QUESTION 1

Direct Shear Test: Samples were taken from a clay soil specimen, and undrained direct shear tests were carried out on the samples. The results were as follows: [is99]

Test	Effective normal stress (kPa)	Ultimate shear stress at failure (kPa)
1	100	120
2	200	145
3	300	201
4	400	230

a. Draw the graph of shear stress against normal stress.
b. Determine the cohesion *c'* for the soil.
c. Determine the angle of shearing resistance ϕɔ (angle of friction) for the soil.
d. Predict the ultimate shear capacity of the soil when the normal load is 250 kPa.

QUESTION 2

A series of drained Triaxial tests were performed on undisturbed samples of a soil. Each test was continued until the sample failed. The principle stresses at failure for the tests are shown in the table below.

Test	Cell pressure σ'_3 (kPa)	Major principal stress σ'_1 (kPa)
1	100	470
2	200	775
3	300	1062

1. Plot the Mohr circles and plot the strength envelope of the soil for effective stress.
2. Then determine values for cohesion (c') and the friction angle (ϕ').
3. Based on the graph, how would you classify this soil; explain why you think this classification is appropriate.

QUESTION 3

Test results for a standard Proctor Test are shown below. The mass of the compaction mould was 1.230kg. The volume of the mould is 1.00 litres. The specific gravity of the soil particles is 2.70

Sample Number	**1**	**2**	**3**	**4**	**5**	**6**
Mass of compacted soil+mould (kg)	3.350	2.883 3.296	3.157	3.324	3.381	
Moisture content %	8.1 18.2	9.9	12.0	14.3	16.1	

a. Plot the curve of dry unit weight against moisture content
b. Determine the optimum moisture content
c. Determine the maximum dry density (or dry unit weight) for the test results.
d. Plot the zero air voids line and the 5% air voids line on the graph plotted in (a) above.
e. Determine the acceptable range of field moisture content for this soil if it is to be compacted to at least 95% dry density (or dry unit weight).