GEOMATICS ENGINEERING TEST 2

Number of Questions: 30 **Time: 75 min.**

Directions for questions 1 to 30: Select the correct alternative from the given choices.

1. A closed contour line with one or more higher contour lines inside represents
(A) cliff (B) hill
(C) valley (D) cave

2. Any convenient direction towards a permanent and prominent mark is called
(A) True meridian (B) Magnetic meridian
(C) Arbitrary meridian (D) None of the above

3. Theodilite is a measuring device which is included under category of
(A) First order measurements
(B) Second order measurements
(C) Third order measurements
(D) Fourth order measurements

4. A tape is standardized at 100N pull. If the load applied is 120N the sag correction
(A) $L_1\ W_1^2\ (1.12 \times 10^{-6})$
(B) $L_1\ W_1^2\ (1.273 \times 10^{-6})$
(C) $L_1\ w_1^2\ (1.73 \times 10^{-6})$
(D) $L_1\ W_1^2\ (1.53 \times 10^{-6})$

5. The long and short sides of a rectangle measure 9.32 m and 4.82 m, with errors ± 5 mm. Express the area of correct number of significant figures
(A) 44.98 m^2 (B) 44.96 m^2
(C) 44.92 m^2 (D) 44.85 m^2

6. An offset is laid out 3° from its true direction of the field. If the scale of plotting is 10 m to 1 cm, find the maximum length of offset so that the displacement of the point on paper may not exceed 0.25mm.
(A) 4.43 (B) 4.58
(C) 4.23 (D) 4.77

7. The combined correction of curvature and refraction for distance of 1.29 km is
(A) 0.234 m (B) 0.121 m
(C) 0.112 m (D) 0.187 m

8. The observation ray between two triangulation stations *A* and *B* just grazes the sea. If the heights of *A* and *B* are 6000 m and 2000 m respectively, the distance *AB* is (Let radius of earth *R* = 6440 km)
(A) 432.4 km (B) 438.3 km
(C) 450.2 km (D) 442.4 km

9. The constant for an instrument is 750, the value of *C* = 0.3 m and intercept *S* = 2 m. The distance from instrument to the staff when the micrometer readings are 4.326 and 4.283 and the line of sight is at +8° 361 when the staff was held vertical is
(A) 172.4 m (B) 173.2 m
(C) 174.8 m (D) 170.8 m

10. The survey which is done for fixing the property lines is known as
(A) Topographical survey
(B) Cadastral survey
(C) City survey
(D) Astronomical survey

11. The volume of 130 m long road of formation width 10 m, side slopes 1 : 1, average depth of cutting along center of line is 5m and slopes of ground in cross-section is 10 to 1 is
(A) 9880 m^3 (B) 9723 m^3
(C) 9624 m^3 (D) 9892 m^3

12. In a region with magnetic declination of 4°E, the magnetic fore bearing (*FB*) of a line *AB* was measured as N 82° 50^1 E. There was a local attraction at *A*. To determine the correct magnetic bearing of the line, a point *O* was selected at which there was no local attraction. The magnetic *FB* of line *AO* and *OA* were observed to be S 42° 40^1 E and N 48° 20^1 W respectively. What is the true *FB* of line *AB*?
(A) N 81° 50’ (B) N 82° 10’ E
(C) N 79° 30’ E (D) N 84° 10’ E

13. The length of the tape is 30 m and the sag is 30.35 cm at the mid span under a tension of 100 N, the weight of the tape is
(A) 0.248 N/m (B) 0.269 N/m
(C) 0.326 N/m (D) 0.459 N/m

14. Two distances of 30 and 100 meters were accurately measured out and the intercepts on the staff between the outer stadia webs were 0.176 m at the former distance and 0.892 m at the latter. The tacheometric constant *K* is
(A) 100 (B) 97.7
(C) 95 (D) 96.2

15. A flag staff of 2 m height was erected on topic of hill (*Q*) and the observations were made from two stations *P* and *R*, 50 meters apart. The horizontal angle measured at *P* between *R* and top of flag staff was 50° 30’ and that measured at *R* between the top of the flag-staff *P* was 50° 18’. Angle of elevation to top of staff was measured to be 10° 12^1 at *P*. The angle of elevation to top of flag staff and was measured to be 10° 48’ at *R*. Staff readings on *B.M* when the instrument was at *P* = 1.826 m and that with the instrument at *R* = 2.285 m. The elevation of the top of hill *Q* if the *BM* was 485.065 m is
(A) 485.36 m (B) 488.32 m
(C) 494.22 m (D) 498.32 m

16. Match the following

	List – I		List – I
i.	Correction for standard length	a.	$C_a = \frac{L.c}{l}$
ii.	Correction for tension	b.	$C_p = \frac{(P - P_o)}{AE}L$
iii.	Sag correction	c.	$C_t = \alpha(T_m - T_o)L$
iv.	Correction for Temperature	d.	$C_{sa} = \frac{W^2L}{24P^2}$

	i	ii	iii	iv		i	ii	iii	iv
(A)	d	a	b	c	(B)	a	b	d	c
(C)	d	c	b	a	(D)	c	a	b	d

17. (i) Optical square is better than prism square.
(ii) In both optical and prism squares, the principle of operation is same.
(A) only (i) is correct
(B) only (ii) is correct
(C) Both (i) and (ii) are correct
(D) None of the above

18. Match the following

	List – I		List – II
i.	Vertical cliff	a.	contour lines of different elevations unite to form one line
ii.	Steep slope	b.	contour lines of different elevations cross one another
iii.	Hill	c.	Contour lines are closely spaced
iv.	Overhanging cliff	d.	closed contour lines with higher values inside them

	i	ii	iii	iv
(A)	d	c	a	b
(B)	a	c	d	b
(C)	a	b	d	c
(D)	d	b	a	c

19. A Circular curve has 300 m radius and 55° deflection angle, then the apex distance is
(A) 38.23m (B) 38.21m
(C) 39.23m (D) 40.24m

20. The length of mid ordinate in the above question is
(A) 37.23m (B) 38.62m
(C) 33.89m (D) 32.43m

21. Find the area between line *AB* and the stream taken at a regular interval of 30 m along line *AB*, using simpson's rule.

Distance	0	30	40	90	120	150	180	210	240
Offset length	23	40	42	30	32	60	10	14	22

(A) 7980 m^2 (B) 6352 m^2
(C) 5652 m^2 (D) 4734 m^2

Common Data for Questions for 22 and 23:
In reciprocal levelling, the following readings are taken.

Instrument station	Staff reading		
	A	B	
A	1.286	2.768	Distance AB = 1150 m
B	1.292	2.432	RL of A = 100 m Collimation error = $\frac{0.003}{150m}$

22. The correction for collimation is
(A) 0.021 (B) 0.048
(C) 0.023 (D) 0.032

23. Correction for refraction is
(A) 1.33m (B) 1.34m
(C) 1.38m (D) 1.29m

24. The following observations were taken during testing of a dumpy level *s*

Instrument at	Staff readings at	
	A	B
A	1.342	2.125
B	1.485	1.683

If *A* and *B* are 100 m apart the angle of inclination of line of collimation is
(A) 14' 15.50' (B) 12' 23.30'
(C) 10' 2.29' (D) 13^1 3.40'

25. The distance between two points *A* and *B* by tachometer fitted with anallactic lens which made a vertical angle of +10° 46' and staff intercept of 1.763 m. Later on the constants of instrument were changed to 100 and 0.5. The percentage error is computed horizontal distance is
(A) 0.287% (B) 0.321%
(C) 0.262% (D) 0.213%

26. In a quadrilateral ABCD, the coordinates of points are as follows

Point	East	North
A	0	0
B	0	–842.8
C	600.1	742.8
D	1023.4	659.3

The area of the figure is
(A) 4.68 hectares (B) 7.06 hectares
(C) 9.12 hectares (D) 12.51 hectares

27. The incorrect statement among the following is
(A) The direction of magnetic meridian is variable
(B) The direction of true meridian is invariable
(C) The magnetic bearing of line varies with time
(D) Magnetic meridian through various stations are not parallel but converge at poles

28. After surveying an area with plane table at a station it was detected that the centering of the instrument was not done accurately. The displacement of the plotted point at right angles to the ray was 20 cm. The scale used was 1 cm = 20 m. Determine the error in the plotted position of the point (in cm)

(A) 0.03 (B) 0.04
(C) 0.01 (D) 0.02

29. To continue a survey line *AB* past an obstacle, a 400 m long line *BC* was set out perpendicular to *AB* and from *C* angles *BCD* and *BCE* were set out 60° and 45° respectively. Determine the lengths which must be chained off along *CD* and *CE* in order that *ED* may be in line with *AB* produced.

(A) 747 m, 620.4 m (B) 827 m, 580.3 m
(C) 800 m, 565.6 m (D) 852 m, 648.3 m

30. Match the following related to Electromagnetic distance measurement (EDM)

i.	short range	a.	less than 3km
ii.	Medium range	b.	less than 100km
iii.	long range	c.	less than 25km

	i	ii	iii
(A)	b	c	a
(B)	a	c	b
(C)	c	a	b
(D)	a	b	c

Answer Keys

1. B	**2.** C	**3.** B	**4.** B	**5.** C	**6.** D	**7.** C	**8.** B	**9.** D	**10.** B
11. A	**12.** C	**13.** B	**14.** B	**15.** C	**16.** B	**17.** C	**18.** B	**19.** B	**20.** C
21. D	**22.** C	**23.** A	**24.** C	**25.** A	**26.** B	**27.** D	**28.** C	**29.** C	**30.** B

Hints and Explanations

1. A closed contour line with one or more higher ones inside represents a hill. Choice (B)

2. Any convenient direction towards a permanent and prominent mark is called Arbitrary meridian. Choice (C)

3. The odilite is included under second order measurements. Choice (B)

4. Total sag correction = Sag correction for 100N pull – Sag correction for 120 N pull

$$= \frac{L_1 W_1^2}{24(100)^2} - \frac{L_1 W_1^2}{24(120)^2}$$

$$= \frac{L_1 W_1^2}{24}\left[\frac{1}{100^2} - \frac{1}{120^2}\right]$$

$= L_1 W_1^2\ (1.273 \times 10^{-6})$. Choice (B)

5. $A = 9.32 \times 4.82 = 44.92\ m^2$

Maximum error in individual measurements = 0.005 m

$$\therefore \quad \text{error ratios are} = \frac{\Delta L}{L} = \frac{0.005}{9.32} = \frac{1}{1864} \text{ and}$$

$$\frac{\Delta b}{b} = \frac{0.005}{4.82} = \frac{1}{964}$$

$$\delta A = 44.92\left[\frac{1}{1864} + \frac{1}{964}\right] = \pm 0.07\ m^2$$

Hence the area limits can be $44.92 + 0.07 = 44.99\ m^2$

$44.92 - 0.07 = 44.85\ m^2$

The compatible area is $44.92\ m^2$. Choice (C)

6. Displacement of point on the paper

$$= \frac{L \sin \propto}{S} = \frac{L \sin 3^o}{10} \text{cm}$$

This should not exceed 0.025 cm

$$\frac{L \sin 3^o}{10} = 0.025$$

$L \sin 3° = 0.025 \times 10$

$L = 4.77$ m. Choice (D)

7. Combined correction = $0.06728\ (1.29)^2 = 0.1196$ m. Choice (C)

8. $C_1 = A^1 A = 6$ km

Radius of earth (R) = 6440 km

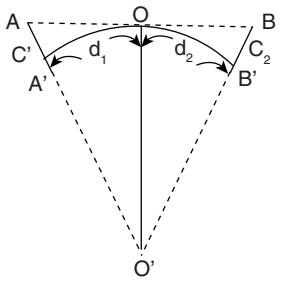
$C_2 = B^1 B = 2$ km

Correction of curvature

$$C_1 = \frac{d_1^2}{2R}$$

Distance $d_1 = \sqrt{2 \times R \times C_1}$

$$d_1 = \sqrt{2 \times 6440 \times 6} = 277.9 \text{ km}$$



Distance $d_2 = \sqrt{2 \times R \times C_2} = \sqrt{2 \times 6440 \times 2}$

$= 160.49$ km $= OA + OB = OA' + OB'$

Distance $AB = d_1 + d_2 = 438.3$ km. Choice (B)

9. The sum of micrometer reading = 4.326 + 4.283 = 8.609

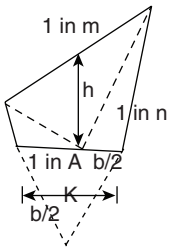
$$D = \frac{K.S}{n}\cos^2\theta + \cos\theta \text{ ⩾ 1 (one)}$$

$$= \left[\frac{750 \times 2}{8.609} \times \cos^2\left(8^o\,36^1\right)\right] + [0.3 \times \cos(8°\,36^1)]$$

$= 170.6$ m. Choice (D)

10. Cadastral survey is the survey in which fixing of property lines is done. Choice (B)

11.



$$A = \frac{n\left(\frac{b}{2}\right)^2 + m^2\left(bh + nh^2\right)}{m^2 - n^2}$$

Where $n = 1$, $m = 10$, $h = 5$, $b = 10$

$$\therefore \quad A = \frac{1\left(\frac{10}{2}\right)^2 + 10^2\left(10 \times 5 + 1 \times 5^2\right)}{10^2 - 1^2} = 76 \text{ m}^2$$

$V = A \times L = 76 \times 130 = 9880$ m^3. Choice (A)

12. Declination (D) = 2° E

Magnetic $F.B.$ of AB = N82° 50′ E = 82° 50′

Correct $F.B$ of OA = N48° 20′ W = 311° 40′

∴ Correct $B.B$ of OA = 131° 40′ = True variation (as O is free from local attraction) In general, $F.B.$ of $AO = B.B.$ of OA.

But $F.B.$ of $AO = S42°40'$ E = 137°20′. ≠ 131°40′.

As A has local attraction,

∴ Magnetic variation = 137°20′ ($F.B.$ of AO)

∴ Error = Magnetic variation – True Variation

= 137°20′ – 131°40′ = 540°.

Therefore Correction = –5°40′

True $F.B.$ of line AB = 2°50′+2°–5°40′

= 79°10′ = N79°10′E. Choice (C)

13. For sag $h = \frac{wL_1d_1}{8P}$

Here $L_1 = d_1$ (Considering approximately) as not given

$h = 30.35$ cm $= 0.3035$ m

$$\therefore \quad 30.35 = \frac{wL_1^2}{8P}$$

$$\Rightarrow \quad w = \frac{0.3035 \times 8 \times 100}{30 \times 30}$$

$= 0.269$ N/m. Choice (B)

14. In the first observation

$30 = K \times S + C$

$\therefore \quad 30 = K \times (0.176) + C$ ——— (1)

In the second observation

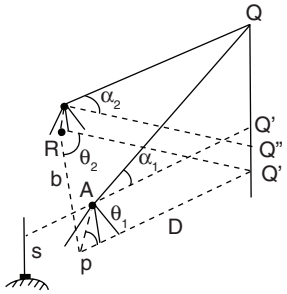
$100 = K \times (0.892) + C$ ——— (2)

Subtracting equations (2) – (1)

$K(0.892 - 0.176) = 100 - 30$

$K = 97.7$ Choice (B)

15.



$b = 50$ m, $\theta_1 = 58°\,18'$

$\theta_2 = 50°30'$

$\alpha_1 = 10°12'$

$\alpha_2 = 10°48'$

S = staff readings.

$$PQ_1 = D = \frac{b\sin\theta_2}{\sin(\theta_1 + \theta_2)}$$

$$= \frac{50 \times \sin(50^o30')}{\sin(50^o30' + 58^o18')} = 40.75 \text{ m}$$

$h_1 = D\tan\alpha_1 = (40.75)\tan(10°\,12^1) = 7.33$m

RL of Q = ($R.L$ of instrument axis at P) + h_1

= ($R.L$ of $BM + s$) + h_1

= 485.065 + 1.826 + 7.33

= 494.22 m. Choice (C)

19. The apex distance $= R\left(\sec\frac{\Delta}{2} - 1\right)$

$$= 300\left(\sec\frac{55}{2} - 1\right) = 38.21 \text{ m.}$$ Choice (B)

20. Length of mid ordinate $= R\left(1 - \cos\frac{\Delta}{2}\right)$

$$= 300\left(1 - \cos\frac{55}{2}\right)$$

$= 33.89$ m. Choice (C)

21. $A = \frac{d}{3}\begin{bmatrix}(0_1+0_n)+4(0_2+0_4+....+0_{n-1})\\+2(0_3+0_5+....0_{n-2})\end{bmatrix}$

$= \frac{30}{5}[(23+22)+4(40+30+60+14)+2(42+32+10)]$

$= 4734\ m^2$. Choice (D)

22. Collimation error $= \frac{0.003}{150} \times 1150 = 0.023$ m

Correction for collimation $= -0.023$ m. Choice (C)

23. Correction for refraction

Error due to curvature $(C_c) = 0.0785d^2 = 0.0785(1.15)^2$

$C_c = 0.104$ m

Correction for curvature $C_c = -0.104$ m

Combined correction for curvature and refraction

$= -0.104 + C_R$

Total correction $= -0.023 - 0.104 + C_R$

Corrected staff reading at B

$= 2.768 - 0.023 - 0.104 + C_R$

$= 2.641 + C_R$

Incorrect level difference between A and B at A

$= 2.768 - 1.286 = 1.482$ M

Incorrect level difference between A and B at B

$= 2.432 - 1.292 = 1.14$ m

True difference of level between A and B

$= \frac{1.482+1.14}{2}$ 1.311 m

$2.641 + C_R = 1.311$

$C_R = -1.33$ m. Choice (A)

24. If instrument is at A

Apparent difference of level $= 2.125 - 1.342 = (0.783)$

If instrument is at B

Apparent difference of level $= 1.683 - 1.485 = (0.198)$

True level difference $= \frac{0.783+0.198}{2} = 0.490$

Collimation error when instrument is at B

Correct reading on $B = 1.683$

Correct reading on $A = 1.683 - 0.490 = 1.193$m

The amount of inclination $= 1.485 - 1.193 = 0.292$m

Inclination of line of collimation

$\tan\theta = \frac{0.292}{100} = 2.93\times10^{3}$

$\theta = 10'\ 2.29''$. Choice (C)

25. Case 1:– $K = 100$, $C = 0$

$D = KS\cos^2\theta + C\cos\theta$

$= [100 \times 1.763 \times \cos^2(10° 46^1)] + [0 \times \cos(10° 46^1]$

$= 170.14$ m

Case 2:– $K = 100$, $C = 0.5$

$D = \mathrm{KScos}^2\theta + C\cos\theta$

$= [100 \times 1.763 \times \cos^2(10° 46')]$

$+ [0.5 \times \cos(10° 46')] = 170.63$ m

Percentage error $= \frac{170.63-170.14}{170.14} \times 100$

$= 0.287\%$. Choice (A)

26. Area of quadrilateral $ABCD$

Let $y \rightarrow$ North, $x \rightarrow$ East Area

Area $A = \frac{1}{2}\begin{bmatrix}y_1(x_2-x_4)+y_2(x_3-x_1)\\+y_3(x_4-x_2)+y_4(x_1-x_3)\end{bmatrix}$

$\frac{1}{2}\begin{bmatrix}0(0-10234)-8428\times(600.1-0)\\+7428(10234-1)+659.3(0.600.1)\end{bmatrix}$

$= |-70614.345\ m^2|$

$= 7.0614 \times 10^4 m^2 = 7.06$ hectars Choice (B)

27. Magnetic meridian through various stations are not parallel, so donot converge at poles. Choice (D)

28. Scale is 1 cm = 20 cm

Representative fraction $K = \frac{1}{2000}$

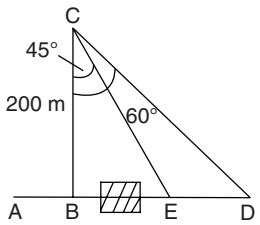
Displacement of the plotted position

$e = 20 \times \frac{1}{2000} = 0.01$ cm < 0.025 cm

As the permissible error in plane table survey is 0.025 cm. The above error is not much significant.

Choice (C)

29.



From ΔBCD

$CD = BC \sec 60° = 400 \sec 60° = 800$ m

From ΔBCE

$CE = BC \sec 45° = 400 \sec 45° = 565.6$ m Choice (C)