11 CHAPTER

Circular Curve

Q.1 The angle substended by the long chord of a simple circular curve at its centre is equal to
(a) angle of deflection
(b) two times the angle of deflection
(c) 180° – angle of deflection
(d) $\left(180^\circ - \frac{\text{angle of deflection}}{2}\right)$

Q.2 The radial offset at a distance X from the point of commencement of curve of radius R is given by
(a) $\sqrt{R^2 - X^2} - R$ (b) $R - \sqrt{R^2 - X^2}$
(c) $R - \sqrt{R^2 + X^2}$ (d) $\sqrt{R^2 + X^2} - R$

Q.3 In a reverse curve, the superelevation provided at the point of reverse curvature is
(a) zero
(b) minimum
(c) maximum
(d) dependent on elements of reverse curve

Q.4 The shape of the vertical curve generally provided is
(a) circular (b) parabolic
(c) spiral (d) elliptical

Q.5 For a simple circular curve, which one of the following gives the correct relation between the radius, R and degree of curve D, for 20 m arc length?
(a) $R = 5729.6/D$ (b) $R = 1718.9/D$
(c) $R = 1145.9/D$ (d) $R = 572.9/D$

Q.6 Which of the following elements of a simple curve are correctly matched?
1. Tangent length ..... R tan $\Delta/2$
2. Apex distance .... $2R$ sin $\Delta/2$
3. Length of long chord.... $2R$ cosec $\Delta/2$
4. Mid-ordinate .... R ver sin $\Delta/2$

(R is the radius and Δ is the deflection angle)
Select the correct answer using the codes given below:
(a) 1 and 3 (b) 2 and 4
(c) 1 and 2 (d) 1 and 4

Q.7 If Δ is the angle of deflection of the curve, T_1 and T_2 are its points of tangencies, the angle between the tangent at T_1 and long chord T_1, T_2 will be
(a) $\frac{\Delta}{4}$ (b) $\frac{\Delta}{3}$
(c) $\frac{\Delta}{2}$ (d) Δ

Q.8 Setting out a bridge involves determination of
1. length of centre line
2. height of piers
3. direction of centre line
4. position of piers

Of these statements
(a) 1 and 2 are correct
(b) 2 and 3 are correct
(c) 3 and 4 are correct
(d) 1 and 4 are correct

Q.9 Assertion A : Nautical sextant is used in hydrographic surveying
Reason R : This instrument helps in determining the depth of water
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.10 If an upgrade of 1.5% is followed by a downgrade of 0.5% and rate of change of grade is 0.2% per 20 m chain, then the length of vertical curve is
(a) 100 m (b) 200 m
(c) 300 m (d) 400 m

Q.11 Assertion A : The degree of curve is directly proportional to the radius of the curve
Reason R: A sharp curve has a large degree of curve and a flat curve has a small degree of curve
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.12 If the azimuths of the two tangents to a circular curve of radius 100 m are due north and due east, then the area bounded by the two tangents and the circular curve will be
(a) 7857 sq.m (b) 5000 sq.m
(c) 3143 sq.m (d) 2146 sq.m

Q.13 A parabolic vertical curve is set out connecting a + 0.7% grade to a - 0.6% grade. The chainage and R.L. of the point of intersection are 1000 m and 250 m respectively. The admissible rate of change of grade is 0.05% per 20 m The chainage of the tangent points will be
(a) 600 and 1400 (b) 650 and 1350
(c) 700 and 1300 (d) 740 and 1260

Q.14 If 'g_1' and 'g_2' are the two gradients, 'r' is the rate of change of grade (%) per chain, the length of the vertical curve will be
(a) $\left(\frac{g_1+g_2}{r^2}\right)$ (b) $\left(\frac{g_1-g_2}{\sqrt{r}}\right)$
(c) $\left(\frac{g_1-g_2}{r}\right)$ (d) $\frac{\sqrt{g_1+g_2}}{r^3}$

Q.15 The lengths of long chord and tangents of a circular curve are equal for a deflection angle of
(a) 30° (b) 60°
(c) 90° (d) 120°

Q.16 The radius of a simple circular curve is 300 m and the length of its specified chord is 30 m. The degree of the curve is
(a) 5.73° (b) 5.37°
(c) 3.57° (d) 3.75°

Q.17 The shift of a circular curve is given by
(a) $\frac{L^2}{6R}$ (b) $\frac{L}{24R}$
(c) $\frac{L^2}{24R}$ (d) $\frac{L}{6R}$
Where, L = Length of transition curve
R = Radius of circular curve

Q.18 The versed sine of a curve is
(a) the distance between the vertex and tangent point
(b) the distance between vertex and apex of a curve
(c) the distance between apex of a curve and mid-point of a long chord
(d) the distance between vertex and mid-point of long chord

Q.19 Setting out a circular curve by the two theodolite method involves:
(a) Linear measurements only
(b) Angular measurement only
(c) Both angular and linear measurements
(d) Linear, Angular and elevation measurements

Q.20 Two bubble tube A and B are filled with water and alcohol respectively. Which of the following is the correct statement?
(a) Sensitivity of B is more than A
(b) Sensitivity of A is more than B
(c) Sensitivity of A and B are same
(d) All of these

Q.21 The ends of a 4° circular curve are to be joined with the straights, using a transition curve of 150 m length. The radius of curvature of the curve will be about
(a) 430 m (b) 286 m
(c) 143 m (d) 586 m

Q.22 Which of the following is the radius of 1° curve?
(a) 1719 m (b) 1179 m
(c) 1779 m (d) None of these

Q.23 The linear method of laying out a simple circular curve is
(a) Rankine's method of deflection angle
(b) Two theodolite method
(c) Tacheometric method
(d) Chain and tape method

Q.24 If the degree of a curve (specified length 30 m) is 3°, the radius of curve is approximately
(a) 382 m (b) 573 m
(c) 1910 m (d) none of these

Q.25 If 0.8% grade meets –0.7% grade and the rate of change of grade for 30 m distance is 0.05, the length of vertical curve (in m) will be
(a) 600 (b) 700
(c) 800 (d) 900

Q.26 If D is the degree of the curve of radius R, the exact length of its specified chord is
(a) $R\times\sin\frac{\theta}{2}$ (b) $2R\times\sin\frac{\theta}{2}$
(c) $2R\times\cos\frac{\theta}{2}$ (d) $2R\times\tan\frac{\theta}{2}$

Q.27 If Δ is the angle of deflection of a simple curve of radius R, the length of the curve is
(a) $\frac{\pi R\Delta}{90°}$ (b) $\frac{\pi R\Delta}{180°}$
(c) $\frac{\pi R\Delta}{270°}$ (d) $\frac{\pi R\Delta}{360°}$

Q.28 The ratio of the length of long chord and the tangent length of a circular curve of radius R and deflecting angle is
(a) $2\sin\frac{\Delta}{2}$ (b) $2\cos\frac{\Delta}{2}$
(c) $\cos\frac{\Delta}{2}$ (d) $\sin\frac{\Delta}{2}$

Q.29 The distance between the point of intersection of an upgrade g_1% and downgrade g_2% and the highest point of the vertical curve of length L is
(a) $\frac{L(g_1-g_2)}{400}$ (b) $\frac{L(g_1+g_2)}{400}$
(c) $\frac{L(g_1+g_2)}{800}$ (d) $\frac{L(g_1-g_2)}{800}$

Q.30 The ratio of the radius and apex distance of curve deflecting through $\Delta°$, is
(a) $\left(\sec\frac{\Delta}{2}-1\right)$ (b) $\left(1-\sec\frac{\Delta}{2}\right)$
(c) $\left(\cos\frac{\Delta}{2}-1\right)$ (d) $\left(\tan\frac{\Delta}{2}-1\right)$

Q.31 If the radius of a simple curve is 600 m, the maximum length of the chord for calculating offset is
(a) 20 m (b) 30 m
(c) 15 m (d) 35 m

Q.32 If the sight distance (S) is equal to the length of vertical curve ($2l$) joining two grade g_1, g_2, height of apex is
(a) $\frac{(S-L)}{400}(g_1-g_2)$ (b) $\left(\frac{g_1-g_2}{400}\right)l$
(c) $\frac{(g_1-g_2)S^2}{1600L}$ (d) None of these

Q.33 A circular curve of radius 200 m and 65° deflection angle. The apex distance of circular curve using 30 m chord length is
(a) 47.31 m (b) 40.13 m
(c) 37.13 m (d) 39.31 m

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Answers : Circular Curve

1. (a)	2. (d)	3. (a)	4. (b)	5. (c)	6. (d)	7. (c)	8. (d)	9. (a)	10. (b)
11. (d)	12. (d)	13. (d)	14. (c)	15. (d)	16. (a)	17. (c)	18. (c)	19. (b)	20. (a)
21. (a)	22. (a)	23. (d)	24. (b)	25. (d)	26. (b)	27. (b)	28. (b)	29. (d)	30. (a)
31. (b)	32. (b)	33. (c)							

Explanations : Circular Curve

5. (c)

For 20 m arc $R = 1145.9/D$

For 30 m arc $R = 1718.9/D$

10. (b)

Length of vertical curve

$$L = \frac{1.5-(-0.5)}{0.2} \times 20 = 200 \text{ m}$$

12. (d)

$$A = r^2 - \frac{\pi r^2}{4} = (100)^2\left(1-\frac{\pi}{4}\right) = 2146 \text{ m}^2$$

13. (d)

Length of vertical curve

$$= \frac{0.7-(-0.6)}{(0.05/20)} = 520 \text{ m}$$

Length of curve on either side of the apex

$$= \frac{520}{2} = 260 \text{ m}$$

Chainage of I-tangent point i.e. point of curve
= 1000 – 260 = 740 m
Chainage of II-tangent point
= 1000 + 260 = 1260 m

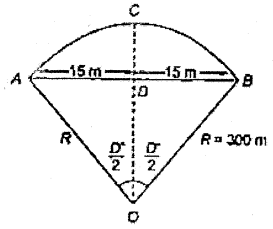
15. (d)

The length of long chord (L) = $2R\sin\frac{\Delta}{2}$ and the length of tangent (T) = $R\tan\frac{\Delta}{2}$

when $L = T$

$$\Rightarrow 2R\sin\frac{\Delta}{2} = R\tan\frac{\Delta}{2} \Rightarrow \Delta = 120^\circ$$

16. (a)



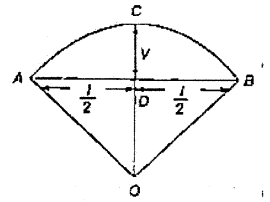
In ΔADO, $\sin\left(\frac{D}{2}\right)^\circ = \frac{15}{300} = 0.05$

$$\left(\frac{D}{2}\right)^\circ = 2.87^\circ$$

$$D^\circ = 5.73^\circ$$

Hence option (a) is correct.

18. (c)



CD = Versine of curve = V

Using property of circle,

$$\frac{l}{2}\times\frac{l}{2} = V(2R-V)$$

$$\Rightarrow \frac{l^2}{4} = 2RV - V^2$$

$$\Rightarrow V \simeq \frac{l^2}{8R} \quad [\because V^2 \ll 2RV]$$

20. (a)

Sensitivity of bubble tube depends upon viscosity of liquid

Viscosity of water

$$= 8.90 \times 10^{-4} \text{ N-s/m}^2$$

Viscosity of alcohol

$$= 5.6 \times 10^{-4} \text{ N-s/m}^2$$

Hence sensitivity of B (less viscous) will be more than A.

21. (a)

Degree of curve,

$$D^\circ = \frac{1720}{R}$$

$$4 = \frac{1720}{R}$$

$$R = \frac{1720}{4} = 430 \text{ m}$$

Hence option (a) is correct.

22. (a)

Degree of curve,

$$D^\circ = \frac{1719}{R}$$

$$1 = \frac{1719}{R}$$

$$\therefore \quad R = 1719 \text{ m}$$

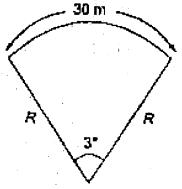
Hence option (a) is correct.

23. (d)

Rankine's method, two theodolite method and tacheometric method are angular method.

24. (b)

$D^\circ = 3^\circ$ (for 30 m chain)



$$\frac{2\pi R}{360} = \frac{30}{30}$$

$$\therefore \quad R = \frac{360\times 30}{2\pi\times 3} = 573 \text{ m}$$

Hence option (b) is correct.

25. (d)

$$L = \frac{0.8-(0.7)}{0.05}\times 30 = 30\times 30 = 900$$

32. (b)

$$L = \frac{(g_1-g_2)S^2}{800h}$$

$$\therefore \quad h = \frac{(g_1-g_2)S^2}{800L} \quad [\because S = L]$$

$$= \frac{(g_1-g_2)L}{800} = \frac{(g_1-g_2)l}{400} \quad (\because L = 2l)$$

33. (c)

Chord length = 30 m

$$R\times D\times\frac{\pi}{180^\circ} = 30$$

or, $$D = \frac{30\times 180^\circ}{R\times\pi} = 8.595^\circ$$

$$\text{Apex distance} = R\left(\sec\frac{\Delta}{2}-1\right)$$

$$= 200\left(\sec\frac{65^\circ}{2}-1\right)$$

$$= 37.13 \text{ m}$$

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