UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

BACHELOR OF SCIENCE IN ENVIRONMENTAL
MANAGEMENT AND WATER RESOURCES

MAIN EXAMINATION PAPER 2017

TITLE OF PAPER	:	HYDROLOGY
COURSE CODE	:	EHS319 / EHM318
DURATION	:	2 HOURS
MARKS	:	100

INSTRUCTIONS	:	READ THE QUESTIONS & INSTRUCTIONS CAREFULLY
	:	ANSWER **ANY FOUR** QUESTIONS
	:	EACH QUESTION **CARRIES 25** MARKS.
	:	WRITE NEATLY & CLEARLY
	:	NO PAPER SHOULD BE BROUGHT INTO THE EXAMINATION ROOM.
	:	BEGIN EACH QUESTION ON A SEPARATE SHEET OF PAPER.

DO NOT OPEN THIS QUESTION PAPER UNTIL PERMISSION IS GRANTED BY
THE INVIGILATOR.

QUESTION ONE (5 Marks each)

1A. Draw a diagram of the hydrological cycle, indicating the important components and the movement of water through the cycle.

1B. Describe each of the summer wet season and the winter dry season of Swaziland in terms of the pressure zones and movement of air between the different pressure zones corresponding to a monsoon climate.

1C. Figure Q1C below shows the annual movement of moisture within the hydrological cycle. From the volume of water moving in each phase of the hydrological cycle, calculate the average residence time of water in the atmosphere. Indicate also the implication that this residence time has in the ability to make weather forecast.
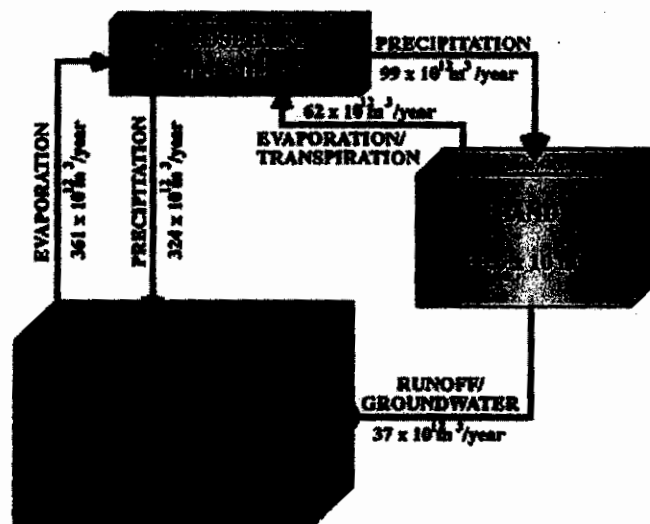

Figure Q1C: Annual movement of moisture in the hydrological cycle

1D. Figure Q1D shows the atmospheric circulation over earth. From the diagram of air circulation indicate where the high and low pressures lie, the occurrence of precipitations as well as the factor that dictates the direction in which wind is blowing (easterly or westerly winds)
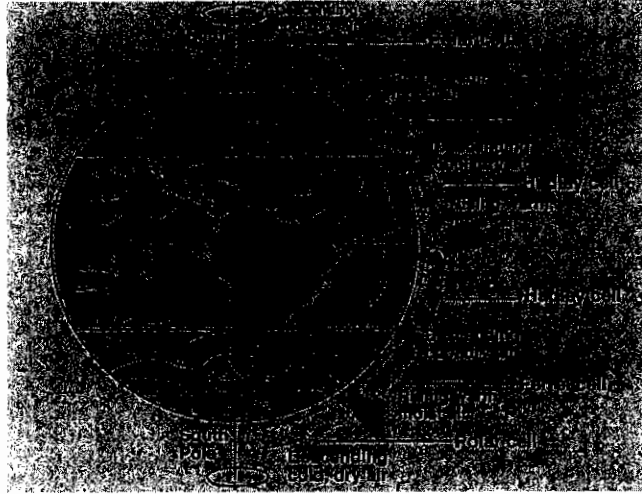

Figure Q1D: Atmospheric circulation

1E. Figure Q1E shows the intensity-duration – frequency diagram of rainfall occurring over a certain region. Complete the diagram indicate the intensity, duration, frequency and return period lines
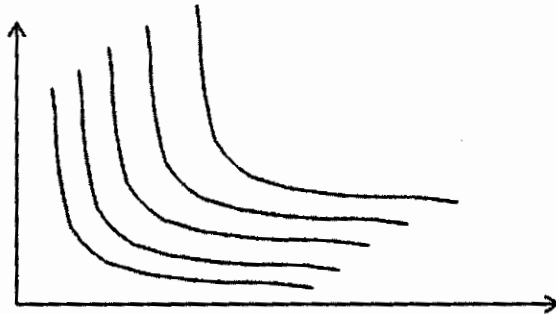

Figure Q1E: Intensity-duration-frequency diagram of rainfall over a region

QUESTION TWO (25 Marks)

2A. The annual normal rainfall at stations A, B, C and D in a basin are 80.97, 67.59, 76.28 and 92.01, respectively. In the year 1975, the station D was inoperative and the stations A, B and C recorded annual precipitations of 91.11, 72.23 and 79.89 respectively. Estimate the rainfall at station D in that year. ....[7 Marks]

2B. Name the three types of rain gauges shown in Figure Q2B below and describe their working principles. ....[8 marks]

(i)   **(ii)**   **(iii)**
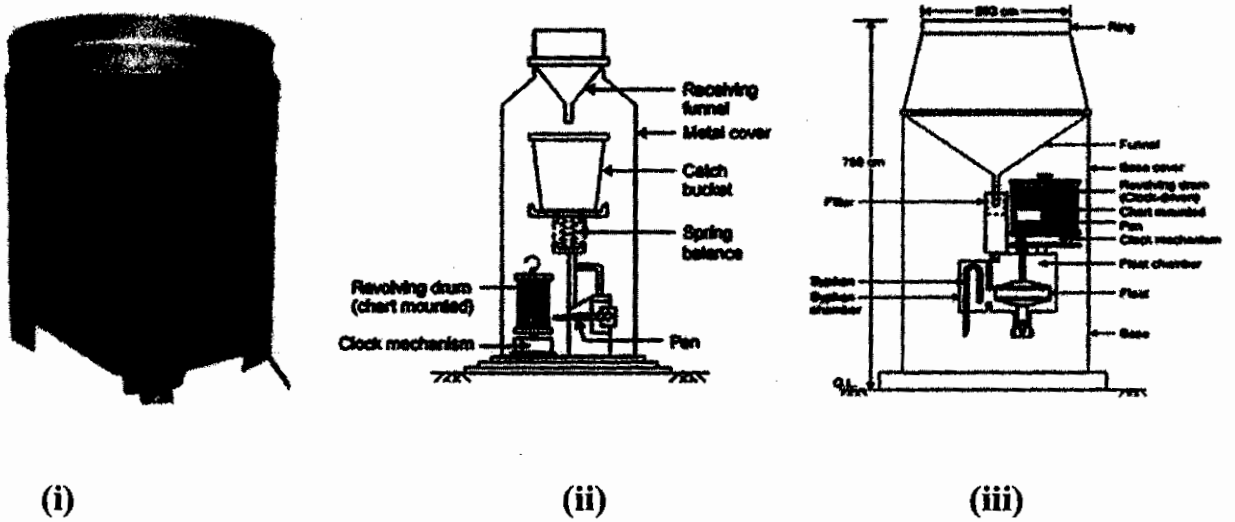
Figure Q2B: Three different types of rain gauges

2C. Draw the Theissen polygon for each of the rainfall stations shown in circle in Figure Q2C over the catchment boundary shown. Detach this paper after drawing the Theissen polygon and include it in your answer sheet. ....[10 marks]
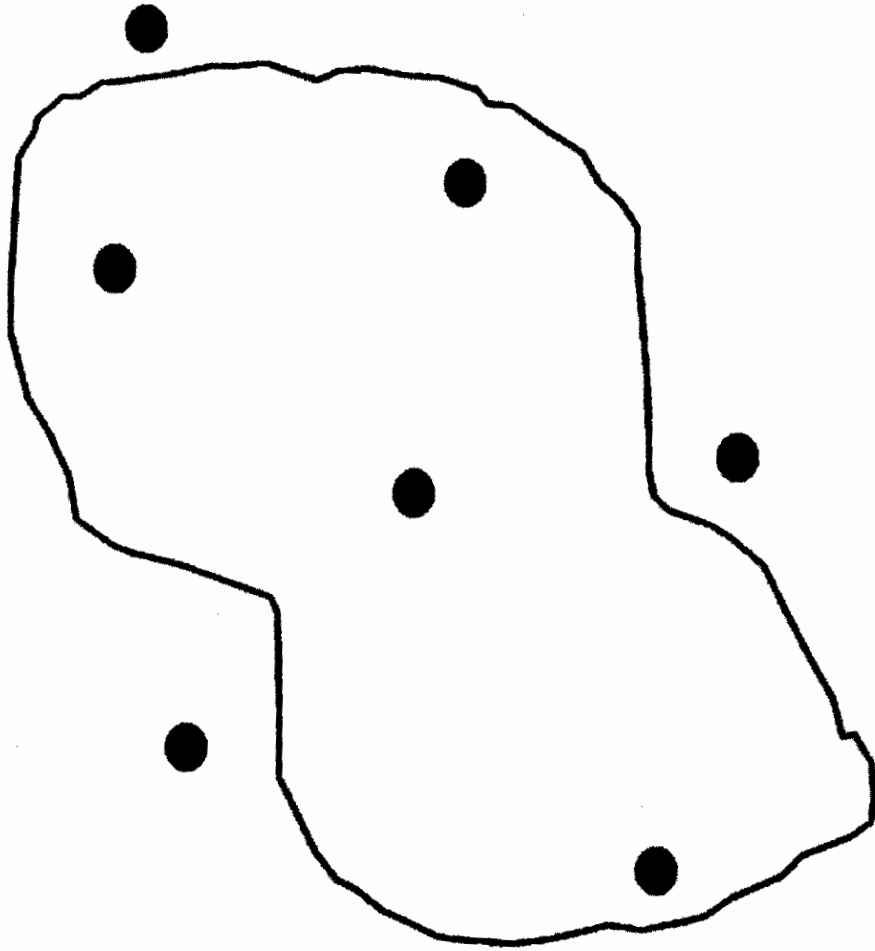
Figure Q2C: Rain gauging station of a hydrological basim

QUESTION THREE (25 Marks)

Given the following hydrograph of a given watershed having drainage area of 104 km^2 derive the unit hydrograph for the watershed.

Date	Hour	Total flow m^3/sec	Base flow m^3/sec
16-Feb	6	11	8
	8	170	8
	10	260	6
	12	266	6
	14	226	8
	16	188	9
	18	157	11
	20	130	12
	22	108	14
	24	91	16
17-Feb	2	76	17
	4	64	19
	6	54	21
	8	46	22
	10	38	24
	12	32	26
	14	27	27

QUESTION FOUR (5 Marks each)

4A. How do you compare the density of air with that of water vapour? Taking into account the density differences between air and water vapor explain as to why water vapor is restricted largely to the lower part of the atmosphere.

4B. Figure Q4B shows the variation of saturation vapour pressure with temperature in the lower atmosphere. Meteorological measurement data of a certain day in a given region showed that the temperature was 30 ^{0}C whereas the vapour pressure was 30 mb. Calculate the relative humidity and dew point of the air corresponding to this temperature and vapour pressure.
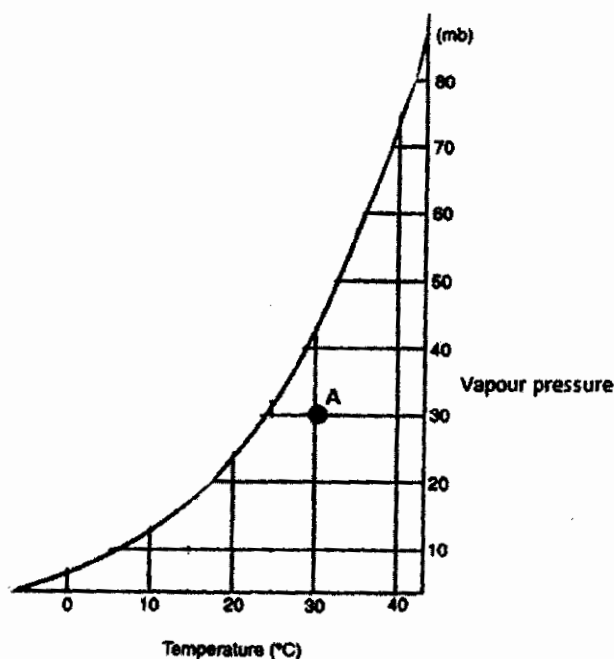
Fig Q4B: variation of saturation vapour pressure with temperature

4C. List the five major factors affecting the solar constant.

4D. On the 1st of June, 2009, Air France Flight 447 flying from Rio de Janiero, Brazil to Paris crashed into the Atlantic Ocean. Investigators believed that the crash may have been caused by super-cooled water as the plane was flying through a storm. Discuss this meteorological characteristic of a super-cooled water and how it may have caused the plane crash.

4E. Discuss the origin and occurrence of tropical cyclones that are also called hurricanes.

QUESTION FIVE (25 marks)

5A. [12 marks]

In a certain alluvial basin with an areal extent of 75 km^2 and 80 Million m^3 of ground water storage, water was pumped in a year and the water table dropped by 7 m during the year. Assume no replenishment and estimate the specific yield of the aquifer. If the specific retention is 10 %, what is the porosity of the soil?

5B. [13 marks]

A fully penetrating well of diameter 0.25 m is located in an unconfined aquifer of saturated depth 50 m. If the drawdown in the well is 13 m for the discharge of 1000 m^3/day and the radius of influence is 450 m, compute the hydraulic conductivity.