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CHAPTER

Surveying and Geology

Tacheometry

Q.1 **Assertion A :** The object of providing an additional concave lens in the telescope, in a tacheometer is to eliminate the additive constant
Reason R : The anallactic lens absorbs some of the incident light and to compensate this and to increase the illumination, a larger object glass is required
(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.2 If the intercept on a vertical staff is observed as 0.75 m from a tacheometer, the horizontal distance between tacheometer and staff station is
(a) 7.5 m (b) 25 m
(c) 50 m (d) 75 m

Q.3 If the focal length of the object lens is 25 cm and the distance from object lens to the trunnion axis is 15 cm, the additive constant is
(a) 0.1 (b) 0.4
(c) 0.6 (d) 1.0

Q.4 If the spacing of cross hairs in a stadia diaphragm of a tacheometer is 1.2 mm and the focal length of object glass is 24 cm, then the multiplying constant of tacheometer is
(a) 50 (b) 100
(c) 150 (d) 200

Q.5 In an external focussing tacheometer, the fixed interval between stadia hairs is 5 mm; the focal length of the objective is 25 cm and the distance of the vertical axis of the instrument from the optical centre of the objective is 15 cm. Which one of the following is the set of constants of the tacheometer?
(a) 30, 0.15 (b) 30, 0.40
(c) 50, 0.25 (d) 50, 0.40

Q.6 The tachometer focal length of object glass is 20 cm, the distance between the object glass and trunnion axis is 10 cm and the spacing between the outer lines of diaphragm axis is 4 mm. If the staff intercepts are 1.000 (top) and 2.500 (middle) when the line of collimation is perfectly horizontal, then the horizontal distance between the staff station and instrument station will be
(a) 75.3 m (b) 78 m
(c) 150.3 m (d) 153 m

Q.7 If a tacheometer is fitted with an anallatic lens
(a) additive constant is 100, multiplying constant is zero
(b) multiplying constant is 100, additive constant is zero
(c) both multiplying and additive constants are 100
(d) both multiplying and additive constants are 50

Q.8 The staff intercepts on a vertically held staff at a distance of 50 m and 200 m were found to be 0.49 m and 1.99 m respectively. The constants of instrument used are
(a) $K = 101$ and $C = 1$
(b) $K = 100$ and $C = 0$
(c) $K = 101$ and $C = 0$
(d) $K = 100$ and $C = 1$

Q.9 The multiplying constant of a tacheometer is given by
(a) $\frac{f}{i}$ (b) $\frac{i}{f}$
(c) $(f + d)$ (d) $\frac{f}{d}$

Where,
f = Focal length of the objective
d = Distance between objective and vertical axis
i = Stadia interval

Q.10 Tacheometric formula for horizontal distances using inclined sights through angle θ is obtained by multiplying :
(a) the constants by $\sin^2\theta$
(b) the constants by $\cos^2\theta$
(c) the constants by $\cos\theta$
(d) the multiplying constant by $\cos^2\theta$ and additive constant by $\cos\theta$

Q.11 In the movable hair method of tacheometric surveying
(a) the staff intercept vary
(b) the stadia interval is constant
(c) both the staff intercept and stadia interval are constant
(d) none of the above

Q.12 If the focal length of a tacheometer is 20 cm, stadia interval is 2.5 mm and the distance between the vertical axis and the lens is 20 cm, the multiplying constant and additive constant will be respectively
(a) 100 and 1 (b) 100 and 0.4
(c) 80 and 0.4 (d) 80 and 0.5

Q.13 The value of multiplying constant of a tacheometer is kept about
(a) 1000 (b) 1.0
(c) 0.5 (d) 100

Q.14 The additive and multiplying constants of a tacheometer, respectively, are
(a) $(f + d)$ and $\frac{f}{d}$ (b) f and $\frac{f}{i}$
(c) $(f + i)$ and $\frac{f}{d}$ (d) $(f + d)$ and $\frac{f}{i}$
where f = focal length of objective, i = stadia interval and d = distance between the objective lens and axis of theodolite

Q.15 Tilt of the staff in stadia tacheometry increases the intercept if it is
(a) away from the telescope pointing down hill
(b) towards the telescope pointing up hill
(c) away from the telescope pointing up hill
(d) None of these

Q.16 In a telescope, the object glass of focal length 14 cm, is located at 20 cm from the diaphragm. The focussing lens is midway between them when a staff 16.50 m away is focussed. The focal length of the focussing lens is
(a) 5.24 cm (b) 6.24 cm
(c) 7.24 cm (d) 8.24 cm

Q.17 If vertical angles of inclined sight do not exceed 10° and non-vertically if the staff remains with 1°, stadia system of tacheometric observation are made on
(a) staff normal
(b) staff vertical
(c) staff normal as well vertical
(d) None of these

Q.18 Tacheometric formula for horizontal distance using horizontal sights can also suitably be employed for inclined sights through θ by multiplying
(a) $\sin^2\theta$ (b) $\cos^2\theta$
(c) $\cos\theta$ (d) All of these

Q.19 In tacheometric observations, vertical staff holding is generally preferred to normal staffing, due to
(a) minimum effect of careless holding on the result
(b) ease of reduction of observations
(c) facility of holding
(d) None of those

Q.20 Which of the following represents a correct match?
1. **Moveable hair method :**
The intercept on levelling staff is kept constant and stadia hair interval is variable.
2. **Fixed hair method :**
The intercept on levelling staff is variable and stadia hair interval is fixed.
3. **Tangential hair method:**
The stadia hairs are not used.

(a) only 3 is correct
(b) only 1 and 2 are correct
(c) All 3 are correct
(d) None of them is correct

Q.21 To measure a line *AB*, a theodolite was set up at *A* and subtense bar of length 2 m was setup at *B*. The horizontal angle measured of *A* for the subtense bar targets was 4° 02' 26.4". The length of *AB* is
(a) 26.438 m (b) 25.438 m
(c) 27.348 m (d) 28.348 m

Q.22 The instrument is fitted with anallactic lens and staff is held vertical. The vertical angle upto which sloping distance may be assumed to be horizontal so that the errors may not exceed 1 in 300 is
(a) 4° 14' 16" (b) 2° 18' 14"
(c) 3° 18' 14" (d) 4° 16' 14"

Q.23 Two vanes are fixed at an interval of 1 m on a 3 m staff with bottom vane at 1 m in tangential method of tacheometry. The staff was held vertical at station A and vertical angles measured for two vanes were 5° 30' and 3° 15' respectively. The reduced level of point A (station) if the RL of a B.M. was 400 m is
(a) 400.313 m (b) 400.137 m
(c) 400.173 m (d) 400.437 m

Q.24 A point 3000 m away from the instrument is used to sight a vane 3.0 m above the foot of a staff. The observed angles of elevation was 2° 30'. The reduced level of trunion axis being 200 m. The reduced level of staff station is (consider correction for curvature and refraction)
(a) 327.952 m (b) 327.5857 m
(c) 328.5857 m (d) 328.9520 m

Q.25 The stadia readings with horizontal sight on a vertical staff held 50 m from tacheometer were 1.285 m and 1.780 m. The focal length of the object glass was 25 cm. The distance between the object glass and vertical axis of tacheometer was 15 cm. The stadia interval is
(a) 3.49 m (b) 2.49 m
(c) 3.39 m (d) 4.39 m

Q.26 Match List-I (instrument and List-II (use) and select the correct answer.

List-I
A. Subtense bar
B. Sextant
C. Tangent clinometer
D. Range finder

List-II
1. To determine difference in elevation b/w points
2. To determine horizontal distance
3. To measure angles
4. To establish right angles

Codes:

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

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Answers Tacheometry

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

Explanations Tacheometry

2. (d)
As we know
$$D = ks + C$$
Now, for a tacheometer
$$C = 0$$
and $k = 100$
$$\therefore \quad D = 100 \times 0.75 + 0$$
$$= 75 \text{ m}$$

3. (b)
Additive constant = $f + d = 0.25 + 0.15 = 0.40$

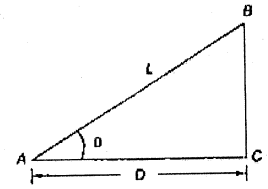
4. (b)
$$\text{Multiplying constant} = \frac{f}{i} = \frac{24}{2 \times 0.12} = 100$$

5. (d)
For a tacheometer multiplying constant,
$$k = \frac{f}{i} = \frac{25}{0.5} = 50$$
Additive constant,
$$C = f + d$$
$$= 0.25 + 0.15 = 0.40$$

8. (d)
$$D_1 = 50 = 0.49\ K + C \quad \text{...(i)}$$
$$D_2 = 200 = 1.99\ K + C \quad \text{...(ii)}$$
On solving (i) and (ii) we get,
$K = 100$ and $C = 1$

9. (a)
Horizontal distance of the staff from the vertical axis of instrument is given by
$$D = kS + C$$
where, k = multiplying constant
$$= \frac{f}{i}$$
C = Additive constant
$$= (f + d)$$
where, f = focal length of objective
i = stadia interval
d = distance between the objective lens and axis of theodolite
Hence option (a) is correct.

10. (d)



For incline line of sight,
$$L = k(S \cos \theta) + C$$
Horizontal distance,
$$D = L \cos\theta$$
$$D = k(S \cos\theta) \cos\theta + \cos\theta\ C$$
$$D = \cos^2\theta\ kS + \cos\theta\ C$$
Hence option (d) is correct.

11. (d)
In the movable hair method, staff intercept (S) is kept fixed and stadia interval (i) is varied.
Hence none of the above i.e., option (d) is correct.

12. (c)
Given, $f = 20 \text{ cm} = 0.20 \text{ m}$
$i = 2.5 \text{ mm} = 0.0025 \text{ m}$
$d = 20 \text{ cm} = 0.20 \text{ m}$
We know,
Multiplying constant,
$$k = \frac{f}{i}$$
and additive constant,
$$C = f + d$$
$$\therefore \quad k = \frac{0.20}{0.025} = 80$$
and $C = 0.20 + 0.20 = 0.40 \text{ m}$
Hence option (c) is correct.

13. (d)
Multiplying constant, $k = \frac{f}{i}$, is kept about 100.
Hence option (d) is correct.

14. (d)

Horizontal distance of the staff from the vertical axis of instrument is given by

$$D = kS + C$$

where k = multiplying constant

$$= \frac{f}{i}$$

C = Additive constant

$= (f + d)$

Where, f = focal length of objective

i = stadia interval

d = distance between the objective lens and axis of theodolite

Hence option (d) is correct.

21. (d)

In subtense tachometry, horizontal distance is given by

$$AB = \frac{b}{2}\cot\left(\frac{\theta}{2}\right)$$

$$= \frac{2.0}{2}\cot\left(\frac{1°02'26.4''}{2}\right)$$

$$= 28.348 \text{ m}$$

22. (c)

Let the vertical angle be θ

True horizontal distance,

$$D = Ks\cos^2\theta$$

Sloping distance, $L = Ks$

$$\frac{\text{Sloping distance}}{\text{Horizontal distance}} = \frac{Ks}{Ks\cos^2\theta} = \sec^2\theta$$

Permissible error is 1 in 300, hence

$$\frac{L}{D} = \frac{300+1}{300} = \frac{301}{300}$$

$$\Rightarrow \quad \sec^2\theta = \frac{301}{300}$$

or, $\theta = 3° 18' 14''$

23. (d)

$$D = \frac{S}{(\tan\theta_1 - \tan\theta_2)}$$

$$= \frac{1}{\tan 5°30' - \tan 3°15'}$$

$$= 25.313 \text{ m}$$

$$V = D\tan\theta_2 = 25.313 \times \tan 3° 15'$$

$$= 1.4370 \text{ m}$$

RL of A = 400 + 1.4370 – 1

= 400. 437 m

24. (c)

Let '0' be instrument station and A be staff station.

$V = 3000 \tan 2° 30' = 130.98$ m

Correction $C = 0.0673\ D^2$ = where D is in km

$= 0.0673 \times (3)^2 = 0.6057$ m

Hence RL of staff station A

= RL of '0' + HI + V – 3 + C

= RL of instrument axis + V – 3 + C

= 200 + 130.98 – 3 + 0.6057

= 328.5857 m

25. (b)

$C = f + d$

$= 5 + 15 = 40$ cm $= 0.40$ m

$S = 1.780 - 1.285 = 0.495$ m

Now, $D = \frac{f}{i}S + (f + d)$

$$50 = \frac{0.25}{i} \times 0.495 + 0.40$$

$$\Rightarrow \quad i = 2.49 \times 10^{-3} \text{ m} = 2.49 \text{ mm}$$

26. (c)

Sextant is to measure angle. Subtense bar is used to determine horizontal distance and clinometer is used to determine difference in elevation b/w points.

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