PROBLEM SOLVING ABILITY TEST
IN SCIENCE

CONSTRUCTED AND STANDARDISED

BY

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Different people think in different ways. You are going to be asked to think about some interesting problems in science. You will find that each problem can be solved in two, three or more different ways. You are allowed to think in as many different ways, as you can. In order to make your thinking easier, you have been given ideas of what your solution would be—classificatory, explanatory, experimental, numerical, logical, and symbolical etc. For this, you have been provided extra papers. This information about your thinking is very valuable and you should report almost all of it. This you can do in the following manner:

First read the problem as a whole. As you go through the problem, many ideas will strike you. Please write down your ideas. If you find that the problem is difficult then do not get disheartened but do solve any part of the problem you can. Please be neat, clear, and precise in your writings.
Attempt all questions

Item No. I Elements are those which cannot be broken up into simpler substances; compounds are those which are made up of two or more elements combined in a fixed ratio. In compounds elements lose their original properties.

Q.1 Classify the following into elements and compounds:
Copper, Zinc dust, Silver, Nitrogen gas, Carbon dioxide, Water, Sodium Chloride, Gold.

Q.2 Give reasons for the above classification.

Item No. II Catalyst is a substance which generally increases the rate of a reaction.

Q.1 Which of the following statements is correct regarding a catalyst?

a) All reactions can be catalysed.
b) No reaction can be catalysed.
c) The same catalyst can be used for all reactions;
d) Different reactions have different catalyst.

Q.2 Give reasons in choosing that answer.

Item No. III. Atoms of other elements (except inert gases) have a tendency to attain the stable electronic configuration of the nearest inert gas. During bond formation, atoms complete their octet (8 electrons) either by transfer or sharing of electrons. An electrovalent bond is formed between two atoms due to the transference of electrons from one atom to another. A covalent bond is formed due to mutual sharing of electrons between two atoms.

Q.1 Which type of bonding takes place in the following:
a) Sodium chloride (b) water, (c) Ammonia.

Q.2 Why do atoms combine to form molecules.

**Item IV.** Read the summary of the Haber Process for the manufacture of NH₃, and then answer the questions given below:

A mixture of N₂ and H₂ in the proportion 1:3 by volume is passed over a catalyst at 500°C and at a pressure of 200 atm. The reaction can be represented by the equation:

\[ \text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3 \]

There is an approximate 10% conversion to NH₃ for each passage of the gases over the catalyst.

Q.1 What does the sign \( \rightarrow \) indicate?

Q.2 What does atm mean?

Q.3 Once the reaction has started no further heat is applied to catalyst and yet the temperature of the catalyst remains at about 500°C. What does this tell you about the reaction?

Q.4 Is the above equation balanced? If not, balance it.

Q.5 What is the purpose of catalyst and high temperature of 500°C in this reaction?

**Item V.** Some air is enclosed in a cylinder with a moveable piston. Four different positions of the piston, the pressure and volume occupied by the air is shown in the following diagrams:

![Diagram of pressure-volume relationship](image-url)
What do you conclude about the pressure and volume relationship from the above experiment.

**Item VI**

There are two types of quantities. Volume or area is a scalar quantity as it has magnitude only. Velocity is a vector quantity as it has both magnitude and direction.

**Q.1 Classify the following into scalar and vector:**

Density, Displacement, Acceleration, Speed, Length.

**Q.2 Give reasons in support of your answer.**

**Item VII**

In a lever for doing some amount of work, we can increase power and decrease the distance through which power acts and vice versa. The condition is that product of power and distance through which power is applied remains constant.

In a festival boy weighing 50 kgs was sitting at a distance of 10 ft. from the fulcrum. Another boy was sitting at a distance of 5 ft. from the fulcrum and the log was in equilibrium.

**Q.1 Find the weight of the boy:** (a) 50 kg, (b) 500 kg, (c) 100 kg, (d) 200 kg.

**Q.2 Whether a boy having 25 kg weight can keep the log in equilibrium or not? At what distance he should set to bring the lever in equilibrium:**

(a) 10 ft, (b) 20 ft, (c) 5 ft, (d) at the fulcrum.
Item VIII. Find the value of $x$ and $y$ in

$q.1 \quad 3x + 4y = 0 \quad \quad \quad \quad \quad \quad (1)$

$q.2 \quad x + 2y = 4 \quad \quad \quad \quad \quad \quad (2)$

$q.2$ If equation $(2)$ in the above part changes
to $\frac{2x}{5} + \frac{4y}{5} = \frac{8}{5}$, then, will there be any
change in the answer?

Item IX

In $\triangle PQR$, $PQ = QR$

$L$, $M$, $N$ are respectively the middle
points of the sides $PQ$, $QR$ and $RP$

Prove that $LM = MN$, and $\angle PLM = \angle PNM$

Item X

Use figures from 12 to 20 in the plank squares
given so that the total should be 48 while added
in all directions.

Note: Use one figure once a time.

Example: Total of 45 is for you:

guidance.

\[
\begin{array}{ccc}
14 & 11 & 18 \\
17 & 15 & 13 \\
12 & 19 & 14 \\
\end{array}
\]

THANK YOU.