(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2014/2015 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
MASTER OF SCIENCE IN WATER RESOURCES ENGINEERING

COURSE CODE: CWE 811E

COURSE TITLE: ADVANCED FOUNDATIONS OF STRUCTURES

DATE: 18TH DECEMBER 2014 **TIME: 2.00PM – 5.00PM**

INSTRUCTIONS:

1. Answer any **THREE** of the five questions. Marks for each question are indicated in the parenthesis.
2. Standard codes and tables relevant to the subject are allowed.
3. The usual notations apply
4. Examination duration is **3 Hours**

MMUST observes ZERO tolerance to examination cheating

1. a) (i)Outline **FOUR** situations where pile foundation is suitable (2 marks)
   (ii) Enumirate the advantages and disadvantages of timber and pre-cast concrete piles

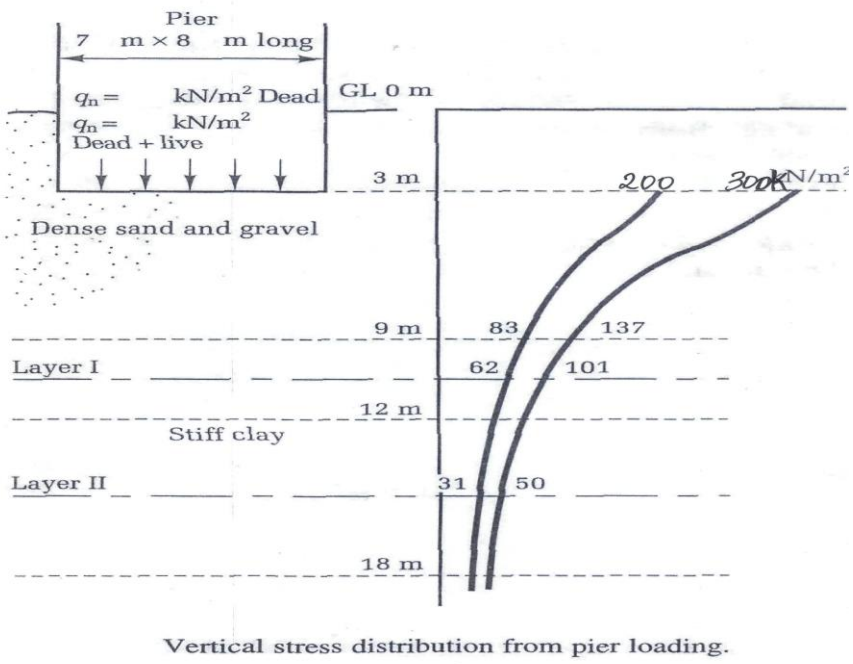
   (8marks)

   b) Masinde Muliro University of Science Technology intends to build engineering complex, you have been given an assignment to carry site investigation near the graduation pavilion. Briefly explain the information required from the site investigation for foundation engineering.

   (10marks)
2. a) Briefly explain the information in the report of site investigation for foundation engineering which will assist in identifying the type of foundation to be used.

   ($7\frac{1}{2}$ marks)

   b) Bridge pier with a base 8m long by 7 m wide, founded at a depth of 3m.the base of the pier imposes a net foundation pressure of 200 KN/m^2 for dead loading and 300 KN/m^2 for combined dead and live loading . Borings showed dense sand and gravel with cobbles and boulders to a depth of 8m below ground level, followed by very stiff over consolidated clay to more than 20m below the ground level. Standard penetration gave an average N-value of 40 blows per 300mm in the sand and gravel stratum. A number of oedometer tests were made on samples of stiff clay. Triaxial tests on undisturbed samples of the clay gave a minimum shear strength of 120 KN/m^2, and modulus of deformation (E_u) of 40MN/m^2. Calculate:
   (i) Immediate settlement in sand and gravel stratum
   (ii) Bearing capacity of stiff clay
   (iii) Settlement in clay stratum
   (iv) Net consolidation settlements



Vertical stress distribution from pier loading.

Fig.1

(12 ½ marks)

3. a) Explain conditions which govern minimum depth of shallow foundations

(10 marks)

b) The governer of Kisii County plans to built a youth rehabilitation center at Nyanturago shopping centre. The county Engineer has recommended use of 305x305x110kg/m H-section piles driven through 5m of loose water bearing sand to a penetration of 2.2m into weathered sandstone and terminating on strong unweathered sandstone with a joint spacing 500mm showed and average uniaxial compression strength of 60MN/m^2. The surface area of the pile is 2.4m^2/m and the cross sectional area is 0.015m^2.

The skin friction mobilized in the loose sand can be neglected. Driving the pile into the weathered sandstone will cause disintegration into the condition of medium-dense sand with a value say 33^o. Take K_0 as 1-sin33^o=0.45 and Ks=1x0.45=0.45. Determine the allowable load on a single pile.

(10 marks)

4. a) Briefly explain the factors influencing choice of pile foundation to be used.

(10 marks)

b) MMUST pension scheme is planning to build a 40-storey building in Kakamega County. The storey is to be founded on a stiff raft 50m long by 30m wide at a depth of 4m below the ground level and is sited over a weathered rock becoming less weathered with increasing depth until a relatively incompressible stratum is met at adepth of 45m.Deformation modulus values obtained from plate bearing tests made

in a large diameter borehole are shown in figure1. Estimate the settlement of the building for a net bearing pressure of 240kN/m^2. A straight line variation of E_d with depth is plotted in figure1. At 30m below ground level E_d=4000MN/m^2 and at foundation level E_f=220MN/m^2.

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Fig.2

(10 marks)

5 a) Kisumu county is carrying out a survey of the foundations of the existing buildings in Kisumu City. The county structural Engineer has identified a multi storey building with excessive settlement and has recommended underpinning as a corrective measure. Outline the important to be considered before implementing underpinning. (6 marks)

b) Kakamega County is planning to build a governor's residence .from site investigation it has been found that mat foundation is the most suitable. A structural Engineer recommended a mat foundation on saturated clay soil dimensions of **30m x30m**. Given: dead and live load = **50** MN, $\mathbf{C_u = 30 kN/m^2}$, and $\boldsymbol{\gamma_{clay} = 20 kN/m^3}$.

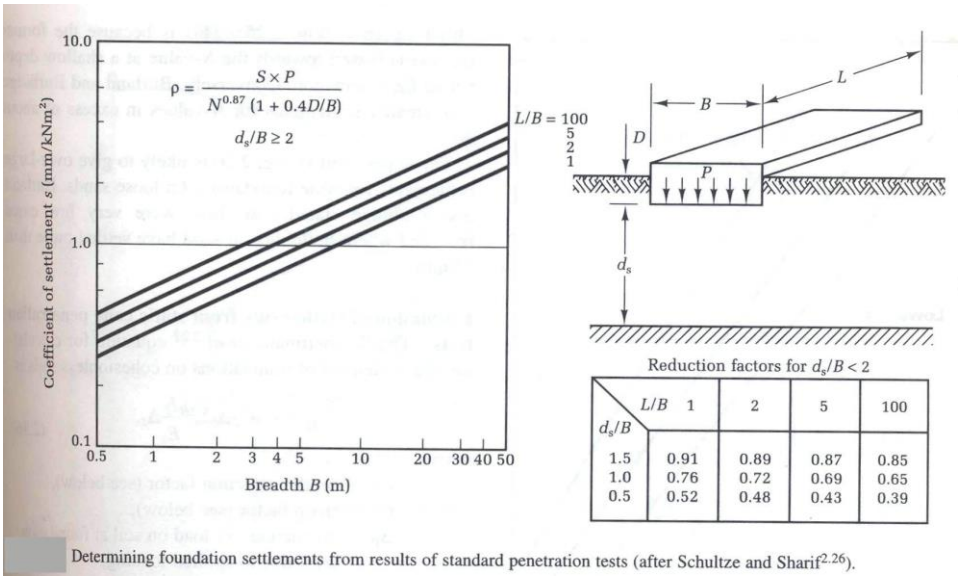
(i) Find the depth, D_f, of the mat to be fully compensated foundation.

(ii) What will be the depth of the mat (D_f) for a factor of safety of 2 against bearing capacity failure.

APPENDICES

APPENDICES FOR Q2

Appendix for Q2

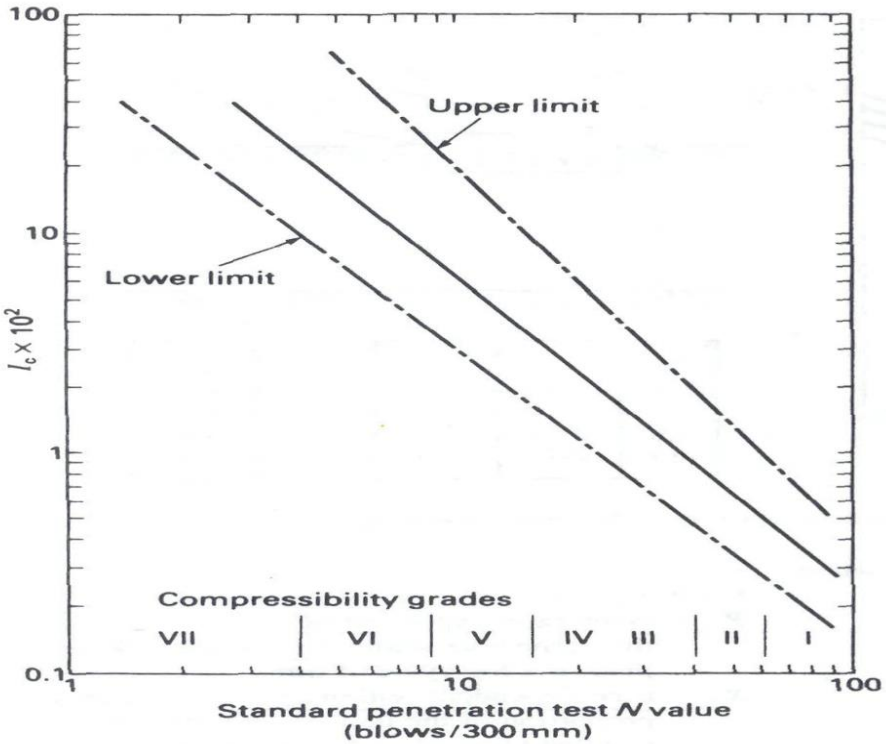


Reduction factors for $d_s/B < 2$

d_s/B \ L/B	1	2	5	100
1.5	0.91	0.89	0.87	0.85
1.0	0.76	0.72	0.69	0.65
0.5	0.52	0.48	0.43	0.39

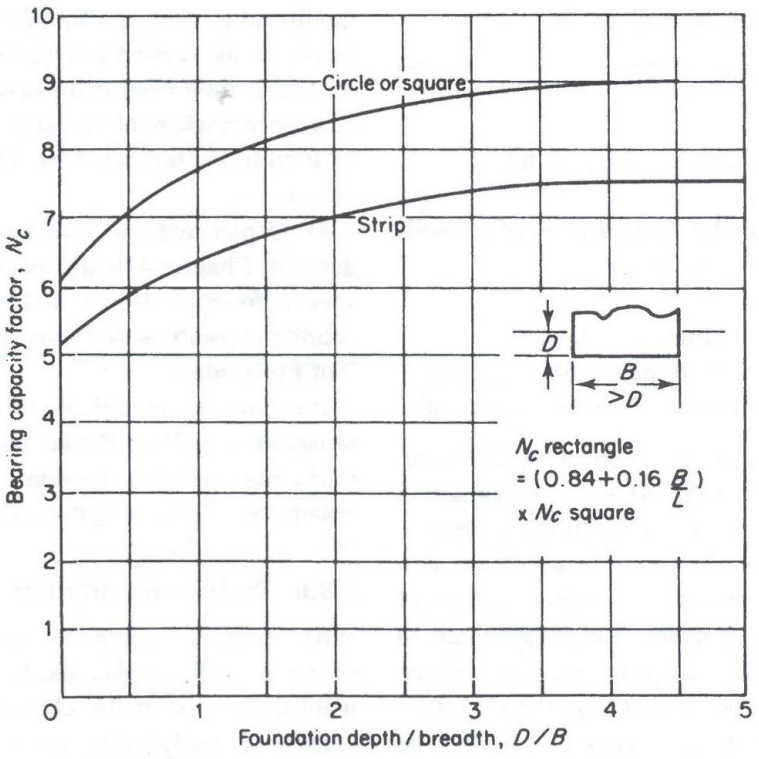
Determining foundation settlements from results of standard penetration tests (after Schultze and Sharif[2.26]).

Appendix 1



Values of the compressibility index for sands and gravels (after Burland and Burbidge[2.11]).

Appendix 2



Bearing capacity factor N_c for cohesive soil ($\phi = 0$) (after Skempton[2.6]).

Appendix 3

APPENDICES FOR Q3

Friction angle values for intact rock (after Wyllie[7.33])

Classification	Type	Friction angle (degrees)
Low friction	Schists (high mica content) Shale Marl	20–27
Medium friction	Sandstone Siltstone Chalk Gneiss	27–34
High friction	Basalt Granite	34–40

Appendix 4

Values of the coefficient of horizontal soil stress K_s (after Kulhawy[7.2])

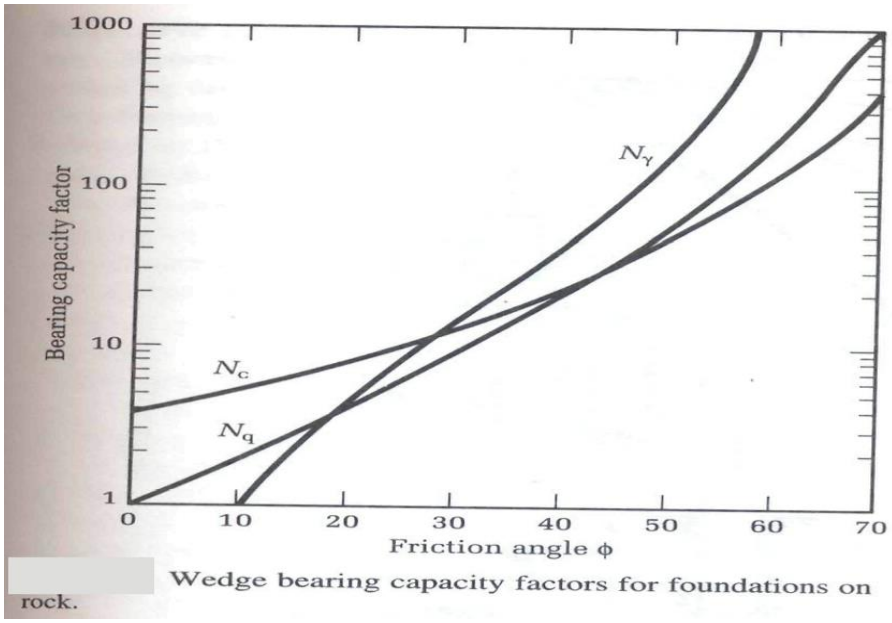
Installation method	K_s/K_0
Driven piles, large displacement	1–2
Driven piles, small displacement	0.75–1.75
Bored and cast-in-place piles	0.71–1
Jetted piles	0.5–0.7

Appendix 5

Properties of a rock mass related to the unconfined compression strength (q_{uc}) and the RQD value

RQD (%)	q_c	c	ϕ
0–70	$0.33q_{uc}$	$0.1q_{uc}$	30°
70–100	$0.33–0.8q_{uc}$	$0.1q_{uc}$	30–60°

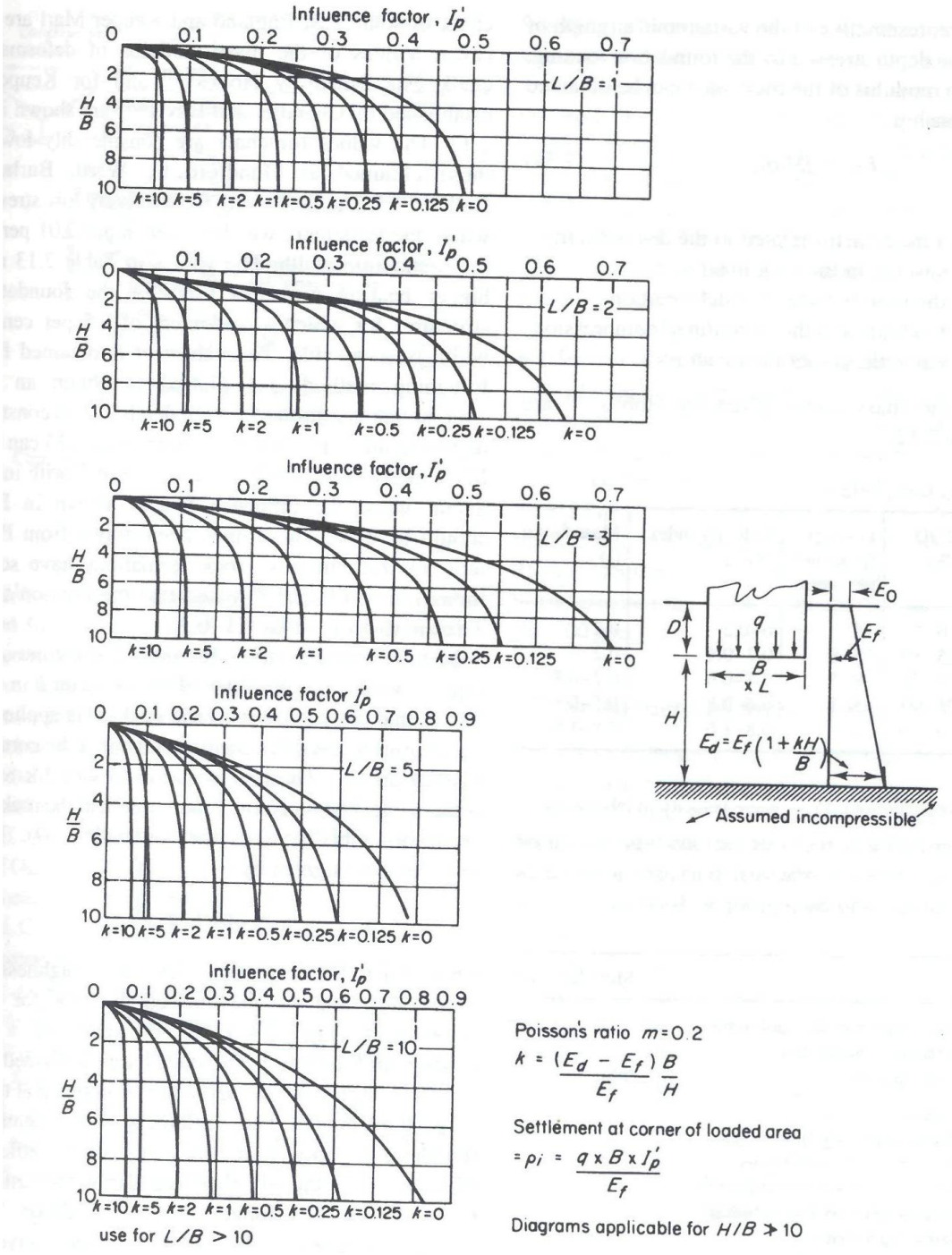
Appendix 6



Wedge bearing capacity factors for foundations on rock.

Appendix 7

APPENDICES FOR Q4



Poisson's ratio $m = 0.2$

$$k = \frac{(E_d - E_f)}{E_f}\frac{B}{H}$$

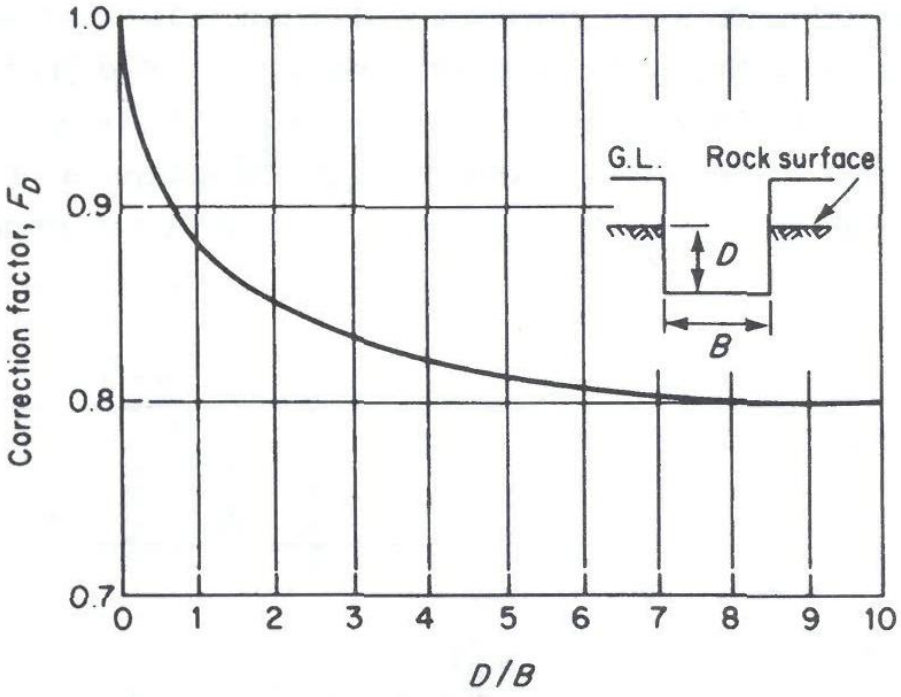
Settlement at corner of loaded area

$$= \rho_i = \frac{q \times B \times I_p'}{E_f}$$

Diagrams applicable for $H/B \nrightarrow 10$

Values of influence factor I_p for deformation modulus increasing linearly with depth and modular ratio of 0.2

Appendix 8



Correction factors for depth of embedment of foundation below surface of rock.

Appendix 9

Meyerhof (1963) Bearing Capacity Theory

Table 03: Bearing capacity factors (Eq. 11, Eq. 12, and Eq. 13)

ϕ'	N_c	N_q	N_γ	ϕ'	N_c	N_q	N_γ
0	5.14	1.00	0.00	26	22.25	11.85	12.54
1	5.38	1.09	0.07	27	23.94	13.20	14.47
2	5.63	1.20	0.15	28	25.80	14.72	16.72
3	5.90	1.31	0.24	29	27.86	16.44	19.34
4	6.19	1.43	0.34	30	30.14	18.40	22.40
5	6.49	1.57	0.45	31	32.67	20.63	25.99
6	6.81	1.72	0.57	32	35.49	23.18	30.22
7	7.16	1.88	0.71	33	38.64	26.09	35.19
8	7.53	2.06	0.86	34	42.16	29.44	41.06
9	7.92	2.25	1.03	35	46.12	33.30	48.03
10	8.35	2.47	1.22	36	50.59	37.75	56.31
11	8.80	2.71	1.44	37	55.63	42.92	66.19
12	9.28	2.97	1.69	38	61.35	48.93	78.03
13	9.81	3.26	1.97	39	67.87	55.96	92.25
14	10.37	3.59	2.29	40	75.31	64.20	109.41
15	10.98	3.94	2.65	41	83.86	73.90	130.22
16	11.63	4.34	3.06	42	93.71	85.38	155.55
17	12.34	4.77	3.53	43	105.11	99.02	186.54
18	13.10	5.26	4.07	44	118.37	115.31	224.64
19	13.93	5.80	4.68	45	133.88	134.88	271.76
20	14.83	6.40	5.39	46	152.10	158.51	330.35
21	15.82	7.07	6.20	47	173.64	187.21	403.67
22	16.88	7.82	7.13	48	199.26	222.31	496.01
23	18.05	8.66	8.20	49	229.93	265.51	613.16
24	19.32	9.60	9.44	50	266.89	319.07	762.89
25	20.72	10.66	10.88				

Appendix 10 (Q)