

# POSTAL Book Package

# 2023

## CIVIL ENGINEERING

### Construction Materials

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## Cement

- Q.1** Regarding the composition of raw materials used for manufacturing ordinary Portland cement, match **List-I** with **List-II** and select the correct answer by using the codes given below the lists:

List-I	List-II
A. Calcium oxide (CaO)	1. 2%
B. Silica (SiO <sub>2</sub> )	2. 3%
C. Aluminium oxide (Al <sub>2</sub> O <sub>3</sub> )	3. 5%
D. Ferrous oxide (Fe <sub>2</sub> O <sub>3</sub> )	4. 65%
E. Magnesium oxide (MgO)	5. 25%

**Codes:**

	A	B	C	D	E
(a)	4	5	3	2	1
(b)	1	2	3	4	5
(c)	2	4	5	1	2
(d)	2	1	3	5	4

- Q.2** The constituent compounds of cement in decreasing order of rate of hydration are
- C<sub>2</sub>S, C<sub>3</sub>S and C<sub>3</sub>A
  - C<sub>3</sub>S, C<sub>3</sub>A and C<sub>2</sub>S
  - C<sub>3</sub>A, C<sub>3</sub>S, and C<sub>2</sub>S
  - C<sub>3</sub>A, C<sub>2</sub>S and C<sub>3</sub>S
- Q.3** The tricalcium aluminate compound present in cement
- provides weak resistance against sulphate attack.
  - is responsible for highest heat of evaluation.
  - is characteristically fast reacting with water.
  - all of the above.
- Q.4** Match **List-I** with **List-II** and select the correct answer by using the codes given below the list:

List-I	List-II
A. Argillaceous	1. Sand (silica SiO <sub>2</sub> )
B. Silicious	2. Lime (CaO)
C. Calcareous	3. Clay (alumina Al <sub>2</sub> O <sub>3</sub> )

**Codes:**

	A	B	C
(a)	1	2	3
(b)	3	2	1
(c)	2	1	3
(d)	3	1	2

- Q.5** Gypsum consists of
- H<sub>2</sub>S and CO<sub>2</sub>
  - CaSO<sub>4</sub> and H<sub>2</sub>O
  - Lime and H<sub>2</sub>O
  - CO<sub>2</sub> and calcium
- Q.6** A sample of cement is said to be sound when it does not contain free
- lime
  - silica
  - iron oxide
  - alumina
- Q.7** Le Chatelier's device is used for determining the
- setting time of cement.
  - soundness of cement.
  - tensile strength of cement.
  - compressive strength of cement.
- Q.8** Low heat cement contains lower percentage of which of the following?
- C<sub>3</sub>A
  - C<sub>3</sub>S
  - C<sub>2</sub>S
  - None of these
- Q.9** An excess of free lime in portland cement
- results in an increase in strength.
  - increases the initial setting time.
  - causes unsoundness in the product.
  - improves the quality of the product.
- Q.10** Initial setting time is maximum for
- portland-pozzolana cement
  - portland-slag cement
  - low-heat portland-pozzolana cement
  - high strength portland cement

**Q.11** Snow cream is

- (a) chalk powder
- (b) powdered lime
- (c) mixture of chalk powder and lime
- (d) coloured-cement

**Q.12** The cement used in construction of docks and harbours is

- (a) blast-furnace slag cement.
- (b) water proof cement.
- (c) hydrophobic cement.
- (d) sulphate-resisting portland cement.

**Q.13** The field test for the quality of cement consists in putting a small quantity of cement in a bucket containing water. A good quality cement will

- (a) immediately dissolve in the water.
- (b) float on the water surface.
- (c) sink to the bottom of the bucket.
- (d) produce steam.

**Q.14** Match **List-I** (Apparatus) with **List-II** (Purpose) and select the correct answer using the code given below the lists:

**List-I**

- A.** Le-Chatelier's apparatus
- B.** Vicat Needle
- C.** Vee-Bee apparatus
- D.** Briquettes test machine

**List-II**

- 1.** Workability of concrete.
- 2.** Soundness of cement.
- 3.** Tensile strength.
- 4.** Final setting time of cement.

**Codes:**

- |     | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> |
|-----|----------|----------|----------|----------|
| (a) | 1        | 3        | 2        | 4        |
| (b) | 2        | 4        | 1        | 3        |
| (c) | 1        | 4        | 2        | 3        |
| (d) | 2        | 3        | 1        | 4        |

**Q.15** Match **List-I** with **List-II** and select the correct answer by using the codes given below the lists:

**List-I**

- A.** Water and cement
- B.** Tricalcium silicate
- C.** Di-calcium silicate
- D.** Tri-calcium aluminate

**List-II**

- 1.** Fast in reaction
- 2.** Slow in reaction
- 3.** Slowest in reaction
- 4.** Hydrates

**Codes:**

- |     | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> |
|-----|----------|----------|----------|----------|
| (a) | 4        | 2        | 3        | 1        |
| (b) | 1        | 3        | 2        | 4        |
| (c) | 4        | 1        | 2        | 3        |
| (d) | 3        | 2        | 1        | 4        |

**Q.16** High alumina cement is produced by fusing together a mixture of

- (a) limestone and bauxite.
- (b) limestone, bauxite and gypsum.
- (c) limestone, gypsum and clay.
- (d) limestone, gypsum, bauxite, clay and chalk.

**Q.17** Which of the following is correct if they are arranged in decreasing order of heat of hydration?

- (a)  $C_3A > C_4AF > C_3S > C_2S$
- (b)  $C_3A > C_4AF > C_2S > C_3S$
- (c)  $C_3A > C_3S > C_2S > C_4AF$
- (d)  $C_3A > C_3S > C_4AF > C_2S$

**Q.18** Pick out the incorrect statement.

- (a) For hydraulic structures, a cement with small percentage of  $C_3S$  and more  $C_2S$  is recommended.
- (b) Setting and hardening of cement stop as soon as the concrete becomes dry.
- (c) The product C - S - H get is known as tobermorite gel.
- (d) The stiffening of cement without strength development is caused because of  $C_4AF$ .

**Q.19** Which one of the following statement regarding the cement fineness is NOT correct?

- (a) Fine cement is more liable to suffer from shrinkage cracking than a coarse cement.
- (b) Fine cement will show faster rate of hardening than coarse cement.
- (c) Fine cement shows faster rate of heat evolution and total quantity of heat evolved is much larger than coarse cement.
- (d) Fine cement shows the same setting time as coarse cement.

**Directions :** Each of the next items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the codes given below:

**Codes:**

- (a) Both Statement (I) and Statement (II) are individually true; and Statement (II) is the correct explanation of Statement (I)
- (b) Both Statement (I) and Statement (II) are individually true; but Statement (II) is NOT the correct explanation of Statement (I)
- (c) Statement (I) is true; but Statement (II) is false
- (d) Statement (I) is false; but Statement (II) is true

**45. Statement (I):** The higher percentage of tricalcium silicate in cement results in rapid hardening with an early gain in strength at a higher heat of hydration.

**Statement (II):** A higher percentage of dicalcium silicate in cement results in slow hardening and less heat of hydration and greater resistance to chemical attack.

**Q.46 Statement (I):** A low  $C_3A$  cement generates less heat and develops higher ultimate strength.

**Statement (II):** During setting and hardening, the amount of lime liberated appears to be about 15 to 20 per cent by weight of cement.

**Q.47 Statement (I):** The greater the surface area of a given volume of cement the greater the hydration.

**Statement (II):** The reaction between the water and cement starts from the surface of the cement particles.

**Q.48 Statement (I):** Finer the cement, greater is the need for water for hydration and workability.

**Statement (II):** Bleeding of a mix occurs due to low water-cement ratio.

**Q.49 Statement (I):** Expansive cement is used in repair work for opened up joints.

**Statement (II):** Expansive cement expands while hardening.

**Q.50 Statement (I):** Fine cement is more liable to suffer from shrinkage cracking than a coarse cement.

**Statement (II):** Fine cement shows the same setting time as that shown by coarse cement.

## Multiple Select Questions (MSQ)

**Q.51** Which of the following pair(s) in respect of ordinary portland cement (OPC) is/are correctly matched?

- (a) Initial setting time — 30 minutes
- (b) Final setting time — 10 hours
- (c) Normal consistency — 10%
- (d) Fineness (sp. surface in  $m^2/kg$ ) — 225

**Q.52** Which of the following statement(s) is/are correct regarding the fineness of cement?

- (a) Fine cement is more liable to suffer from shrinkage cracking than a coarse cement.
- (b) Fine cement shows faster rate of heat evolution and total quantity heat evolved is much large than coarse cement.
- (c) Fine cement will show faster rate of hardening than coarse cement.
- (d) Fine cement shows the same setting time as coarse cement.

**Q.53** Which of the following statement(s) is/are correct?

- (a) Test on cement paste to determine initial and final setting times are done at normal consistency condition.
- (b) Low heat cement has a high percentage of tricalcium aluminate.
- (c) Quick setting portland cement is used when concrete is to be laid under water or in running water.
- (d) High early strength portland cement contains a larger percentage of tricalcium silicate and a lower percentage of dicalcium silicate.

**Q.54** Which of the following statement(s) is/are correct regarding setting of cement?

- (a) Final setting time decides the strength of cement.
- (b) Initial setting time of low heat portland cement is taken not less than 1 hour.
- (c) Air induced setting is observed when cement is stored under damp conditions.
- (d) Addition of gypsum retards the setting time.

**Q.55** Which of the following pair(s) is/are correctly matched?

- (a) Soundness                      Autoclave
- (b) Fineness                      Nurse & Blaine's apparatus
- (c) Specific gravity              Le-Chatelier flask
- (d) Setting time                  Vicat's apparatus

## Explanations

## Cement

1. (a)

Constituents of Portland cement (Raw Material)

Oxide	Composition	Average
Lime (CaO)	60-65	63
Silica (SiO <sub>2</sub> )	17-25	20
Alumina (Al <sub>2</sub> O <sub>3</sub> )	3-8	6
Iron oxide (Fe <sub>2</sub> O <sub>3</sub> )	0.56	3
Magnesia (MgO)	0.5-4	2
Soda or Potash (Na <sub>2</sub> O + K <sub>2</sub> O)	0.5-1	1
Sulphur trioxide (SO <sub>3</sub> )	1-2	1.5

2. (c)

The compound C<sub>3</sub>A characteristically reacts fast with water and may lead to an immediate stiffening of paste. C<sub>3</sub>A phase is responsible for the highest heat of evolution, both during the initial period as well as in the long run. In between C<sub>3</sub>A and C<sub>2</sub>S, C<sub>3</sub>S results in rapid hardening and higher heat of hydration than C<sub>2</sub>S.

3. (d)

The compound C<sub>3</sub>A characteristically reacts fast with water and may lead to an immediate stiffening of paste, and this process is termed flash set. It provides weak resistance against sulphate attack and its contribution to the development of strength of cement is less significant than that of silicates.

4. (d)

Argillaceous	Calcareous
<ul style="list-style-type: none"> <li>Shale and Clay</li> <li>Blast furnace slag</li> <li>Slate</li> </ul>	<ul style="list-style-type: none"> <li>Cement Rock</li> <li>Lime stone</li> <li>Chalk</li> <li>Mrine cells</li> <li>Marl</li> </ul>

6. (a)

The unsoundness of cement is caused by the undesirable expansion of some of its constituents, sometimes after setting the unsoundness is due to the presence of free lime and magnesia in the cement.

7. (b)

LeChatelier's apparatus is used to determine the soundness of cement.

8. (a)

Low heat cement is a Portland cement with relatively, lower contents of the more hydrating compounds C<sub>3</sub>S and C<sub>3</sub>A and more contents of C<sub>2</sub>S.

9. (c)

Unsoundness in cement is due to excess of lime, excess of magnesia or excessive proportion of sulphates. Le Chatelier test detects unsoundness due to free lime only. Autoclave test is used to detect unsoundness due to magnesia and lime.

10. (c)

Low-heat Portland cement is less reactive than OPC and is obtained by increasing the proportion of C<sub>2</sub>S and reducing the proportion of C<sub>3</sub>S and C<sub>3</sub>A. The initial setting time is about one hour, i.e., greater than that of OPC.

11. (d)

Snow cream is type of coloured cement.

12. (d)

Sulphate resisting cement contains low C<sub>3</sub>A and C<sub>4</sub>AF contents and is very effective against sulphate attack. The use of sulphate resisting cement is recommended for concrete to be used in the marine environment, foundations in chemically aggressive soils etc.

13. (b)

If a small quantity of cement is thrown in a bucket of water. It should float for some time before they sink.

14. (b)

**Le-Chatelier apparatus:** Soundness of cement

**Vicat needle:** Final setting time of cement

**Vee bee apparatus:** Workability of concrete

**Briquettes test machine:** Tensile strength

15. (a)

**Water and cement :** Hydrates

**Tri-calcium silicate:** Slow in reaction

**Di-calcium silicate:** Slowest in reaction

**Tri-calcium aluminate:** Fast in reaction

16. (a)

High alumina cement (IS : 6452)

The raw material used for its manufacture consists of 40% bauxite, 40% lime, and 15% Iron oxide,