The National University of Lesotho

BSc and BSc. Ed Supplementary Examination

PG3412: Hydrometeorological Instrumentation and Observations

August 2023 Marks: 100 3 Hours

Instructions:

- Answer any FOUR (4) questions
- Where applicable, illustrate your answers with equations and diagrams.
- Where there are calculations, clearly show the calculation steps that were followed.

Question 1

a) Temperature range of a mobile phone is found to be 0°C to 35°C. Find the temperature range in ^{o}F. (3)

b) Thebe bought a cold drink, and the temperature of the cold drink was 3 °C. Find the temperature of the cold drink in Kelvin. (4)

c) After the snowstorm in Semonkong, the drop in temperature was found to be 10 K. If before the snowstorm it was 298 K. Find the new temperature in °F? (4)

d) Which reservoirs/water storage units are connected by such processes? (4)

e) Explain any five parameters that are measured in hydrometeorology. (10)

Question 2

a) Figure 1 illustrates one of the temperatures measuring instruments used in the field. label **A -G**

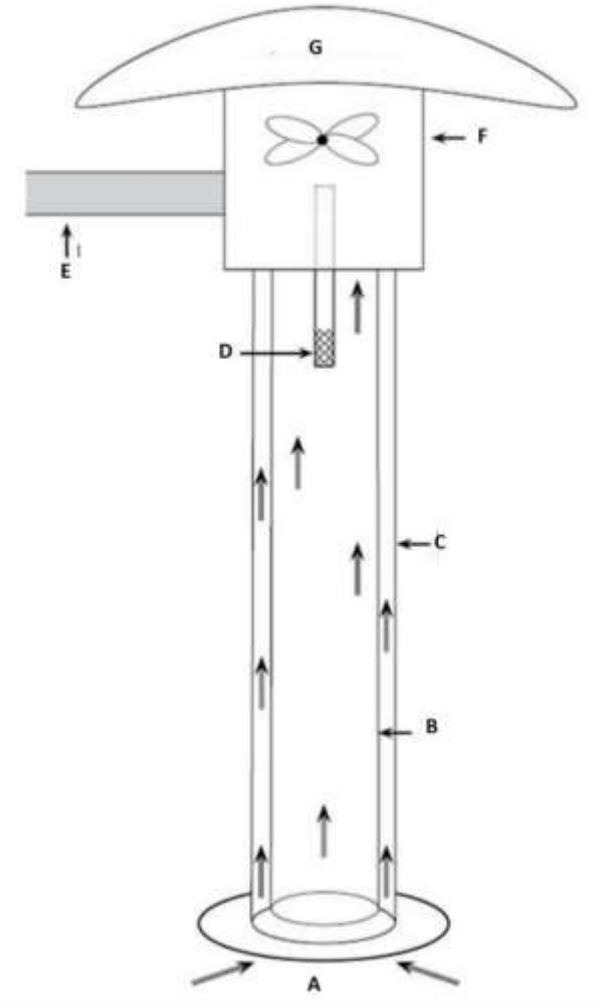


Fig.1 (6)

b) Fig. 2 illustrates an instrument used to measure

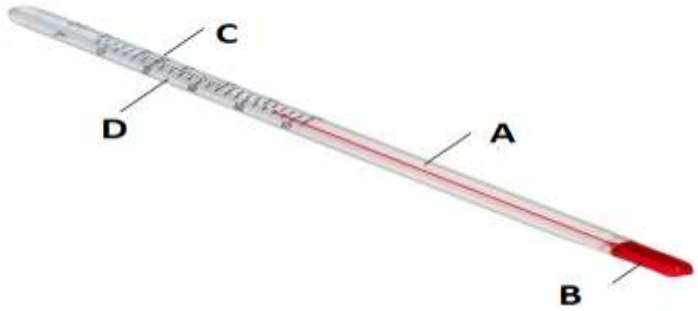


Fig. 2

1) Name the instrument (1)
2) Give <u>two **2**</u> advantages and disadvantages of this instrument compared to its liquid-in-glass instrument (4)
3) Label **A-D** (4)

c) What are the causes of:

1) Gross Error (4)
2) Instrumental Error (3)
3) Environmental Error (2)
4) Observational Error (1)

[25]

Question 3

Consider the following three data sets A, B and C. from 3 different weather stations

A = {9,10,11,7,13}

B = {10,10,10,10,10}

C = {1,1,10,19,19}

a) Calculate the mean of each data set. (6)
b) Calculate the variance of each data set. (9)
c) Which set has the largest variance (3)
d) Calculate the standard deviation of data set B. (4)
e) Which set has the largest standard deviation? (3)

[25]

Question 4

a) Reproduce table 1 and fill in the missing values accordingly:

Table 1

Quantity	Name of Unit	Symbol
Amount of substance		
Thermodynamic Temperature		
Time		
Plane angle		
Mass		
Luminous temperature		
Electrical Current		
Length		

(16)

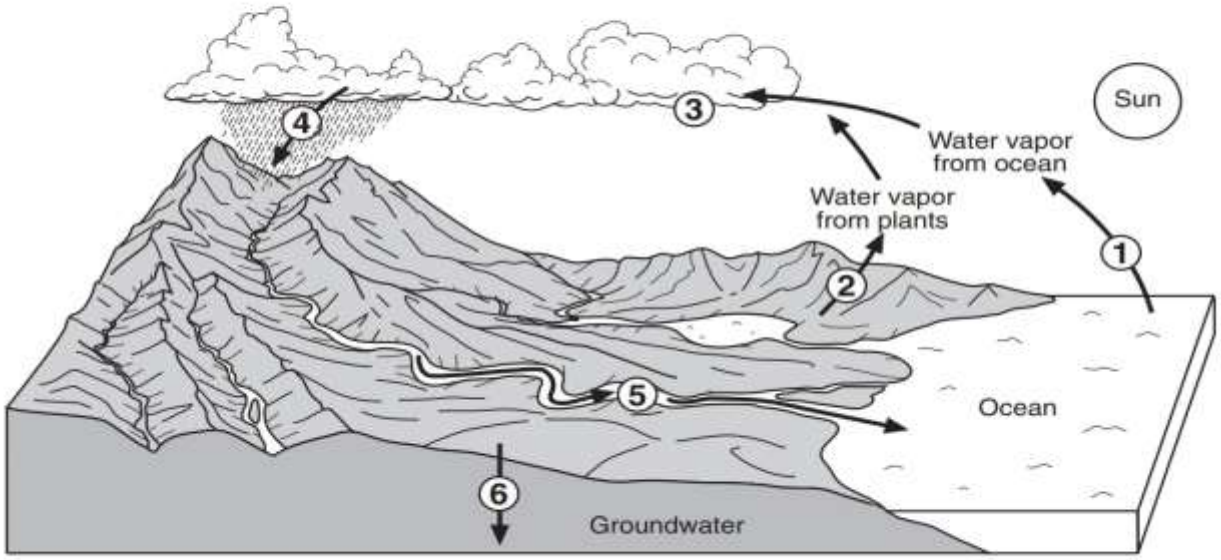
b) Define the following terms:
   1) Static Error (3)
   2) Accuracy (2)
   3) Sensitivity (2)
   4) Fidelity (2)

[25]

Question 5

a)

The diagram below shows a model of the water cycle. The arrows show the movement of water molecules through the water cycle. The circled numbers represent the processes that occur as the water molecules reach the different stages of the water cycle.



Complete the table below by identifying the name of the water cycle process occurring at each number.

Fig 3.

Number	Water cycle Process	Unit of measurement
1		
2		
3		
4		
5		
6		

(12)

b) The LHWP has constructed the reservoir in the Senqu catchment. A newly hired hydrologist is trying to familiarise himself with the operational rules of the reservoir.
Please help this scientist to calculate the amount of water collected into the **DAM** from the catchment area around the dam.
Given Precipitation of 150 m^3, Infiltration of $3m^3$, Interflow of 25 m^3 groundwater inflow of 150 m^3, Evaporation of 20 m^3, Surface flow of 20 m^3, water usage of 55 m^3.

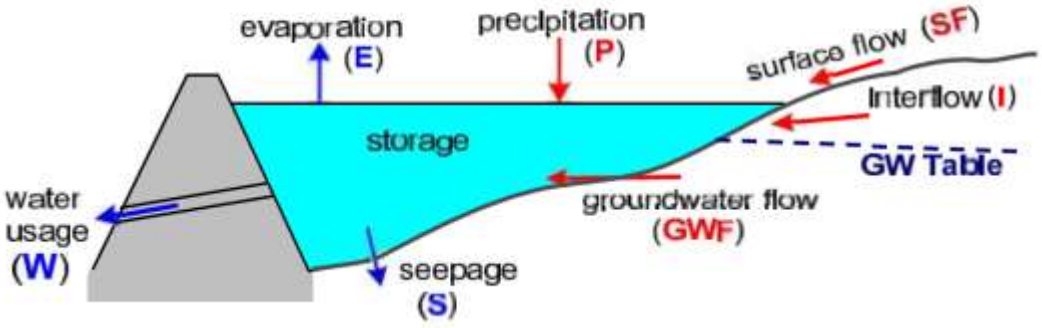


Fig 4. (10)

c) To calibrate a tipping bucket gauge, a known amount of liquid is passed through the instrument. Suppose an operator wants to calibrate a tipping bucket rain gauge using 350 ml (milliliters) of water in a gauge. The cylindrical opening of the gauge has area of 0.5 m^2. Each bucket tips over after collecting 2 mm.
How many tips of the bucket should the operator expect to record if the gauge is working according to specifications? (3)

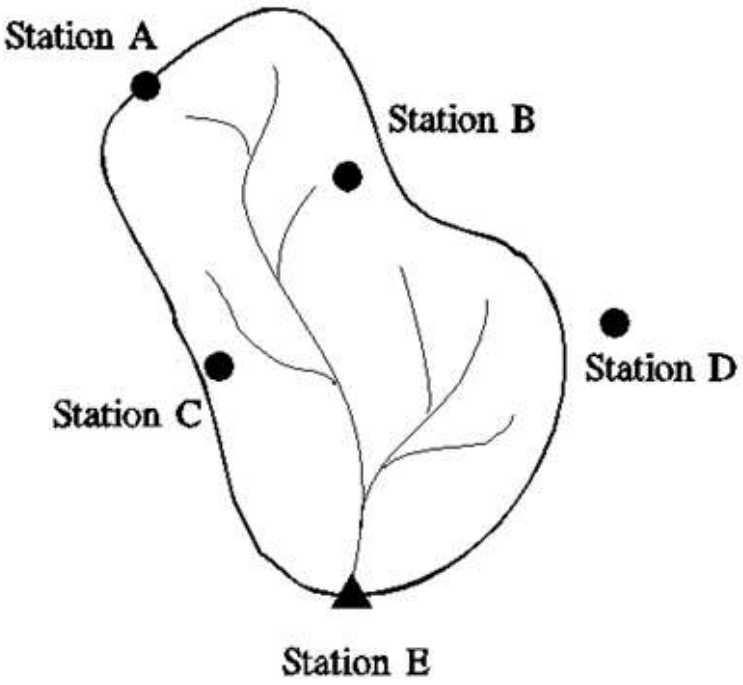
[25]

Question Six

a) Fig 5 below: show Senqu Catchment populated with few rainfall stations located strategically. With elaborate calculation find the precipitation of the Senqu catchment using the arithmetic mean method if:

Station	A	B	C	D	E
Rainfall (mm)	0.84	0.97	0.65	0.98	1.45

Fig. 5



(5)

c) A drainage basin has the catchment area of 626 km^2. There are in all 11 rain- gauging stations of which 6 are within the catchment and 5 are in the vicinity but outside the catchment. The point rainfall observed during a particular storm at various stations has been shown in Fig. 6. Calculate precipitation using Thyssen polygon method

Rainfall (cm)	0.65	1.46	1.92	2.69	1.54	2.98	5	4.5
Area of Polygon (Km^2)	7	120	109	120	20	92	82	76

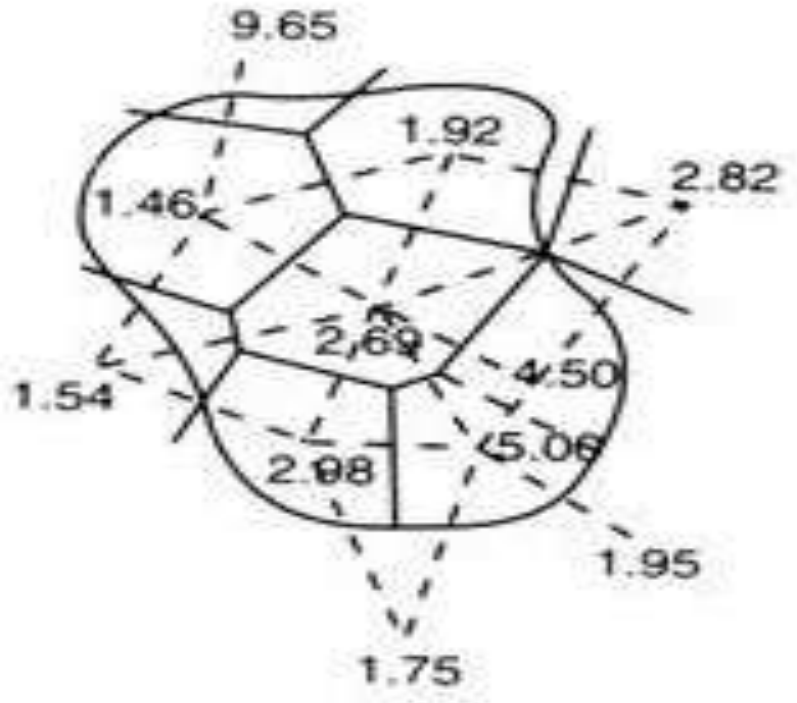


Fig 6

(5)

d) Mention any 11 weather elements measured by the Automated Weather Stations

(11)

e) What is the name of this instrument (1)

f) Mention any **3** disadvantages of this instrument (3)

[25]