

(c) Steel arches

(d) Sand stowing

vii. Block caving is generally applicable to ore bodies which are:

(a) Narrow and strong

(b) Massive and weak/fractured

(c) Flat and very hard

(d) Shallow and high-grade

Q.2 (A) What is Sub-level Stopping? Explain the stope preparation, drilling, and blasting processes involved in this method. [7]

Q.2 (B) Discuss the applicability, advantages, and disadvantages of the Sub-level Stopping method. [7]

Q.3 (A) Explain the Vertical Crater Retreat (VCR) method of stoping in detail. What is the fundamental principle behind this technique? [7]

Q.3 (B) Make a detailed comparison between Cut and Fill Stopping and Shrinkage Stopping. [7]

Q.4 (A) What are the special methods of shaft sinking? Explain the "Freezing Method" of shaft sinking with a neat sketch. Mention the coolants generally used. [7]

Q.4 (B) Why does a shaft need to be deepened? Explain the cycle of operations and safety precautions taken during shaft deepening. [7]

Q.5 (A) Describe the Square-set Stopping method. Under what geological conditions is this method highly applicable? [7]

Q.5 (B) Explain the working principle and operation of the Jora Raise Lift method for raising. [7]

Q.6 (A) State the differences between Raising and Winzing. Give technical and operational reasons why raising is generally preferred over winzing. [7]

Q.6 (B) What is Block Caving? Describe the basic principle of block caving and the conditions suitable for its successful implementation. [7]

Q.7 Write short notes on any FOUR of the following: [4 × 3.5 = 14]

A. Cactus Grab

B. Crown Pillar and Sill Pillar

C. Drop Raising method

D. Cementation method of shaft sinking

E. Permanent shaft lining

PAPER 2 - ANSWER KEY & MODEL HINTS

Q1 (MCQ Answers): i-(b), ii-(b), iii-(c), iv-(c), v-(a), vi-(b), vii-(b)

Model Hints for Theory:

Q2(A) Sub-level Stopping: An open stopping method where the ore body is divided into horizontal sublevels (usually 10-20m apart) between the main levels. Drilling is done from sublevel drifts. Large amounts of ore are blasted and fall into the draw points at the bottom. Highly productive and safe as miners work in small drifts, not in the open stope.

Q3(A) Vertical Crater Retreat (VCR): Based on the theory of spherical charges. Large diameter holes (165 mm) are drilled vertically downwards. Short, heavy spherical charges are placed at the bottom of the holes. Blasting creates a crater, breaking the rock horizontally in slices from bottom to top. It eliminates the need for raise boring and sublevel development.

Q3(B) Cut & Fill vs Shrinkage: *Cut & Fill:* Working floor is made of waste fill (sand/tailings), used for weak walls, highly selective, expensive. *Shrinkage:* Working floor is made of broken ore itself, used for strong walls and strong ore, less selective, cheaper but ties up capital as 60% of ore stays in the stope until completely mined.

Q4(A) Freezing Method: Used in heavily water-logged strata (e.g., quicksand). Freezing pipes are driven in a ring around the proposed shaft. A coolant (like Calcium Chloride brine cooled by Ammonia) is circulated to freeze the water, creating a solid ice wall. Sinking is then done safely within this frozen barrier.

Q5(A) Square-set Stopping: An expensive and slow method where heavily timbered interlocking frames (square sets) are installed to support the roof and walls immediately after blasting. Used only for extremely weak, heavy ground and very high-grade ore where no other method works.

Q6(A) Raising vs Winzing: *Raising:* Driven upwards. Gravity helps in mucking (broken rock falls naturally). Cheaper, faster, but ventilation and access can be tricky without proper equipment (Alimak). *Winzing:* Driven downwards. Requires hoisting equipment for mucking and pumping for water. Slower and more expensive. Therefore, raising is preferred.