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**Question (1) (40%)**

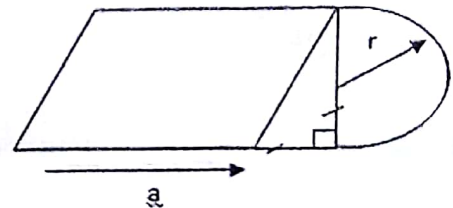
a) The following data of producing cement per hectare and the increase in delay consumption of the project to build the quarries through ten samples

Production	10	11	14	15	20	25	46	50	59	70
Consumption	50	38	35	42	44	39	30	55	52	40

- 1- The equation between the production and the increase in the consumption
- 2- What is the amount of the increase in consumption when increasing the sample to fifty and what the random error?

b) Compute the most probable value of the opposite figure and the following data :

$a = (50.30 \pm 0.01) \text{ m}$   
 $r = (9.50 \pm 0.02) \text{ m}$



c) In a triangle ABC , the side and angles observations are as follows:

$AB = 400.20 \text{ m}$  ,  $\lambda = 45^\circ 20' 14''$  ,  $\phi = 52^\circ 03' 45''$

The mean square error for side AB  $= \pm 0.019 \text{ m}$  , and the mean square error of angles  $\lambda$  and  $\phi$  is  $20''$ . Compute the value of side AC and its mean error.

**Question (2) (30%)**

The precise leveling was used to define a new reduced level of bench mark by using several known bench mark and looping lines. The results of bench marks as the following:

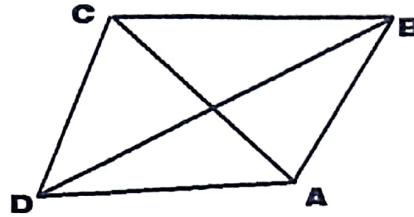
Leveling Line	1	2	3	4	5
R.L (m)	156.283	157.26	158.26	156.258	156.276
Length (km)	5	2	3	1	4

- Check , the above observations inside the limits or not.
- Compute the most probable value of reduced levels?

**Question (3) (30 %)**

a) Determine the most probable angles using correlatives method (المتبادلات) of the following angles in two triangles ABC & BCD:

BAC= A =	48° 1' 17"	ABD= B <sub>1</sub> =	56° 34' 2.4"
CBD= B <sub>2</sub> =	67° 12' 8"	ABC= B =	123° 46' 5.6"
ACB= C =	75° 24' 42.1"	ACD= C <sub>1</sub> =	42° 50' 11"
BCD= C <sub>2</sub> =	118° 14' 50.2"	BDC= C =	59° 57' 50.1"



b) The long line ABCD measured in many parts and the result has the following:

Line	Length(m)	weight	Line	Length(m)	weight
AB	153.64	4	AC	368.89	2
BC	215.17	3	BD	504.55	3
CD	289.42	5	AD	658.29	1

Determine the most probable values of AB, BC & CD using two methods (observation method & correlatives method).

*Good Luck*

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