UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF TECHNOLOGY *ENGINEERING: CIVIL*
SUBJECT	:	**CONCRETE TECHNOLOGY 2A**
CODE	:	**CRTCIA2**
DATE	:	JULY SSA EXAMINATION 16 JULY 2019
DURATION	:	(SESSION 2) 15:00 - 18:00
WEIGHT	:	40: 60
TOTAL MARKS	:	100

ASSESSOR	:	H ZONDI
MODERATOR	:	F THAIMO
NUMBER OF PAGES	:	7 PAGES

INSTRUCTIONS	:	ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.
REQUIREMENTS	:	NONE.

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INSTRUCTIONS TO STUDENTS

PLEASE ANSWER ALL QUESTIONS.

QUESTION 1

The reinforcing steel is to be protected against corrosion by a layer of gamma ferric oxide. However, this layer can be destroyed by carbonation.

1.1 What do you understand by the term carbonation? (5)

1.2 Explain the factors that influence the rate of carbonation (10)

[15]

QUESTION 2

Table 1 contains the concrete cube strength results for 30 tests of a water reservoir project. The specified characteristic cube strength of the concrete is 35 MPa.

TABLE 1: Cube strength results

Set No.	Cube Strength (MPa)		
1	58	56	57
2	45	48	46
3	47	45	40
4	46	50	50
5	44	48	39
6	45	44	44
7	45	52	46
8	46	48	53
9	51	49	48
10	39	45	50

2.1 Will you accept the results of the cube strength? Support your answer by providing objective reasons or motivations. Also, provide the necessary calculations.

[20]

QUESTION 3

There are two types of sand available for making the concrete to be used in constructing the crossing on N2 namely: river sand and pit sand. Tables 2 and 3 contain the results of the grading of these sands.

Tables 2: Sieve analysis of River sand

Sieve size (mm)	Mass retained (g)
4.75	0
2.36	200
1.18	189
0.6	216
0.3	79
0.15	140
0.075	22
<0.075	15

Tables 3: Sieve analysis of Pit sand

Sieve size (mm)	Mass retained (g)
4.75	0
2.36	10
1.18	100
0.6	90
0.3	80
0.15	60
0.075	30
<0.075	20

3.1 Which sand will you prefer for the concrete? Support you answer by providing objective reasons or motivations. Provide also the necessary calculations. Focus on the following:

- The FM of the sand
- The percentage passing the 0.3 mm, 0.15 mm and 0.075 mm sieves to ensure good cohesiveness of the concrete.

[20]

QUESTION 4

Your company is to present a brief on admixtures at the next meeting. The aim is to convince Sedibeng Municipal Council to use admixtures in the concrete at the road crossing. Thus on behalf of your company prepare a brief concentrating on the following:

4.1 Fully define an admixture. (2)

4.2 Discuss the appropriate use of the admixtures (4)

4.3 Give three types of admixtures (3)

4.4 State the one positive and negative properties of each of the three admixtures you mentioned on 4.3. (6)

4.5 How can you ensure that admixtures are stored according to manufacturer's recommendations (6)

[21]

QUESTION 5

When designing a concrete mix, it is important not to have too little, or too much stone in the concrete mix. Discuss what the effect on the concrete will be if:

5.1 there is too much stone in the concrete (3)

5.2 there is too little stone in the concrete (3)

[6]

QUESTION 6

Sedibeng Municipal Council in Vaal has decided to construct a concrete crossing on the road R42 to be used by the heavy vehicles. Your Consulting Company has been appointed as the Civil Engineering Consultants. The following information is available to you as the lead Technologist:

- **CEMENT:**

CEM I 32.5

- **STONE:**

Size: 19.0mm

Compacted Bulk Density (CBD): 1540kg/m3

Relative Density (RD): 2.5

Loose Bulky Density (LBD): 1470kg/m3

Moisture content: 2.5%

- **SAND:**

Fine Modulus (FM): 1.22

Relative Density (RD): 2.7

Loose Bulky Density (LBD): 1450 kg/m3

Moisture content: 3.5%

- Water: Tap water
- Specified characteristic cube strength: 30MPa
- Concrete to be compacted by heavy vibration
- Minimum amount of cement to be used

The contractor has proposed the content of the concrete mix design per m^3 to be as follows:

- CEM I 32.5: 190 kg
- Tap water: 210litres

- Stone: 1720kg
- Sand: 150 kg

6.1 Is it correct to give the contractor site instruction to proceed and order the fresh concrete? Support your answer by providing objective reasons, motivation and necessary calculations. Use C&CI Method (20)

[20]

TOTAL = 102

DESIGN TABLES

TABLE 1: Water requirement of concrete mixes (19.0mm stone and 75mm slump)

Sand quality	Water content, ℓ/m^3	
	Natural	Crusher
Very poor	240	235
Poor	225	225
Average	210	215
Good	195	205
Excellent	180	195

TABLE 2: Adjustment to water content to compensate for stone sizes other than 19.0mm

Maximum size of stone, mm	9,5	13,2	19,0	26,5	37,5
Correction, ℓ/m^3	+20	+10	0	-10	-20

TABLE 3: Increase of stone when using Fly Ash

FA content as % by mass of total cementitious material	Percentage additional stone
15	3
25	4
30	5
40	6
50	7

TABLE 4: Values of *k* for determining of stone

Approximate slump range, mm	Placing requirement	K				
		Maximum size of stone, mm				
		9,5	13,2	19,0	26,5	37,5
75 - 150	Hand compaction	0,75	0,84	0,94	1,00	1,05
25 - 100	Moderate vibration	0,80	0,90	1,00	1,06	1,10
0 - 25	Heavy vibration	1,00	1,05	1,08	1,10	1,15
60 - 125	Pumped	-	0,83	0,86	0,87	-
25 - 50	Concrete roads*	-	-	-	-	1,2

* Calculated on CBD of 37,5-mm stone when using a blend of 37,5- and 19-mm stone

TABLE 5: Particle Relative Densities of cementitious materials

Material	Particle relative density
CEM I	3,14
GGBS	2,9
FA	2,3
CSF	2,1

Figure 1: Ranges of compressive strength performance of South African cements used in concrete