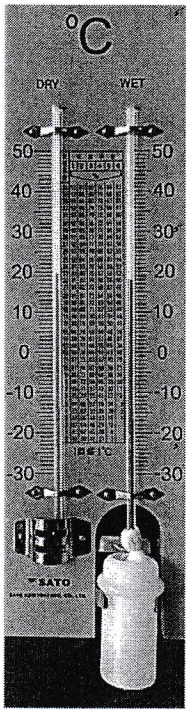
EN32201 Applied Agricultural Engineering and Environmental Technology (Compulsory)

Paper info.	**Theory - Structured and Essay** **Total number of Questions: 4** **Number of Pages: ⑥**	**INSTRUCTIONS** Answer **Three** Questions only. **Part A: Answer All questions** **Part B: Answer ANY two questions** Only non-programmable calculators are permitted. Mobile phones are NOT permitted.
Duration	**One and a half (1 1/2) Hours**	
Index No.		**Date:** July 10, 2026

Part A: Structured Type - Answer ALL Questions

1) A).

a) A wet-bulb and dry-bulb thermometer set is placed inside a Stevenson screen, and a Relative Humidity chart is provided below.



Dry Bulb (°C)	Number of degrees difference between the wet- and dry-bulb readings (°C)									
	1	2	3	4	5	6	7	8	9	10
10	88%	77	66	56	45	35	26	16	7	--
11	89	78	67	57	47	38	28	19	11	2
12	89	79	68	59	49	40	31	22	14	5
13	89	79	69	60	51	42	33	25	16	9
14	90	80	70	61	52	43	35	27	19	11
15	90	80	71	62	54	45	37	29	22	14
16	90	81	72	63	55	47	39	31	24	17
17	91	82	73	64	56	48	41	33	26	19
18	91	82	73	65	57	50	42	35	28	21
19	91	82	74	66	58	51	44	37	30	24
20	91	83	75	67	59	52	45	38	32	26
21	91	83	75	68	60	53	47	40	34	27
22	92	84	76	69	61	54	48	41	35	29
23	92	84	77	69	62	56	49	43	37	31
24	92	84	77	70	63	57	50	44	38	32
25	92	85	77	71	64	57	51	45	40	34
26	92	85	78	71	65	58	52	46	41	35
27	93	85	78	72	65	59	53	47	42	37
28	93	86	79	72	66	60	54	49	43	38
29	93	86	79	73	67	61	55	50	44	39
30	93	86	80	73	67	61	56	50	45	40
31	93	86	80	74	68	62	57	51	46	41
32	93	87	80	74	68	63	57	52	47	42
33	93	87	81	75	69	63	58	53	48	43
34	93	87	81	75	69	64	59	54	49	44

Using the above information:

i) Explain the working principle of a wet-bulb and dry-bulb thermometer in measuring relative humidity. **(5 Marks)**

.....

.....

.....

.....

.....

.....

ii) Using the given table, calculate the relative humidity (%). State the likely weather condition based on the calculated relative humidity. **(5 Marks)**

.....

.....

.....

.....

.....

.....

b) A 5 ha chilli (***Capsicum annuum***) field was monitored during the month of August to assess its water balance for irrigation management. A nearby meteorological station recorded evaporation using a Class A pan evaporimeter. The following data were collected:

- Average daily evaporation measured using a Class A pan evaporimeter = 6.2 mm day^{-1}
- Pan coefficient (Kp) = 0.80
- Crop coefficient (Kc) for the mid-season chilli crop = 0.90
- Number of days in August = 31
- Monthly rainfall = 120 mm
- Irrigation applied = 80 mm
- Deep percolation losses = 15 mm
- Surface runoff = 10 mm

. Assume that there is no capillary rise or groundwater contribution.

i) Calculate the monthly reference evapotranspiration (ETo) and the monthly crop evapotranspiration (ETc) for the Chilli field (Express the answer in **mm $month^{-1}$**) **(10 Marks)**

.....

.....

.....

.....

.....

.....

.....

.....

ii) Using the field water balance equation, calculate the change in soil water storage (ΔS) during the month. Based on your answer, state whether the soil experienced a net gain or a net loss of water. **(10 Marks)**

.....

.....

.....

.....

.....

.....

.....

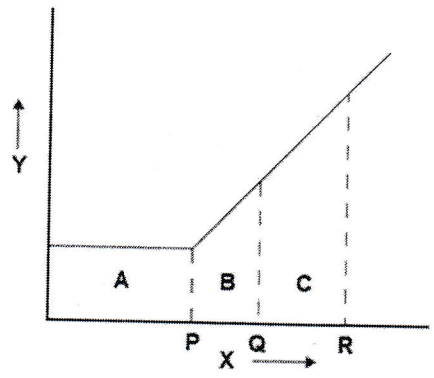
.....

.....

.....

B.

a) A Diagram of the Atterberg limits test is given below.



i) Name the X axis and Y axis in the given diagram **(4 marks)**

ii) Identify the consistency states of the soil **(6 Marks)**

A.....

B.....

C.....

iii) Identify the Atterberg limits **(6 Marks)**

P.....

Q.....

R.....

b) A soil sample gave the following test results in Atterberg test. Determine the Liquid Limit using the semi-logarithmic plot provided. **(14 Marks)**

Moisture Content (%)	Number of blows
42	40
45	30
48	22
51	15

Liquid Limit = ...

C)

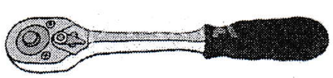
a) Differentiate between Drip Irrigation and Sprinkler Irrigation by completing the following table. **(10 Marks)**

Feature	Drip Irrigation	Sprinkler Irrigation
Water application method		
Suitable crop types		

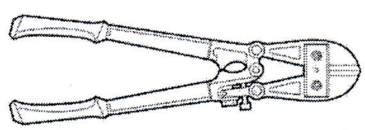
Water use efficiency		
Operating pressure		

b) Sketch the layout of a typical sprinkler irrigation system and label its main components. **(10 Marks)**

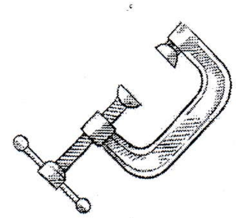
D) Identify each workshop tool shown and state its primary function. **(20 marks)**



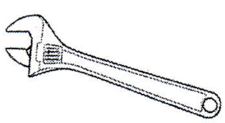
A



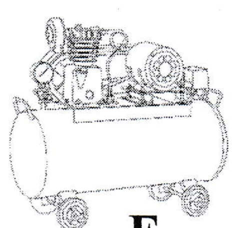
B



C



D



E

Identify the workshop tool	**Function**
A-	
B-	
C-	
D-	
E-	

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

Part B – Essay type - Answer only (Two Questions)

1.

a. *The field capacity of soil in an agricultural farm at a depth of 1m is to be determined using the field method.*

i) If the size of the soil plot to be saturated is 2.0 m × 1.5 m, calculate the volume of the soil column. **(5 Marks)**

ii) The bulk density and particle density of the soil are 1.40 g cm^{-3} and 2.65 g cm^{-3}, respectively. Calculate the soil porosity (%). **(5 Marks)**

iii) The initial soil moisture content (dry basis) of the root zone is 15%. Determine the amount of water (L) required to saturate the soil column. Assume that all pore spaces are filled with water at saturation. **(20 Marks)**

iv) After saturation, the soil moisture content at a depth of 100 cm was measured at different time intervals as shown below. Plot Time (h) on the X-axis and Moisture Content (% dry basis) on the Y-axis using the graph paper provided. **(20 Marks)**

Time (h)	Moisture Content (% Db)
12	39.85
24	35.62
36	32.94
48	30.98
60	29.42
72	28.21
84	27.56
96	27.18
108	27.15
120	27.15
132	27.15
144	27.10

v) Determine the field capacity (%) of the given soil from the plotted graph. Explain clearly how field capacity should be identified from the graph. **(10 Marks)**

b. *Infiltration is an important hydrological process that influences irrigation efficiency and soil water availability.*

i) Briefly explain **three** factors that affect the infiltration rate of soil. **(15 Marks)**

ii) The results of a double-ring infiltrometer test conducted on an agricultural field are given below. Calculate the basic infiltration rate (mm h^{-1}) of the soil. Show all calculations clearly. **(25 Marks)**

Time Difference (min)	Cumulative Time (min)	Water Level (mm)	
		initial water level	Final water level
0	Start	-	100
2	2	92	100
3	5	93	99
5	10	89	101
10	20	84	100
10	30	89	102
10	40	95	101
20	60	92	100
20	80	91	-

2.

a. *The performance of agricultural machinery depends on the properties of the materials used in their manufacture.*

i) Explain the relationship between **material structure, processing, and properties** of engineering materials, using suitable examples. **(10 Marks)**

ii) State **four reasons** why understanding the relationship between material structure, processing, and properties is important when selecting materials for farm machinery and agricultural equipment. **(10 Marks)**

b. *Field efficiency is an important indicator of machine performance in tillage operations.*

i) A rotavator has a working width of 0.8 m and operates at an average speed of 1.2 m s^{-1}. During operation, 0.18 ha of land was cultivated in 1.5 h.

Calculate:

- Theoretical Field Capacity (TFC)
- Effective Field Capacity (EFC)
- Field Efficiency % (FE) **(15 Marks)**

ii) List four factors that reduce the Effective Field Capacity (EFC) during field operations. **(10 Marks)**

c. *Arc welding and gas welding are two commonly used welding processes in the fabrication and repair of agricultural machinery.*

i) Compare Arc Welding and Gas Welding with respect to their **working principles, heat source, advantages, and typical applications. (20 Marks)**

ii) State four safety precautions that should be followed during welding operations. **(5 Marks)**

d. *3D printing is increasingly used for manufacturing agricultural machinery components.*

i) Describe the main steps involved in converting a CAD model into a physical agricultural machine component using 3D printing technology. **(15 Marks)**

ii) Explain five advantages of using 3D printing technology in agricultural engineering, giving one suitable application for each. **(15 Marks)**

3.

a. *Proper calibration of a knapsack sprayer is essential to ensure accurate and uniform application of agrochemicals.*

i) Describe the procedure for calibrating a manually operated knapsack sprayer before field application, and explain the importance of each major step. **(15 Marks)**

ii) A manually operated knapsack sprayer fitted with one flat-fan nozzle is used to apply herbicides in a vegetable field. During the speed test, the operator travelled 25 m in 20 seconds. The nozzle discharged 500 mL of water in 1 minute. The effective spray width of the nozzle is 0.50 m. Calculate the application rate (L ha^{-1}) of the sprayer. Show all calculations. **(15 Marks)**

b. *Soil aggregate analysis is regarded as one of the better tests for evaluating the physical condition of a soil.*

i) Explain the importance of soil aggregate stability in relation to water infiltration and soil erosion. **(10 Marks)**

ii) A dry aggregate analysis was carried out on a soil sample with a total dry weight of 200 g. Using the data provided in the table below, calculate the Mean Weight Diameter (MWD) of the soil. **(25 Marks)**

Aggregate Size Range (mm)	Mean Diameter, (X_i) (mm)	Mean Dry Weight Retained (g)
2.00 – 4.75	3.375	18
1.00 – 2.00	1.500	32
0.50 – 1.00	0.750	28
0.25 – 0.50	0.375	14
0.106 – 0.25	0.178	6
< 0.106	0.053	2

iii) Comment on the soil aggregate stability based on the calculated MWD. **(5 Marks)**

c. *UAV technology has become an important tool in precision agriculture.*

i) State five applications of UAV technology in agriculture. **(10 Marks)**

ii) Explain how UAV technology can improve agricultural productivity and sustainability in Sri Lanka. Support your answer with appropriate examples from Sri Lankan agriculture. **(20 Marks)**