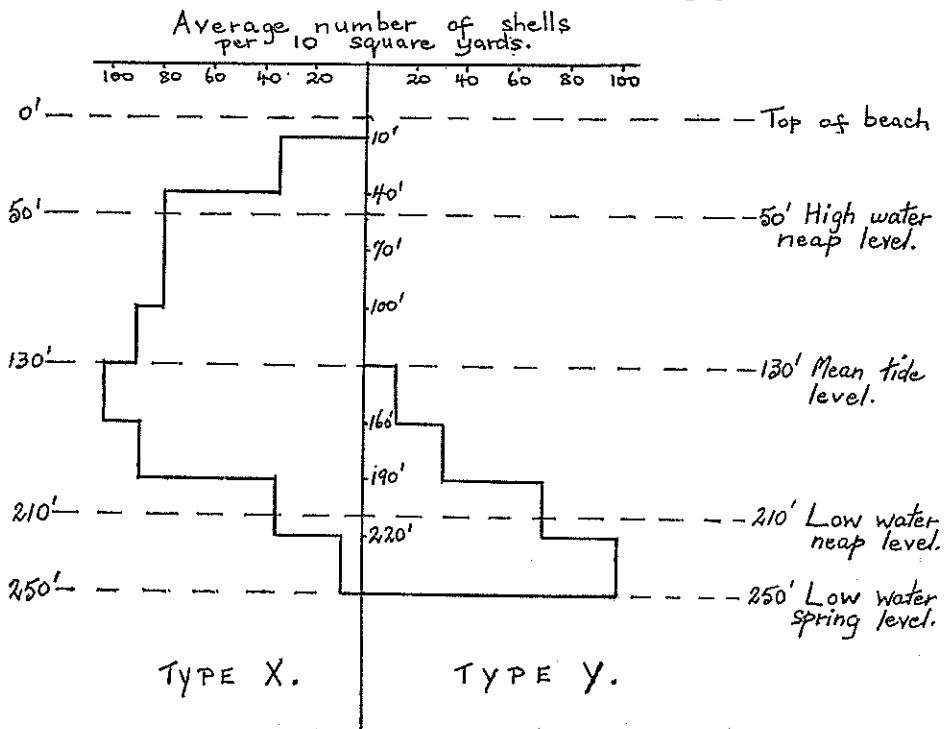
Questions 2-4.

A different method of writing fractions is to write them as number pairs. For example, the fraction  $\frac{2}{3}$  may be written as  $(2, 3)$ . The operations applicable to fractions apply as usual. Using this system of arithmetic, answer the questions following:

2. The value of  $(1, 2) + (1, 4)$  is  
 F.  $(1, 2)$   
 G.  $(2, 6)$   
 H.  $(2, 4)$   
 I.  $(3, 4)$   
 J.  $(3, 8)$
3. The value of  $(3, 5) \div (2, 3)$  is  
 A.  $(2, 5)$   
 B.  $(6, 15)$   
 C.  $(9, 10)$   
 D.  $(15, 6)$   
 E.  $(10, 9)$
4. The value of  $\frac{(5, 7) \times (14, 15)}{(2, 3)}$  is  
 F.  $(1, 1)$   
 G.  $(4, 9)$   
 H.  $(0, 1)$   
 I.  $(9, 4)$   
 J.  $(1, 0)$

Questions 5-7.

The following diagram relates to questions 5-7 on page 3.

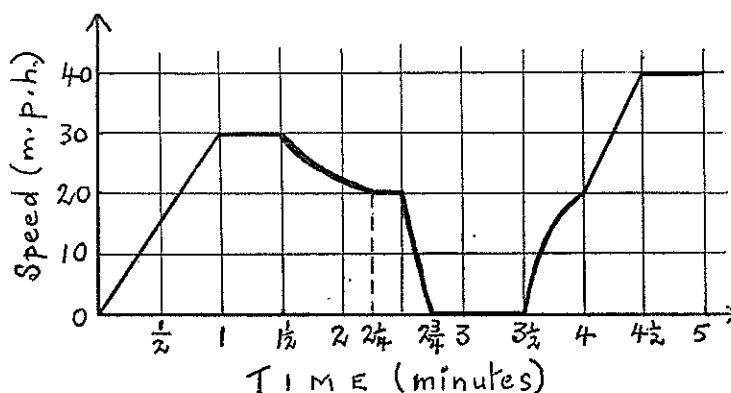


The diagram represents the results of an experiment designed to determine the distribution of two types of shells ( $X$  and  $Y$ ) on a beach. The distribution of shells was only measured to low water spring level. The distribution shown above can be taken as representative of the distribution over the whole beach.

Use the information given above to answer the following questions.

5. Type  $X$  shells are
- probably not found in quantity below low water spring level.
  - more plentiful at low water levels than at high water levels.
  - found on the beach in about the same numbers as type  $Y$  shells.
  - evenly distributed over the whole beach.
6. Type  $Y$  shells
- are distributed over the whole beach.
  - are found higher up the beach than type  $X$  shells.
  - do not appear to be found above mean tide level.
  - do not occur below low water spring level.
7. There will be more type  $Y$  shells than type  $X$  shells on the beach
- between mean tide and low water neap levels.
  - at mean tide level.
  - between low water and high water neap levels.
  - at low water neap level.

Questions 8–10.



The above graph shows how the speed of a man's car varies over the first 5 minutes of his journey to work in the city. A speed limit of 30 m.p.h. applies throughout the journey. It is possible to obtain from the graph the distance the man has actually travelled, but for the purposes of this set of questions let this distance be  $x$  miles.

8. For how long was the car stationary during the part of the journey shown in the graph?
- $\frac{1}{2}$  minute.
  - $\frac{3}{4}$  minute.
  - 1 minute.
  - $1\frac{1}{2}$  minutes.
  - 2 minutes.
9. For how long did the man actually exceed the speed limit for the part of the journey shown?
- $\frac{1}{4}$  minute.
  - $\frac{1}{2}$  minute.
  - $\frac{3}{4}$  minute.
  - 1 minute.
  - None of these.
10. If the man had been able to maintain a constant speed of 25 m.p.h. for the 5 minutes, he would have travelled
- less than  $x$  miles.
  - $x$  miles.
  - further than  $x$  miles.
  - either F, G, or H depending on the value of  $x$ .

## Questions 11–13.

A grandfather clock strikes 4 notes on the quarter hour, 8 on the half hour, and so on. Thus, on the hour it strikes 16 notes, and in addition it strikes the hours as well. In the house with the clock there are three visitors who, in the morning, make statements about the number of times they heard the clock strike during the night. Their statements are numbered as questions 11–13. Circle on your answer sheet the letter

- K. if the visitor could be speaking the truth.  
 L. if the visitor could not be speaking the truth.  
 M. if there is no way of deciding whether the visitor's statement is true or false.

11. "I was awake for no more than half an hour, and the clock struck 20 times."  
 12. "I awoke to hear the clock begin to strike, and it struck 15 times."  
 13. "The clock woke me up striking continuously 33 times."

## Questions 14–16.

In a certain election there are five candidates P, Q, R, S, T of whom two are to be elected. Voters numbered their papers 1 to 5 in order of preference, and all voting papers were found to be satisfactory. The scrutineers in this election prepared the following table (leaving certain gaps) :

|  |          | VOTES |     |     |     |     |
|--|----------|-------|-----|-----|-----|-----|
|  |          | 1st   | 2nd | 3rd | 4th | 5th |
| C<br>A<br>N<br>D<br>I<br>D<br>A<br>T<br>E<br>S | <i>P</i> | 3     | 8   | 2   | 5   | 2   |
|  | <i>Q</i> | 2     |     | 3   |     | 7   |
|  | <i>R</i> | 7     | 5   | 3   | 3   | 2   |
|  | <i>S</i> | 5     | 2   |     | 4   | 4   |
|  | <i>T</i> | 3     | 1   | 7   | 4   | 5   |

A candidate is automatically elected if he receives 35 per cent. or more of the first votes. If less than two candidates are automatically elected, then the other candidates are arranged in order of preference by awarding 5 points to a candidate for each first vote he obtains, 4 points for each second vote, 3 points for each third vote, and so on, and totalling the points so awarded.

14. The number of second votes received by candidate *Q* is  
 A. 2.  
 B. 4.  
 C. 5.  
 D. 8.  
 E. 20.
15. Which one of the following statements follows from the information given ?  
 F. Only candidate *P* was automatically elected.  
 G. Only candidate *S* was automatically elected.  
 H. Only candidate *R* was automatically elected.  
 I. Both candidates *R* and *S* were automatically elected.  
 J. No candidate was automatically elected.
16. The two candidates finally elected were  
 A. Candidates *P* and *R*.  
 B. Candidates *R* and *T*.  
 C. Candidates *R* and *S*.  
 D. Candidates *S* and *T*.  
 E. Candidates *P* and *S*.
17. The number of years in Emily's age is divisible by itself and exactly four other whole numbers greater than 1. In two years' time it will again be divisible by exactly four whole numbers excluding itself and one. Which one of the following could be Emily's present age, in years ?  
 F. 12.  
 G. 18.  
 H. 28.  
 I. 32.

## Questions 18–22.

| Index of Industrial Production 1957 = 100 |       |               |                |                |                  |                  |
|---|-------|---------------|----------------|----------------|------------------|------------------|
| Period                                    | Total | Wood Industry | Paper Industry | Metal Industry | Textile Industry | Other Industries |
| 1957                                      | 100   | 100           | 100            | 100            | 100              | 100              |
| 1958                                      | 111   | 99            | 115            | 111            | 109              | 111              |
| 1959                                      | 114   | 78            | 122            | 113            | 110              | 116              |
| 1960                                      | 117   | 82            | 134            | 115            | 116              | 117              |
| 1961                                      | 113   | 87            | 134            | 107            | 113              | 109              |
| 1962                                      | 123   | 98            | 144            | 120            | 125              | 120              |
| 1963                                      | 140   | 122           | 167            | 140            | 143              | 132              |

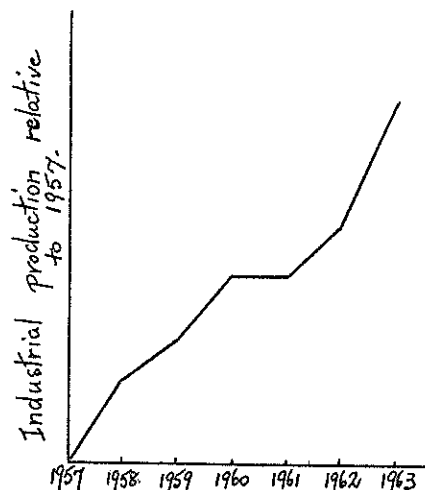
The above table shows the development of Industrial Production in a certain country over the period 1957–1963. The year 1957 was taken as the base for this table (100 units of production), and the production in subsequent years was expressed in terms of this base. For example, in the wood industry the production in 1959 was 78 per cent. of the 1957 production.

Use this table to answer the questions following :

18.

The graph depicts the development of industrial production in the

- A. wood industry.
- B. textile industry.
- C. metal industry.
- D. paper industry.
- E. other industries.



19. The industry whose industrial production advanced most rapidly in any one year of the 1957–63 period was the

- F. wood industry.
- G. paper industry.
- H. metal industry.
- I. textile industry.

20. The increase in the total industrial production in the 1957–63 period was

- A. 22 per cent.
- B. 32 per cent.
- C. 40 per cent.
- D. 43 per cent.
- E. 67 per cent.

21. The smallest positive increase, relative to the previous year's production in the total industrial production occurred in

- F. 1958.
- G. 1959.
- H. 1960.
- I. 1962.
- J. 1963.

22. Suppose two graphs,  $X$  and  $Y$ , are plotted on the same set of axes and using the same scales. (You are not required to draw these graphs.)

If  $X$  is a graph of the industrial production of the textile industry, relative to 1957, for the period 1958–63, and  $Y$  is a similar graph for the metal industry over the same period, then the number of intersections of the two graphs would be

- A. 0.
- B. 1.
- C. 2.
- D. 3.
- E. impossible to tell from the information given.



23. In a certain experiment the numbers  $a, b, c, d$  are such that  $a > b > c > d$ .

Now study this reasoning.

- $$(a + b) > (c + d).$$
- Step F.  $\therefore a > (c + d - b).$   
 Step G.  $\therefore -a > (-c - d + b).$   
 Step H.  $\therefore (d - a) > (b - c).$   
 Step I.  $\therefore (d + c) > (b + a).$

If you think that the reasoning is sound throughout circle the letter J on your answer sheet. If you think that the reasoning is not correct, circle the letter corresponding to the first step in which an error occurs.

24. The least number of things which may be lost out of  $p$  dozen things so that the remainder may not be grouped in lots of three is

- A. 1.  
 B. 2.  
 C.  $4p - 1$ .  
 D.  $4p$ .

25. A cyclic expression in three symbols,  $p, q,$  and  $r,$  is one in which replacement of  $p$  by  $q, q$  by  $r,$  and  $r$  by  $p,$  all at the same time, gives an expression which is the same as the original expression.

For example,  $3(p + q + r) - p^2q^2r^2$  is cyclic because when we replace  $p$  by  $q, q$  by  $r,$  and  $r$  by  $p,$  we have  $3(q + r + p) - q^2r^2p^2$  and this is equal to the original expression.

Which one of the following expressions is not cyclic.

- F.  $p^3 + q^3 + r^3 - pqr.$   
 G.  $(p - q)(q - r)(r - p).$   
 H.  $p^2q + p^2r + q^2r.$   
 I.  $(p + q + r)^2.$   
 J.  $\frac{p}{q} + \frac{q}{r} + \frac{r}{p}.$

#### Questions 26-29.

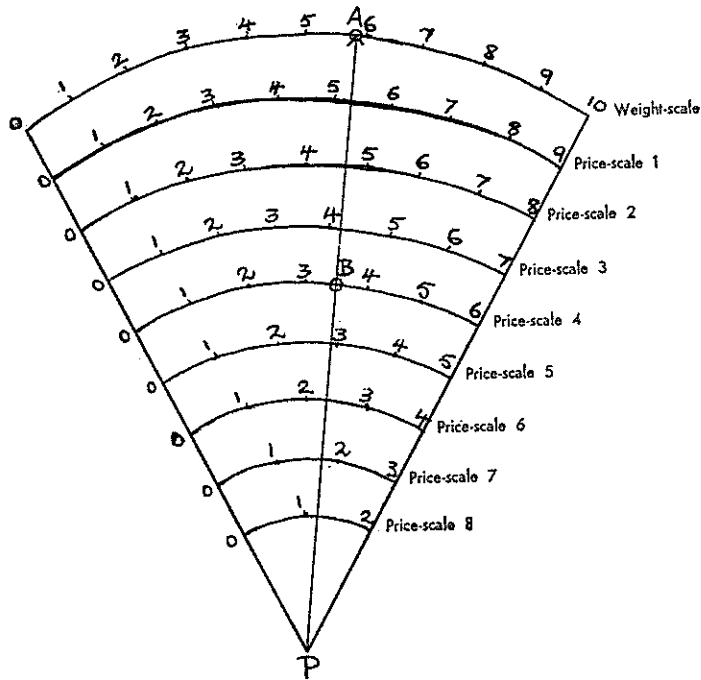
Read the passage below carefully and then the statements 26-29 following. These statements are all true conclusions based on the passage. For each conclusion circle on your answer sheet the letter of the sentence in the passage which must be used to reach it.

“(K) In the space flight of a rocket a factor called the mass-ratio is most important.

- (L) The take-off mass of any rocket is the sum of three quantities called the pay load, dead weight, and fuel load.  
 (M) The pay load is the mass of the compartments used for carrying explosives, scientific instruments and controls, or pilot and crew, and their contents.  
 (N) The dead weight is the total mass of the rocket structure plus all motors, fuel pumps and such like ; and the fuel load is the mass of the fuel carried.  
 (O) After the fuel has been used up the pay load and dead weight form the remaining mass.  
 (P) The mass-ratio is the ratio of the take-off mass to the remaining mass.  
 (Q) Thus, if the take-off mass is 45 tons and the remaining mass is 15 tons, the mass-ratio is 3 : 1.  
 (R) The higher the mass-ratio, the greater the fuel load and the greater the range of the rocket.  
 (S) When a single-stage rocket is fired it travels less than its own length during the first second.  
 (T) However, the velocity of a single-stage rocket increases rapidly, and it is about 40 ft./sec. at the end of the first second, 80 ft./sec. at the end of the second, 120 ft./sec. at the end of the third, and so on.  
 (U) Soon the velocities become very large, partly because the rocket is losing weight steadily as its fuel is consumed and partly because the effect of the motor increases as the rocket reaches the thinner layers of atmosphere where there is less resistance to its motion.”

26. Half a minute after take-off a single-stage rocket has a velocity of the order of 2000 ft./sec.  
 27. If two rockets have the same dimensions and take-off mass, but one has a mass-ratio of 4 : 1 and the other a mass-ratio of 3 : 1, then the rocket with the 4 : 1 ratio will outdistance the other.  
 28. If improvements in scientific instruments result in lighter and smaller instruments it will be possible to use more instruments for a given pay load.  
 29. If in a rocket the fuel load accounts for more than half of the take-off mass, then the fuel load of this rocket exceeds the pay load and dead weight.

Questions 30–33.



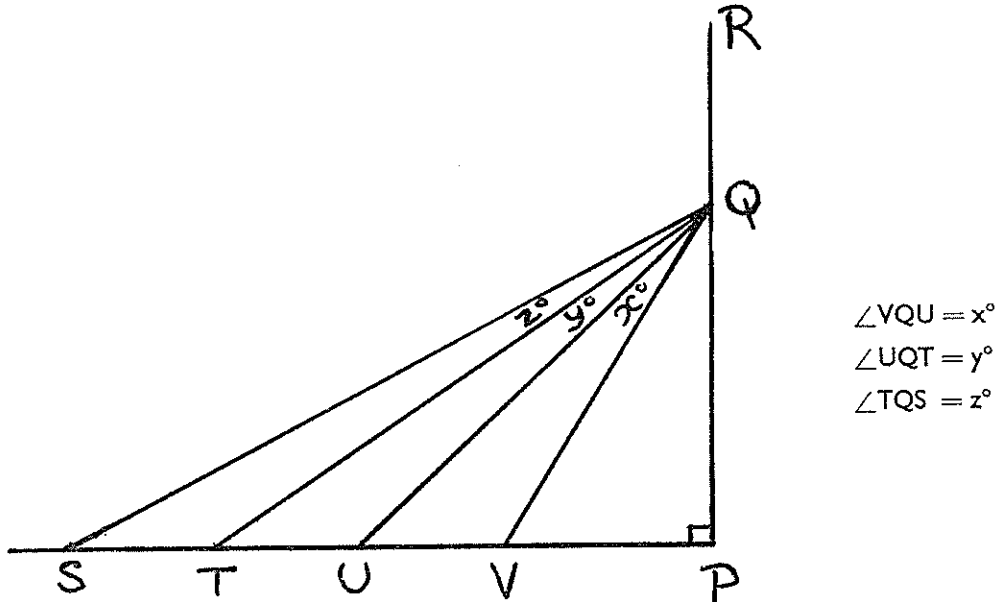
The diagram shows the face of a butcher's automatic weighing machine with the pointer pivoted at *P*. The top scale is marked in lb. (weight-scale) and the scales under it are marked in dollars (price-scales). 1 dollar = 100 cents. Provided that he knows the price per lb. of any meat, the butcher can use the scales to read off, either without any calculation or with only simple addition, the price of any piece of meat he weighs.

For example, Porterhouse steak costs 60 cents per lb. For the pointer in the position shown the butcher can say that he is weighing approximately 5.8 lb. of Porterhouse steak (point *A*) and its cost is 3 dollars 50 cents (point *B*).

30. Gravy beef is sold at 30 cents per lb. To read directly from his weighing machine, without calculation, the cost of 7.3 lb. of gravy beef the butcher will need to use
- price-scale 1.
  - price-scale 4.
  - price-scale 5.
  - price-scale 7.
  - one of the other price scales.
31. The butcher is using his scales to find the cost of 4.6 lb. of rump steak, which is sold at 70 cents per lb. On the relevant price-scale the pointer will be between
- 1 and 2.
  - 2 and 3.
  - 3 and 4.
  - 4 and 5.
  - 5 and 6.
32. What is the cheapest meat which the butcher can sell in order to be able to use his weighing machine to read off from one of the eight price-scales, without calculation, the price of a piece of meat?
- Meat costing 1 cent per lb.
  - Meat costing 2 cents per lb.
  - Meat costing 10 cents per lb.
  - Meat costing 20 cents per lb.
  - Meat costing other than that indicated in A, B, C, or D.
33. If a special meat costs 1 dollar 30 cents per lb., which one of the following pairs of price-scales could be used together to give the cost of this meat?
- Price-scales 3 and 7.
  - Price-scales 2 and 5.
  - Price-scales 2 and 6.
  - Price-scales 1 and 8.
  - Price-scales 3 and 6.

## Questions 34–35.

A number of lamp-posts  $S, T, U, V$  are equally spaced along a straight road  $SP$ . A second straight road  $PR$  meets  $SP$  at right angles.  $Q$  is a point on the road  $PR$ .



34. Which one of the following statements is true ?

- A.  $z - y = y - x$ .
- B.  $x = y$ .
- C.  $z < x$ .
- D.  $2y = x + z$ .
- E.  $y > x$ .

35. If  $Q$  represents the position of a car travelling at constant speed towards  $P$  and along the road  $RP$ , then

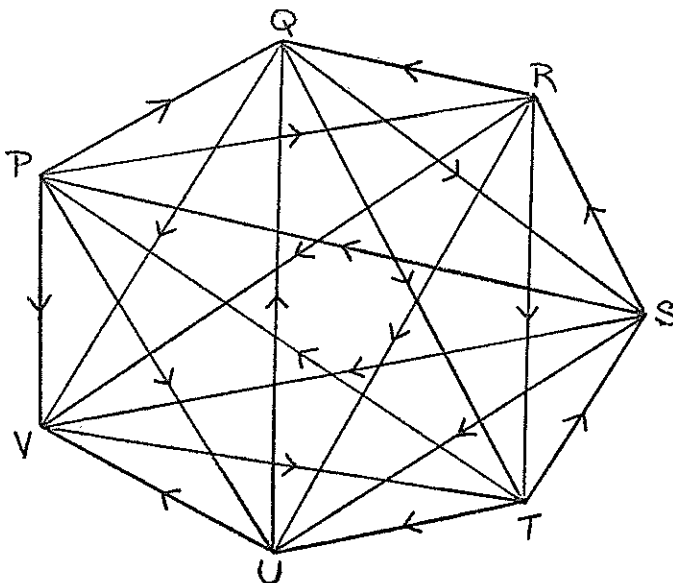
- F. the size of angle  $QVP$  decreases more rapidly than the size of angle  $QUP$ .
- G. the size of angle  $QVP$  decreases at the same rate as the size of angle  $QUP$ .
- H. the size of angle  $QVP$  decreases more slowly than the size of angle  $QUP$ .
- I. any one of F, G, and H may be true, depending on the speed of the car.

36. John is three times as old as Peter. In two years time he will be twice as old as Peter.

Peter's present age, in years, is

- A. 3.
- B. 5.
- C. 7.
- D. 9.
- E. none of these.

## Questions 37–39.



The diagram illustrates the decisions made by a man when considering the relative merits of seven different television sets, represented as  $P, Q, R, S, T, U,$  and  $V$ . The man made his decisions by considering the sets in pairs.

The diagram is interpreted as follows :

- T.V. set  $P$  was considered superior to  $Q$ .
- T.V. set  $P$  was considered superior to  $R$ .
- T.V. set  $T$  was considered superior to  $P$ , and so on.

Use this diagram to answer the questions following.

37. Which one of the following sets was considered superior to set  $R$  ?

- F. set  $U$ .
- G. set  $T$ .
- H. set  $V$ .
- I. set  $Q$ .
- J. set  $S$ .

38. Which one of the following logical arguments is NOT supported by the diagram ?

Argument A :

- set  $P$  is considered superior to set  $U$ .
- set  $T$  is considered superior to set  $P$ .
- $\therefore$  set  $T$  is considered superior to set  $U$ .

Argument B :

- set  $P$  is considered superior to set  $Q$ .
- set  $S$  is considered superior to set  $P$ .
- $\therefore$  set  $S$  is considered superior to set  $Q$ .

Argument C :

- set  $U$  is considered superior to set  $V$ .
- set  $R$  is considered superior to set  $U$ .
- $\therefore$  set  $R$  is considered superior to set  $V$ .

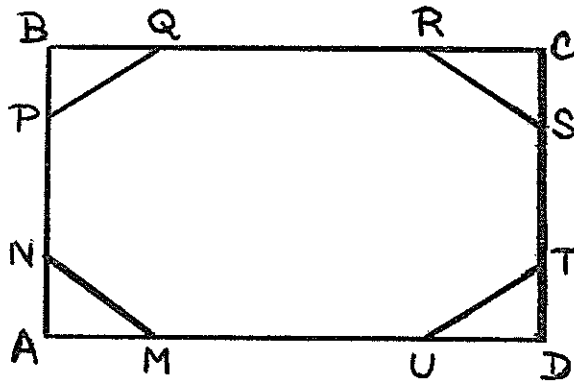
Argument D :

- set  $V$  is considered superior to set  $T$ .
- set  $R$  is considered superior to set  $V$ .
- $\therefore$  set  $R$  is considered superior to set  $T$ .

39. Suppose you depend entirely on the man's judgment, as represented in the diagram, when purchasing a T.V. set. Which one of the following sets would you purchase ?

- F. set  $P$ .
- G. set  $Q$ .
- H. set  $R$ .
- I. set  $S$ .
- J. set  $U$ .

40.

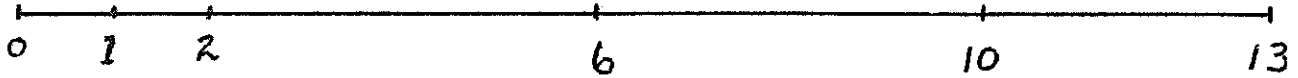


$ABCD$  is a rectangle and  $M, N, P, Q, R, S, T, U$  are points on the sides such that  $AM = \frac{1}{4}AD$ ,  $AN = \frac{1}{4}AB$ ,  $PB = \frac{1}{4}AB$ , and so on.

The area of the octagon  $MNPQRSTU$  expressed as a fraction of the area of  $ABCD$  is

- A.  $\frac{3}{4}$ .
- B.  $\frac{4}{5}$ .
- C.  $\frac{7}{8}$ .
- D.  $\frac{15}{16}$ .
- E.  $\frac{31}{32}$ .

41. A 13-inch ruler with four marks between the ends as shown, allows you to measure, in one step, any integral length from 1 to 13 inches.



For example, marks 0 and 1 can be used to measure 1 inch, 0 and 2 to measure 2 inches, 10 and 13 to measure 3 inches, and so on.

For a 9-inch ruler, three marks between the ends are sufficient to measure, in one step, any integral length from 1 to 9 inches. Which one of the following sets of marks does NOT satisfy this requirement on the 9-inch ruler?

- F. Marks 1, 2, and 6 inches from the left-hand end.
- G. Marks 1, 4, and 7 inches from the left-hand end.
- H. Marks 2, 5, and 8 inches from the left-hand end.
- I. Marks 3, 7, and 8 inches from the left-hand end.
- J. Marks 3, 4, and 7 inches from the left-hand end.

Questions 42–43.

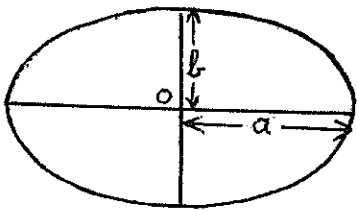


Fig 1

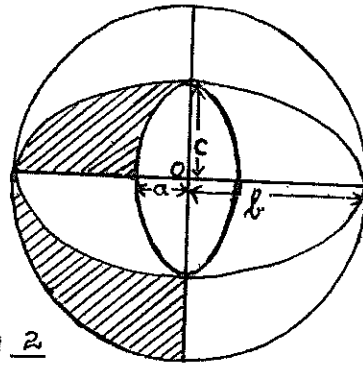


Fig 2

Figure 1 shows an ellipse centred at  $o$ . Its area is  $\pi ab$  square units.

Figure 2 shows two ellipses and a circle, all centred at  $o$ .

42. In figure 2 if the area of the smaller ellipse is to be half the area of the larger ellipse, then
- A.  $b = 4a$ .
  - B.  $b = 2a$ .
  - C.  $a = 4b$ .
  - D.  $a = 2b$ .
  - E. none of A, B, C, D is true.
43. In figure 2 the total area of the shaded parts, in square units, is
- F.  $\frac{\pi}{4}(b^2 - ac)$ .
  - G.  $\frac{\pi}{4}(bc - ac)$ .
  - H.  $\pi(b^2 - bc - ac)$ .
  - I.  $\pi(b^2 - ac)$ .
  - J.  $\frac{\pi}{2}(b^2 - bc - ac)$ .

Questions 44–46.

In algebra  $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$  is given a specific meaning. It has the value  $ad - bc$ . For example,

$$\begin{vmatrix} 4 & 3 \\ 5 & 6 \end{vmatrix} = 4 \times 6 - 3 \times 5 = 9.$$

44. The value of  $\begin{vmatrix} 7 & 3 \\ -5 & 2 \end{vmatrix}$  is

- A. -29.
- B. -1.
- C. 11.
- D. 29.
- E. 31.

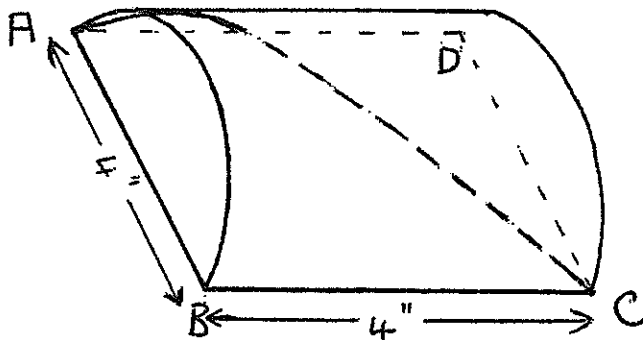
45. Which one of the following will leave the value of  $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$  unaltered?

- F. Change  $a$  with  $d$  and then change  $b$  with  $c$ .
- G. Change  $a$  with  $b$  and then change  $c$  with  $d$ .
- H. Change  $a$  with  $d$  and then change  $d$  with  $b$ .
- I. Change  $a$  with  $b$  and then change  $b$  with  $c$ .
- J. Change  $a$  with  $c$  and then change  $b$  with  $d$ .

46. If each letter in  $\begin{vmatrix} p & q \\ r & s \end{vmatrix}$  is multiplied by 3, then its value is

- A. unaltered.
- B. multiplied by 3.
- C. multiplied by 6.
- D. multiplied by 9.
- E. multiplied by 12.

47.



The figure shows half a circular cylinder of length 4 inches and diameter 4 inches.

What is the shortest distance from  $A$  to  $C$  along the curved surface?

- F. 8 inches.
- G.  $4\sqrt{2}$  inches.
- H.  $2\pi + 2$  inches.
- I.  $4(\pi + 1)$  inches.
- J.  $\sqrt{4\pi^2 + 16}$  inches.

48. A rectangular sheet of paper, corners  $ABCD$ , is cut into two parts by cutting along the diagonal  $BD$ . A point,  $P$ , is chosen on  $BD$  such that  $BP = \frac{3}{4}BA$ , and a further cut is made along the straight line  $PA$ .  $AB = 12''$  and  $AD = 5''$ .

Consider the following statements in the light of this information. If you think that the reasoning is sound throughout circle the letter E on your answer sheet. If you think that the reasoning is not correct, circle the letter corresponding to the FIRST step in which an error occurs.

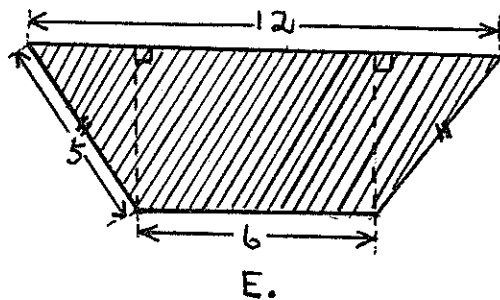
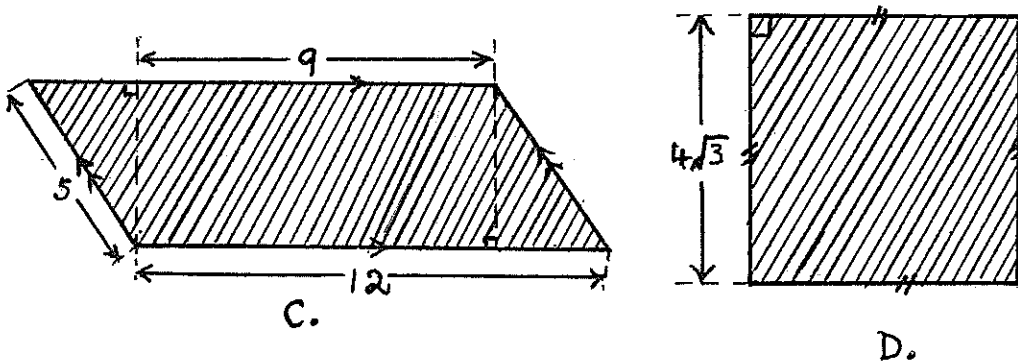
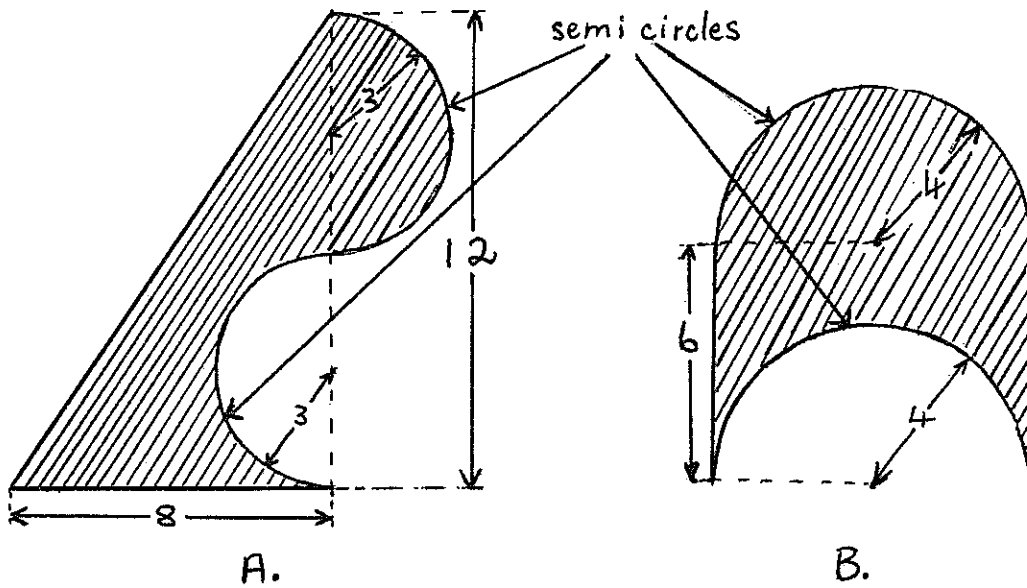
- |   |               |
|---|---------------|
| $BP = \frac{3}{4}BA$                        | (given)       |
| $\therefore BP = 9''$                       | (statement A) |
| Since $\angle BAD = 90^\circ$ , $BD = 13''$ | (statement B) |
| $\therefore PD = 4''$                       | (statement C) |
| But $DA = 5''$                              | (given)       |
| $\therefore PA = 3''$                       | (statement D) |

49. The average weight of eight members of a rowing crew is 11 stone 3 lb. When the weight of the cox is added in, the average weight of the crew and cox becomes 10 stone 11 lb. (14 lb. = 1 stone.)

The weight of the cox is

- F. 6 stone 11 lb.
- G. 7 stone 5 lb.
- H. 7 stone 11 lb.
- I. 8 stone 3 lb.
- J. none of these.

50. Four of the shaded figures below have the same area. If all dimensions are in the same units, write down the letter of the figure which differs in area from the others.



51. In the study of logic in elementary mathematics a proposition is defined as a sentence to which only one of the terms true or false can be meaningfully applied.

Select from the following the sentence which is not a proposition.

- F. This triangle is an equilateral triangle.  
 G. All squares are parallelograms.  
 H.  $x^2 + 4x + 4 = (x + 2)(x + 2)$ .  
 I.  $9 = 7 + 4$ .  
 J.  $2x + 3 = 12$ .
52. In this question the symbol  $[x]$  means "the largest integer which is less than or equal to  $x$ ". For example,

$$[4\frac{1}{7}] = 4, \quad [\frac{25}{4}] = 5, \quad [13\frac{1}{8}] = 13.$$

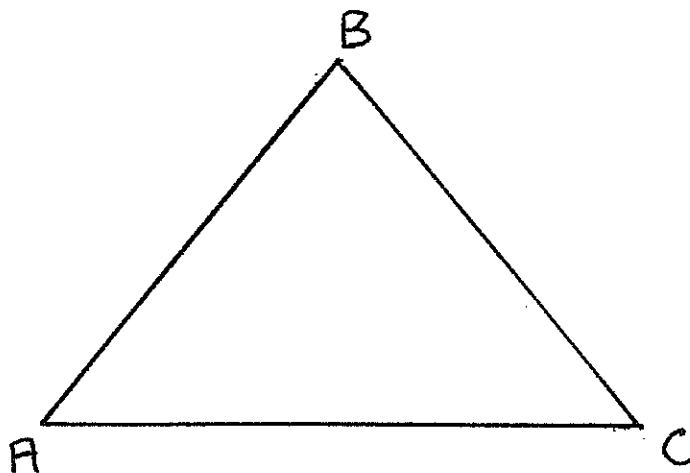
Which one of the following statements is correct for all values of  $x$  greater than 1 ?

- A.  $x[x] = x^2$ .  
 B.  $\frac{x}{[x]} = 1$ .  
 C.  $[x + 1] = [x] + 1$ .  
 D.  $[x(x - 1)] = [x][x - 1]$ .

## Questions 53–57.

Each of the following questions consists of an initial section containing some information and a question. The information is not sufficient to answer the question. Following this initial section there are two additional pieces of information (1 and 2). Consider these carefully and then circle on your answer sheet

- K. if statement (1) ALONE is sufficient additional information to answer the problem but statement (2) alone is not sufficient.
- L. if statement (2) ALONE is sufficient additional information to answer the problem but statement (1) alone is not sufficient.
- M. if both statements (1) and (2) TOGETHER are sufficient additional information to answer the problem but neither alone is sufficient.
- N. if each of statements (1) and (2) is sufficient additional information BY ITSELF to answer the problem.
- O. if both statements (1) and (2) TOGETHER are not sufficient additional information to answer the problem and further information is needed.
53. When a body slides over a rough surface there is a reaction force,  $N$  units, perpendicular to the surface and a friction force,  $F$  units, along the surface. These forces are related by the equation  $F = \mu N$  where  $\mu$  is a positive constant.
- Is the force  $F$  larger than the force  $N$ ?
- (1) The value of  $\mu$  varies from one situation to another.
- (2)  $\mu$  is less than 1.
54. In a certain Austrian town Italian or German or both are spoken by the entire population. Only 75 per cent. of the population speaks Italian. What percentage of the population speaks both Italian and German?
- (1) Only 83 per cent. of the population speaks German.
- (2) Only 17 per cent. of the population cannot speak German.
55. At the beginning of one year there are 250 boys and 200 girls in a school. At the beginning of the next year has the number of girls decreased by 25 per cent.?
- (1) The number of children in the second year is the same as in the first year.
- (2) At the beginning of the second year there are 300 boys in the school.
- 56.



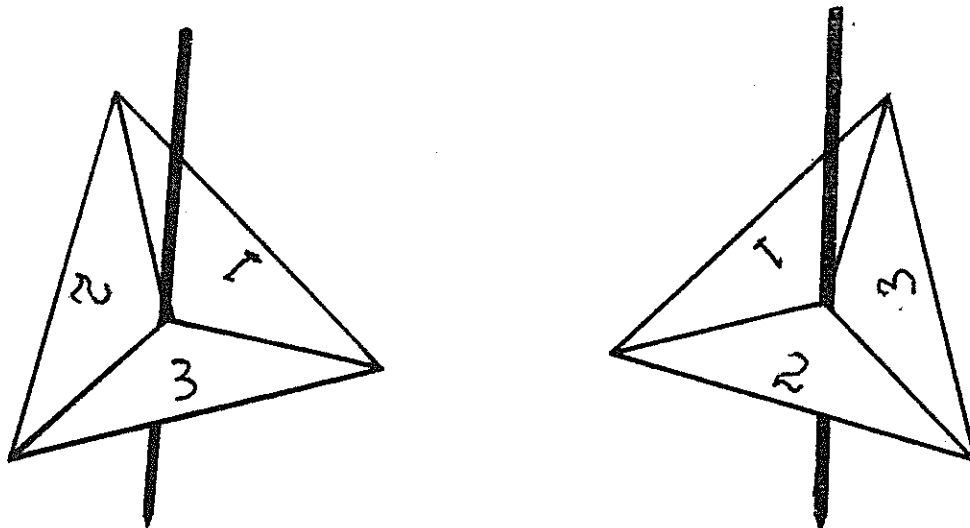
$ABC$  is any triangle. Is the side  $BC$  shorter than the side  $AB$ ?

- (1)  $\angle CAB = 60^\circ$ .
- (2)  $AB = 2''$ .
57. The following is a set of five numbers, one of which is out of place : 2, 5, 10, 15, 26. Which number is out of place?
- (1) The remaining four numbers have factors which are prime numbers.
- (2) The remaining four numbers are each one greater than a perfect square.



## Questions 58–59.

A game is played with two numbered wheels. A turn consists of spinning both to give a score. The wheels are divided into three identical isosceles triangles numbered 1 to 3. For each wheel the score is the number on the face of the triangle whose base comes to rest on the table. Scores on the two wheels can be either added or multiplied to give the score for each turn. To get a progressive total score, the scores from each turn are added.



The winner of the game is the first person with a progressive total score which equals or exceeds 100.

Two players,  $X$  and  $Y$ , play a large number of games.  $X$  obtains his score for each turn by addition and  $Y$  obtains his score for each turn by multiplication.

58. Which one of the following statements is true ?
- F.  $X$  will probably win many more games than  $Y$ .
  - G.  $X$  and  $Y$  will probably win about the same number of games each.
  - H.  $Y$  will probably win many more games than  $X$ .
  - I. Insufficient information is given to make statements F, G, or H.
59. Which one of the following is the most likely number of turns player  $X$  will have to complete a game ?
- A. 4.
  - B. 20.
  - C. 25.
  - D. 36.
  - E. 100.
60. A rectangular lawn,  $x$  ft. long and  $y$  ft. wide, is surrounded by a garden bed such that each point of its outer edge is  $p$  ft. distant from the nearest part of the lawn. The total length, in feet, of the outer perimeter of the garden bed is
- F.  $2(x + y)$ .
  - G.  $2(x + y + 4p)$ .
  - H.  $4x + 4y + \pi p$ .
  - I.  $2(2x + 2y + \pi p)$ .
  - J.  $2(x + y + \pi p)$ .