MODEL ANSWERS
GEE 3622
TERM 3 TEST
2017.

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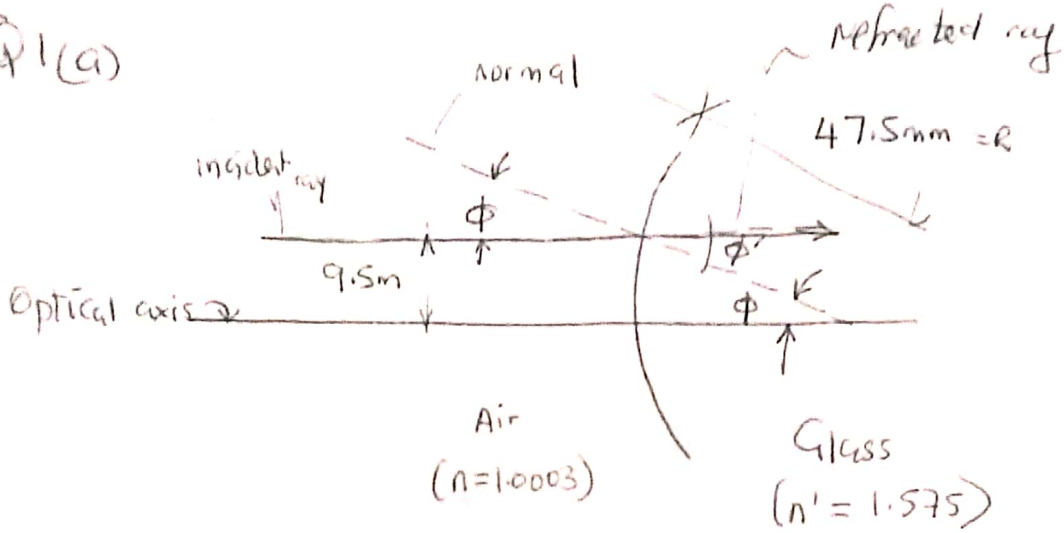
Q1(a)



$\sin\phi = \frac{9.5}{47.5}$ from which $\phi =$ $\phi = 11.54^0$

Applying Snell's law

$n \sin\phi = n' \sin\phi'$

$\sin^{-1}\left[\frac{1.0003 \sin 11.54^0}{n'}\right] = n' \sin\phi'$

$1.0003 \left[\frac{9.5\,mm}{47.5\,mm}\right] = 0.20006$: $\phi' = \sin^{-1} 0.20006$

$= 11.54^0$

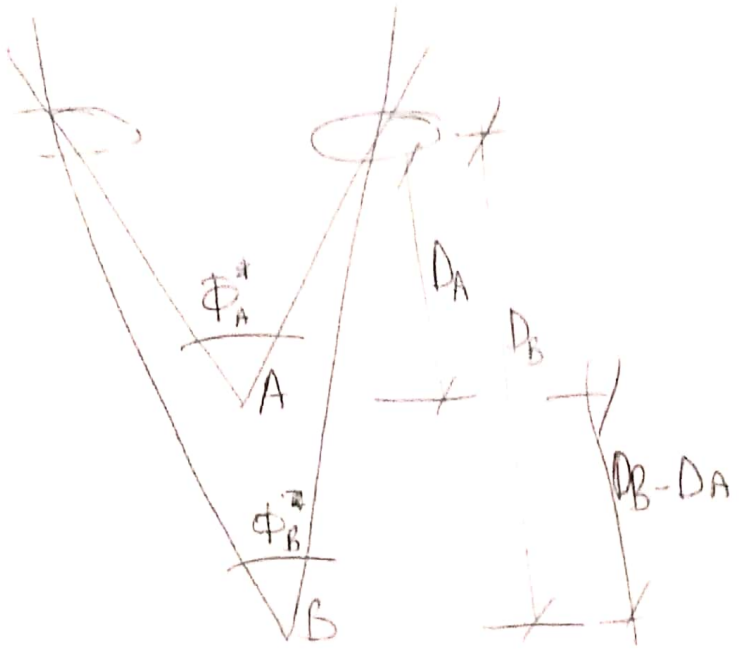
$\sin\phi = \frac{1.575 \sin(11.54)}{1.0003}$

(10)

$\phi = 18.36^0$

$\phi' = 7.29^0$

Q1 (b)



Parallactic angle is the angle of intersection of optical axes that converge on a certain point the degree the object the greater the parallactic angle and vice versa.

The depth of object A and B ($D_B - D_A$) is perceived as the difference in their parallactic angles ($\Phi_A - \Phi_B$).

The collinearity condition states that the perspective center (L), the image point (a) and the object point (A) must ~~lie~~ lie on a straight line (3)

$$x_a = x_0 - f \frac{(X_A - X_L) m_{11} + (Y_A - Y_L) m_{12} + (Z_A - Z_L) m_{13}}{(X_A - X_L) m_{31} + (Y_A - Y_L) m_{32} + (Z_A - Z_L) m_{33}}$$

$$y_a = y_0 - f \frac{(X_A - X_L) m_{21} + (Y_A - Y_L) m_{22} + (Z_A - Z_L) m_{23}}{(X_A - X_L) m_{31} + (Y_A - Y_L) m_{32} + (Z_A - Z_L) m_{33}}$$

where x_a, y_a are measured image coords

X_A, Y_A, Z_A are unknown object coords

X_L, Y_L, Z_L are unknown elements of exterior orientation

$m_{11} \ldots$ are elements of the rotation matrix with embedded rotation angles ω, ϕ, κ which are also unknown elements of exterior orientation.

f is the focal length of the camera

Q2 (a)

Parallax - apparent shift in the position of an object w.r.t a frame of reference, caused by a shift in the position of observation

Principal Point - of a photograph is the foot of the perpendicular dropped from the rear nodal of the lens to the focal plane.

Luminance - is the degree of brightness received per unit area of the image plane during exposure.

Exposure Station - is the position of the camera at the instant of exposure.

Interior Orientation Parameters - refers to the coords of principal point & the focal length.

Exterior Orientation Parameters - refers to the position and angular orientation of the camera at the instant of exposure

Fiducial marks - marks on the sides or corners of a photograph that define the coordinate system of a photograph once joined together.

2(b) A map is an orthogonal projection whilst a photograph is a central or perspective projection.

(4)

Q 2(c) Slow shutter speed – large f-stop – small ϕ of lens opening

Fast shutter speed – small f-stop – large ϕ of lens opening

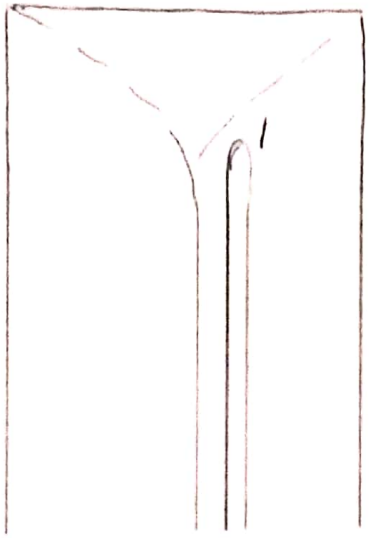
- Larger grains – faster film – short exposure time
  Smaller grains – slow film – longer exposure time
- large grains – less resolution power
  Smaller grains – higher resolution power

(7)

Q3 (a)

A(87.294, 210.223)

B (199.826, 96.996)



Q3 (a)

A(87.294, 210.223)

B(199.826, 96.996)

C(313.054, 209.555)

D(200.512, 322.768)

Step 1: We compute the coords of the intersection of line $\overrightarrow{AC}$ with line $\overrightarrow{BD}$ in this system

From equation of a straight line $y = mx + c$

line $\overrightarrow{AC}$

$210.223 = 87.294m + c$

$209.555 = 313.054m + c$

from which

$m = -0.00296$

$c = 210.421$

line $\overrightarrow{BD}$

$96.996 = 199.826m + c$

$322.768 = 200.512m + c$

from which

$m = 329.114$

$c = -65662.479$

$y = -0.00296x + 210.421 \quad \cdots (1)$

$y = 329.114x - 65662.479 \quad \cdots (2)$

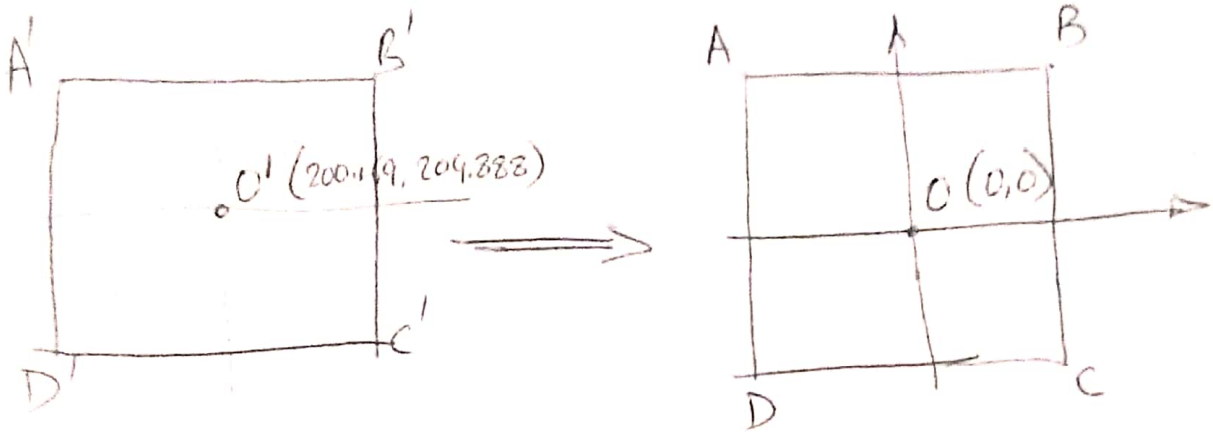
$-329.117x = -65877.960$

$x = 200.169$

$\therefore y = 209.888$

$\therefore O' = (200.169, 209.888)$

But the the conventional system has origin (0) at (0,0);



$\therefore A = A' - O'$

$= (87.294 - 200.169,\ 210.223 - 209.888)$

$= -112.875,\ 0.335$

Do for B, C and D.

Q3(b) $\alpha = 2\tan^{-1}\left(\frac{d}{2f}\right)$

$= 2\tan^{-1}\left(\frac{\sqrt{(23^2 + 23^2)}}{2 \times 15.2\text{ cm}}\right)$

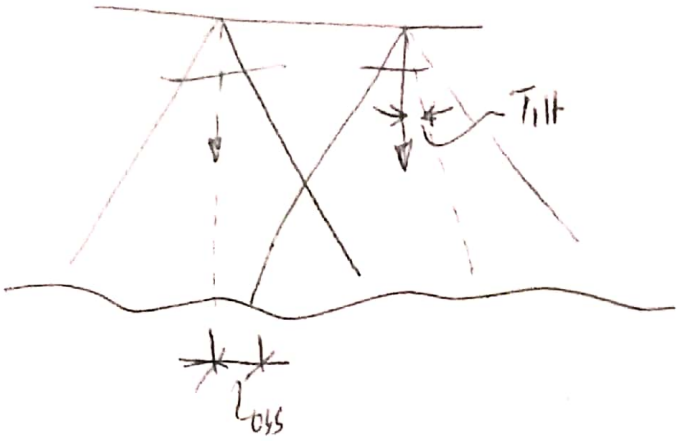
$= 2\tan^{-1}(1.0699642)$

$\alpha = 93.87^\circ$ Wide angle camera

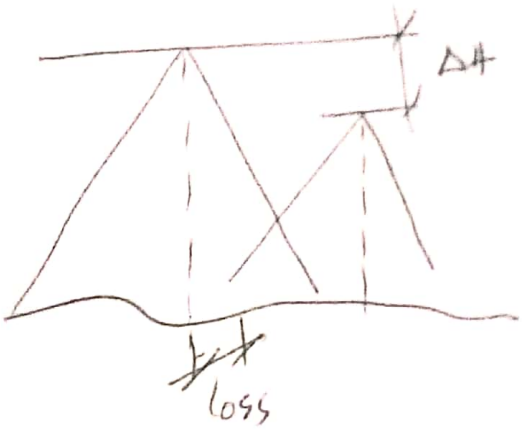
Wide Angle Camera

Q4(a) loss of Stereoscopic Coverage

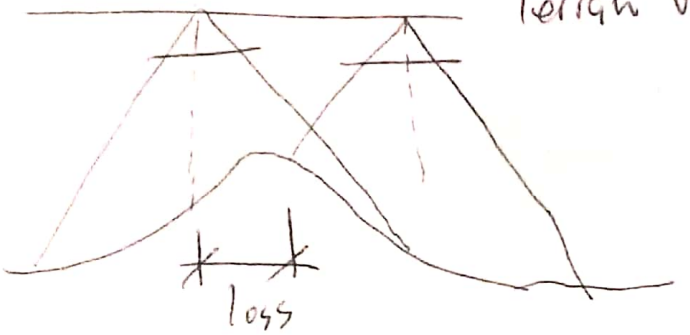
Due to Tilt



Unequal Flyn Height



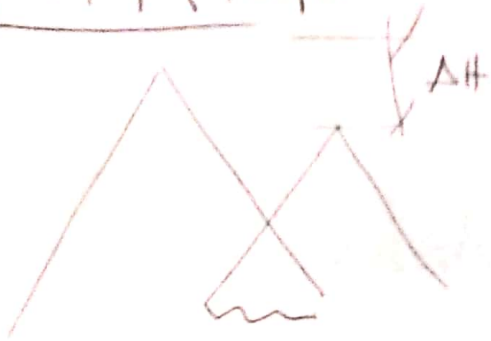
Terrain Variation



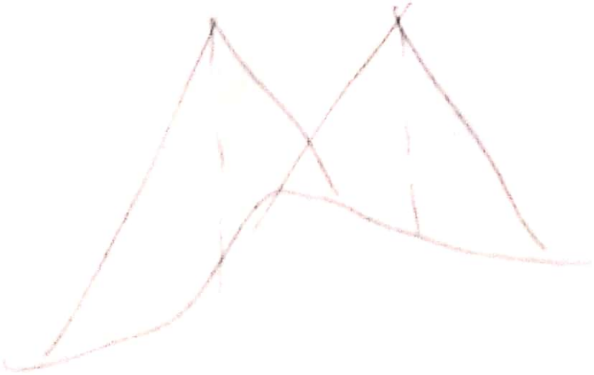
Q 4 (a)

Tilt

Unequal flying Height



Terrain variation



4(b) $PE = \frac{G - B}{G} \times 100$

$PS = \frac{G - W}{G} \times 100$

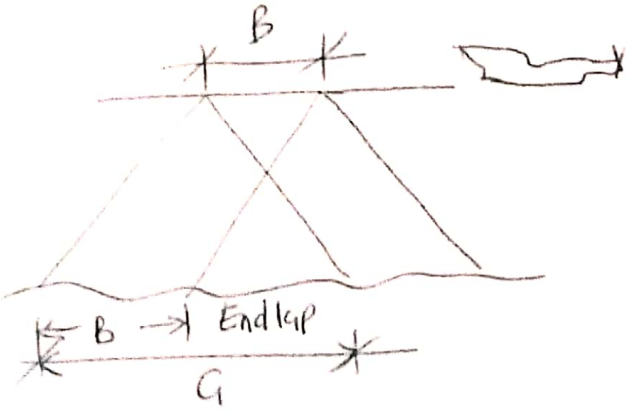
Solution

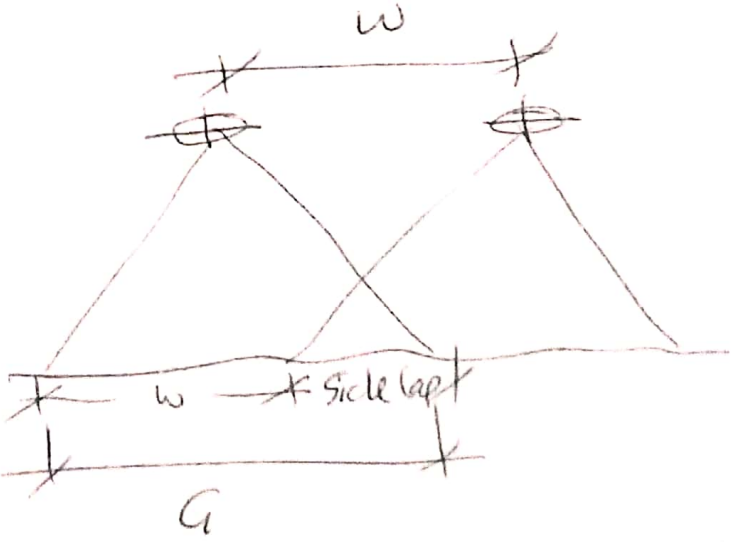
Average Scale $= \frac{f}{H} = \frac{152.4}{2440(1000)} = \frac{1}{16,000}$

Grond Coverage: $G = \left(\frac{23\,cm}{1/16,000}\right)\left(\frac{1m}{100cm}\right) = 3680m$

$PE = \frac{3680m - 1400}{3680} \times 100 = \underline{62\%}$ (4)

$PS = \frac{3680 - 2500}{3680} \times 100 = \underline{32\%}$





A(c) Refer to Example (b) in Aerial Camera Notes

Solution

$$D = \left(325 \text{ km/h}\right)\left(\frac{1}{250} \text{ sec}\right)\left(\frac{1 \text{ h}}{3600 \text{ sec}}\right)\left(\frac{1000 \text{ m}}{1 \text{ km}}\right)$$

= Distance plane travels during exposure

= 0.361 m

$$d = 0.361\left(\frac{152.4}{5200}\right)$$

= distance image moves during exposure

= 0.0106 mm

(b)

Q5 (a) Relief displacement is the shift or displacement in the photographic position of an image caused by the relief of the object i.e its elevation above or below a selected datum.

Q5(b) Select datum at the base of the tower.
Then flying height above datum is

$$H = 535 - 259 = 276\ m$$

By equation, $h = \frac{dH}{r}$

$$h = \frac{(54.1)(276)}{121.7} = \underline{\underline{123\ m}}$$

(5 (c)

$P_a = x_a - x'_a = 54.61 - (-59.45) = 114.06 mm$

$P_b = x_b - x'_b = 98.67 - (-27.39) = 126.06 mm$

$X_A = B \frac{x_a}{P_a} = \frac{600 \times 54.61}{114.06} = 287.27 m$

$X_B = B \frac{x_b}{P_b} = \frac{600 \times 98.67}{126.06} = 469.63 m$

$Y_A = B \frac{y_a}{P_a} = \frac{600 \times 50.80}{114.06} = 267.23 m$

$Y_B = B \frac{y_b}{P_b} = \frac{600 \times (-25.40)}{126.06} = -120.89 m$

$AB = \left[(469.63 - 287.27)^2 + (-120.89 - 257.23)^2 \right]^{1/2}$

$= \underline{428.8 m}$

$h_A = H - \frac{Bf}{P_a} = 1200 - \frac{600 \times 152.4}{114.06} = \underline{398 m}$

$h_B = H - \frac{Bf}{P_b} = 1200 - \frac{600 \times 152.4}{126.06} = \underline{475 m}$