10

Area and Volume

Q.1 In a mass-haul diagram, the distance (D) of the centre of mass of excavation or embankment from the line representing the volume to be hauled over is given by

(a) $D = \dfrac{Area \times Horizontal\ Scale \times Vertical\ Scale}{Volume\ Ordinate}$

(b) $D = \dfrac{Area \times Volume\ Ordinate}{Horizontal\ Scale \times Vertical\ Scale}$

(c) $D = \dfrac{Area}{Volume\ Ordinate}$

(d) $D = \dfrac{Area \times Horizontal\ Scale}{Vertical\ Scale}$

Q.2 In the given formula formats, L is the length of the base line split into 'n' equal segments each of length 'd'. $O_1, O_2 \ldots O_{n+1}$ are the ordinates at the sequential ends of the segments and M_1, $M_2 \ldots M_n$ are the mid-ordinates of successive segments. Which of the following pairs of rules and the formulae for computation of the area standing on the base line are correctly matched?

1. Mid – ordinate Rule

$$A = \left[\frac{O_1 + O_2 + \ldots + O_n}{n}\right] \times L$$

2. Average – ordinate Rule

$$A = \frac{L}{n}\left[M_1 + M_2 + \ldots + M_n\right]$$

3. Trapezoidal Rule

$$A = d\left[\left(\frac{O_1 + O_{n+1}}{2}\right) + O_2 + O_3 + \ldots + O_n\right]$$

4. Simpson's rule

$$A = \frac{d}{3}\left[\begin{array}{l}(O_1 + O_n) + 4(O_2 + O_4 + \ldots) \\ +2(O_3 + O_5 + \ldots + O_n)\end{array}\right]$$

Select the correct answer using the codes given below

(a) 1 and 2
(b) 1 and 3
(c) 3 and 4
(d) 2 and 4

Q.3 Given that for a planimeter,
L = length of the tracing arm
R = radius of the anchor arm
a = distance between the roller and hinge
If the wheel is beyond the hinge, then the area of zero circle will be

(a) $\pi(L^2 - 2aL + R^2)$
(b) $\pi(L^2 + 2aL + R^2)$
(c) $\pi(L^2 - 2aL + R^2)$
(d) $\pi(L^2 - aL + R^2)$

Q.4 Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I
A. Clinometer
B. Pantograph
C. Tellurometer
D. Ghat tracer

List-II
1. Area measuring instrument
2. Gradient finding instrument
3. Angle measuring instrument
4. Plan enlarging instrument
5. Microwave instrument

Codes:

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

Q.5 If the cross-sectional area of an embankment at 30 m intervals are 20, 40, 60, 50 and 30 m² respectively, then the volume of the embankment on the basis of prismoidal rule, is

(a) 5300 m³
(b) 8300 m³
(c) 9300 m³
(d) 9400 m³

Q.6 Excavation is to be made for a reservoir measuring 20 m long, 12 m wide at the bottom and 2 m deep. The side slopes are to be 1:1 and the top to be flushed with the ground which is levelled in the vicinity. As per prismoidal formula, the volume of excavation will be

(a) 610.33 m³
(b) 618.67 m³
(c) 625.00 m³
(d) 633.67 m³

Q.7 Which one of the following method estimates best the area of an irregular and curved boundary?

(a) Trapezoidal method
(b) Simpson's method
(c) Average ordinate method
(d) Mid-ordinate method

Q.8 Which one of the following method of computing area assumes that the short lengths of the boundary between the ordinates are parabolic arcs?

(a) Average ordinate rule
(b) Middle ordinate rule
(c) Simpson's rule
(d) Trapezoidal rule

Q.9 Volume of earth work may be calculated by

(a) mean areas
(b) end areas
(c) prismoidal formula and trapezoidal rule
(d) All of the above

Q.10 The volume of a 6 m deep tank having rectangular shaped top 6 m × 4 m and bottom 4 m × 2 m using prismoidal formula?

(a) 90 m³
(b) 94 m³
(c) 92 m³
(d) 96 m³

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Explanations **Area and Volume**

5. (a)

$$\frac{L}{3}[(A_1 + A_n) + 4(A_2 + A_4 + ...)$$

$$+2(A_3 + A_5 + ...)]$$

$$= \frac{30}{3}[(20 + 30) + 4(40 + 50) + 2(60)]$$

$$= 5300 \ m^3$$

6. (b)

$$V = \frac{1}{3}(A_1 + 4 A_m + A_2)$$

$A_1 = 12 \times 20 = 240 \ m^2$ (Bottom Area)

$A_2 = 16 \times 24 = 384 \ m^2$ (Top Area)

$$A_m = \left(\frac{12+16}{2}\right) \times \left(\frac{20+24}{2}\right) = 308 \ m^2$$

$2L = 2 \ m$

$L = 1 \ m$

$$V = \frac{1}{3}(240 + 4 \times 308 + 384) = 618.67 \ m^3$$

7. (b)

Mid-ordinate and Average ordinate methods are used with the assumption that the boundaries between the extremities of the ordinates are straight lines.

Trapezoidal method is based on the assumption that the figures are trapezoids. This method is more accurate than the above two methods.

Simpson's method assumes that the short lengths of the boundaries between the ordinates are parabolic arcs. This method is more useful when the boundary line departs considerably from the straight line. The results obtained by use of Simpson's method in all cases are the most accurate.

10. (c)

Prismoidal formula is also known as Simpson's rule

Given, $2L = 6 \ m$, $L = 3 \ m$

$A_1 = 6 \times 4 = 24 \ m^2$

$A_2 = 4 \times 2 = 8 \ m^2$

$$A_m = \left(\frac{6+4}{2}\right) \times \left(\frac{4+2}{2}\right) = 15 \ m^2$$

$\therefore \quad V = \frac{L}{3}(A_1 + 4A_m + A_2)$

$$= 24 + (4 \times 15) + 8 = 92 \ m^3$$

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