11-08-2022. IAT - 2

ADVANCED SURVEY 18CV45

Scheme and Solution

Q1) (i) Perspective projection :- It is the projection produced by straight lines radiating from a common point & passing through a point on the sphere to the plane of projection. A photograph is a perspective projection. (2M)

(ii) Principal point :- It is a point where a perpendicular dropped from the front nodal point strikes the photo graph. It is considered to coinside with the intersection of the x-axis & the y-axis. In the figure, (2M)

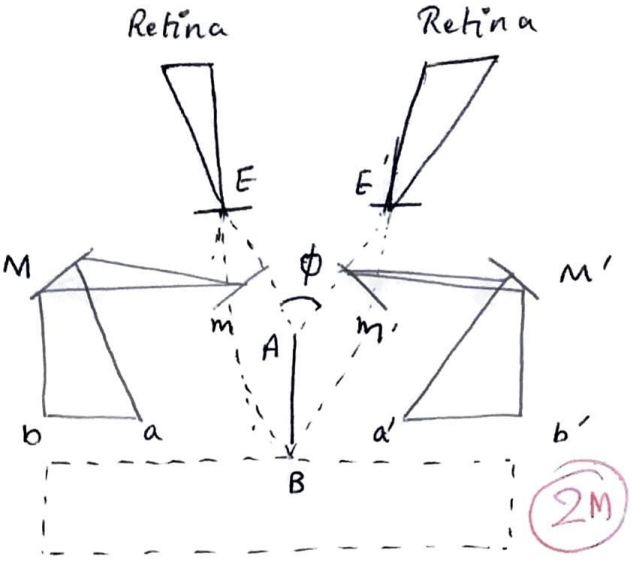
(iii) Principle line :- The line joined by nadir point with principal point in the plane of photograph. (2M)

(iv) Principle plane :- The plane defined by the lens, ground nadir point & ground principal point is called principal plane (2M)

(v) Swing :- It is the angle measured in the plane of the photograph from positive direction of y-axis, clockwise to the nadir point (2M)

Q2) i) Mirror stereoscope :-

As shown in the figure, a mirror stereoscope consists of two plane mirrors m & m' (for the eye piece) & two large wing mirrors M & M' each of which is oriented at 45° to the plane of the photographs.



2M

The camera lens is first placed in the position of the left eye & then later in the position of the right eye & two separate photographs are taken in each position. Here, ab & a'b' are the two separate images of the object AB in the two films.

The total distance bMmE or b'm'm'E' from the eye to the plane of the photographs varies between 30 cm to 45 cm So that the unaided eye can comfortable view the photographs. The angle ϕ is determined by the separation of the photographs that gives the most eye comfort & is compatible with the distance. If this distance is to be reduced, a pair of magnifying lenses are placed at E & E'. Each magnifying lens will have a focal length which is slightly less than bMmE.

3M

ii) Stereoscopic vision :-

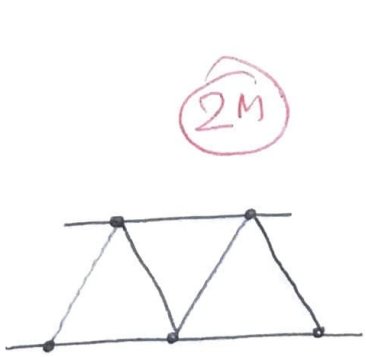
Due to the phenomenon of binocular vision an observer is able to perceive the three dimensions of his field of view. This depth perception of finding the relative distance of objects from the eyes of the observer is called stereoscopic vision (3M)

Q3) Triangulation figures or systems :-

A triangulation figure or system is a group of interconnected network of triangles such that any figure has a side & only one common to each of the preceding & following figures. The common figures are :-

i) Single chain of triangles
ii) Double chain of triangles
iii) Central point figures
iv) Quadrilaterals. (2M)

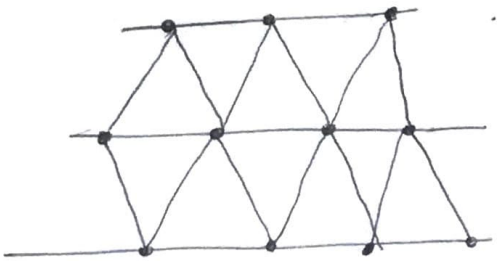
i) Single chain of triangles :-



This system is used when a narrow strip of terrain is to be covered. It is rapid & economical but not so accurate for primary work. If the accumulation of errors is to not excessive, then a number of base line must be introduced. (2M)

ii) Double chain of triangles

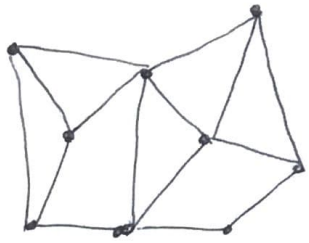
This system is used to cover a greater area



2M

iii) Central point of figures

These figures are used to cover a greater area & gives very satisfactory results in a flat country. The centered figures may be quadrilateral, pentagon, hexagon etc. However, the progress of work will be very slow due to more settings of the instrument.



2M

iv) Quadrilaterals :- Quadrilaterals with four corner stations & observed diagonal forms the best figures. They are best suited for hilly country. This system will be more accurate

2M

(Q4) (i) Let A (X_a, Y_a) & B (X_b, Y_b) be the two ground points having elevation of h_a & h_b above the datum.

Let a (x_a, y_a) & b (x_b, y_b) be the corresponding points on the photograph

Let f = focal length of the lens.

3M

Now, $X_a = \left(\frac{H - h_a}{f}\right) . x_a$, $Y_a = \left(\frac{H - h_b}{f}\right) . y_a$

$X_b = \left(\frac{H - h_b}{f}\right) . x_b$, $Y_b = \left(\frac{H - h_b}{f}\right) . y_b$

3M

Here H = height of exposure station 'o' above the datum

Distance b/w A & B = $L = \sqrt{(X_a - X_b)^2 + (Y_a - Y_b)^2}$

(4M)

(ii) Satellite station :

In order to secure well ~~cordino~~ conditioned triangles or to have better vissibility, objects such as chimney's, church spires, flag poles, towers, light house etc are selected as triangulation stations.

* Such stations can be sighted from other stations but it is not possible to directly occupy the stations by setting up the instrument over such objects. (5M)

* As such, a subsidiary station known as Satellite station (False station or eccentric station) is selected as near to the main station as possible & observations are made to other triangulation stations with the same precision as would have been used in the measurement of angles at the true station.

* These angles are later corrected & reduced to what that would have been if the true station was occupied

* The process of applying corrections to the measured angles due to eccentricity of the station is called "Reduction to Center"

Q5) Classification of triangulation system:

* First order (primary) - to determine the shape & size of the other earth to cover a vast area like a country.
* Second order (Secondary) - Network with in the first order of triangulation & suitted for a specific region or a province
* Third order (Tertiary) - With in the second order triangulation, a network of triangles is formed for detailed engineering & location survey (5M)

Sl No.	Characteristics	1st order	2nd order	3rd order
1.	Length of base lines	8 to 12 km	2 to 5 km	100 to 500 km
2.	Length of sides	16 to 150 km	10 to 25 km	2 to 10 km
3.	Avg triangular error	< 1"	3"	2"
4.	Maximum station closure	≤ 3"	8"	15"
5.	Actual error of base	1 in 50000	1 in 25000	1 in 10000
6.	Probable error of base	1 in 10,00,000	1 in 5,00,000	1 in 250000
7.	Discrepancy blw two measures	$5\sqrt{K}$ mm	$10\sqrt{K}$ mm	$25\sqrt{K}$ mm
8.	Probable errors of the computed distances	1 in 50000 to 1 in 250000	1 in 20000 to 1 in 50000	1 in 5000 to 1 in 20000
9.	Probable error in the astronomical azimuth	0.5"	5"	10"

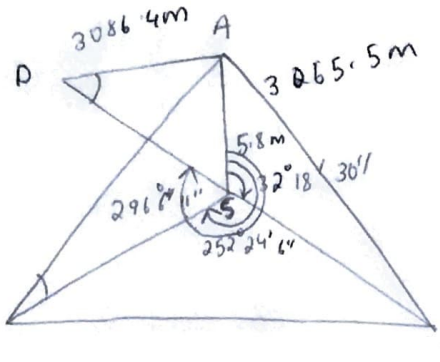
(5M)

Q6) Δ^{le} ASB, by sine rule

$$\frac{5.8}{\sin\alpha} = \frac{3265.50}{\sin 132^\circ 18' 32''}$$

$$\sin\alpha = \frac{5.8 \times \sin 132^\circ 18' 30''}{3265.50}$$

$$\sin\alpha = 1.3135 \times 10^{-3}$$



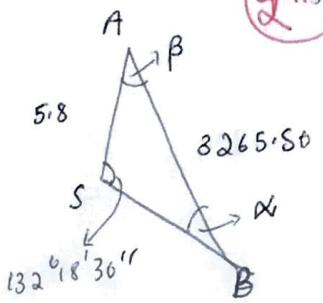
4M

$$\alpha = \sin^{-1}(1.3135 \times 10^{-3}) = 0^\circ 4' 31''$$

$$\beta = 180^\circ - (\alpha + 132^\circ 18' 30'')$$

$$= 180^\circ - (0^\circ 4' 31'' + 132^\circ 18' 30'')$$

$$= 47^\circ 36' 59''$$



∴ Direction of AB = 47° 36' 59" from North

Δ^{le} SCB, $\angle CSB = 232^\circ 24' 6'' - 132^\circ 18' 30'' = 100^\circ 5' 36''$

$\angle ASD = 360^\circ - 296^\circ 6' 11'' = 63^\circ 53' 49''$

$\angle DSC = 296^\circ 6' 11'' - 232^\circ 24' 6'' = 63^\circ 42' 5''$

$\angle ASC = \angle ASD + \angle DSC$

$= 65^\circ 53' 49'' + 63^\circ 42' 5''$

$= 127^\circ 35' 54''$

4M

(a) For AB :-

$d = 5.8\,m$, $D = AB = 3265.5\,m$, $\theta = 132^\circ 18' 30''$

$$\therefore \beta = \frac{5.8 \times \sin 132^\circ 18' 30''}{3265.5} \times 206265 \text{ sec}$$

$$= 0^\circ 4' 31''$$

∴ Direction of AB = $\theta + \beta$ = $132^\circ 18' 30'' + 0^\circ 4' 31''$

$= 132^\circ 23' 1''$

2M

(b) For AC

$d = 5.8\,m$, $D = AC = 4022.2\,m$, $\theta = 232^\circ 24' 6''$

$$\beta = \frac{5.8 \times \sin 232^\circ 24' 6''}{4022.20} \times 206265 = -235.66\ sec$$

$\beta = -0^\circ 3' 55.66''$

$\therefore$ Direction of AC $= 232^\circ 24' 6' - 0^\circ 3' 55.60''$

$= 232^\circ 20' 10.3''$ (2M)

(c) For line AD

$d = 5.8\,m$, $\theta = 296^\circ 6' 11''$, $D = 3086.4\,m$

$$\therefore \beta = + \frac{d \sin 296^\circ 6' 11''}{D} \times 206265$$

$$= \frac{+5.80 \times \sin 296^\circ 6' 11''}{3086.4} \times 206265$$

$= 348.08\ sec$

$\beta = -0^\circ 5' 48''$

Direction of AD $= \theta + \beta = 296^\circ 6' 11'' - 0^\circ 5' 48''$

$= 296^\circ 0' 23''$ (2M)

Q7)

$x_a = 0.03$ $\quad x_b = 0.15$

$y_a = 0.19$ $\quad y_b = -0.23$

$H = 5000\,m$ $\quad h_a = 500\,m$ $\quad h_b = 800\,m$

$f = 0.2\,m$

$$X_a = \left(\frac{H - h_a}{f}\right) x_a = \left(\frac{5000 - 500}{0.2}\right) \times \frac{0.03}{100} = 6.75\,m$$

$$Y_a = \left(\frac{H - h_a}{f}\right) y_a = \left(\frac{5000 - 500}{0.2}\right) \times \frac{0.19}{100} = 42.75\,m$$

$$X_b = \left(\frac{H - h_b}{f}\right) \cdot x_b = \left(\frac{5000 - 800}{0.2}\right) \times \frac{0.15}{100} = 31.5\,m$$

$$Y_b = \left(\frac{H - h_b}{f}\right) \cdot y_b = \left(\frac{5000 - 800}{0.2}\right) \times \frac{-0.23}{100} = 48.3\,m$$

(6m)

Distance $AB = (L) = \sqrt{(x_a - x_b)^2 + (Y_a - Y_b)^2}$

$$= \sqrt{(6.75 - 31.5)^2 + (42.75 - 48.3)^2}$$

$$= 25.365\,m$$

(4m)

End of Scheme.