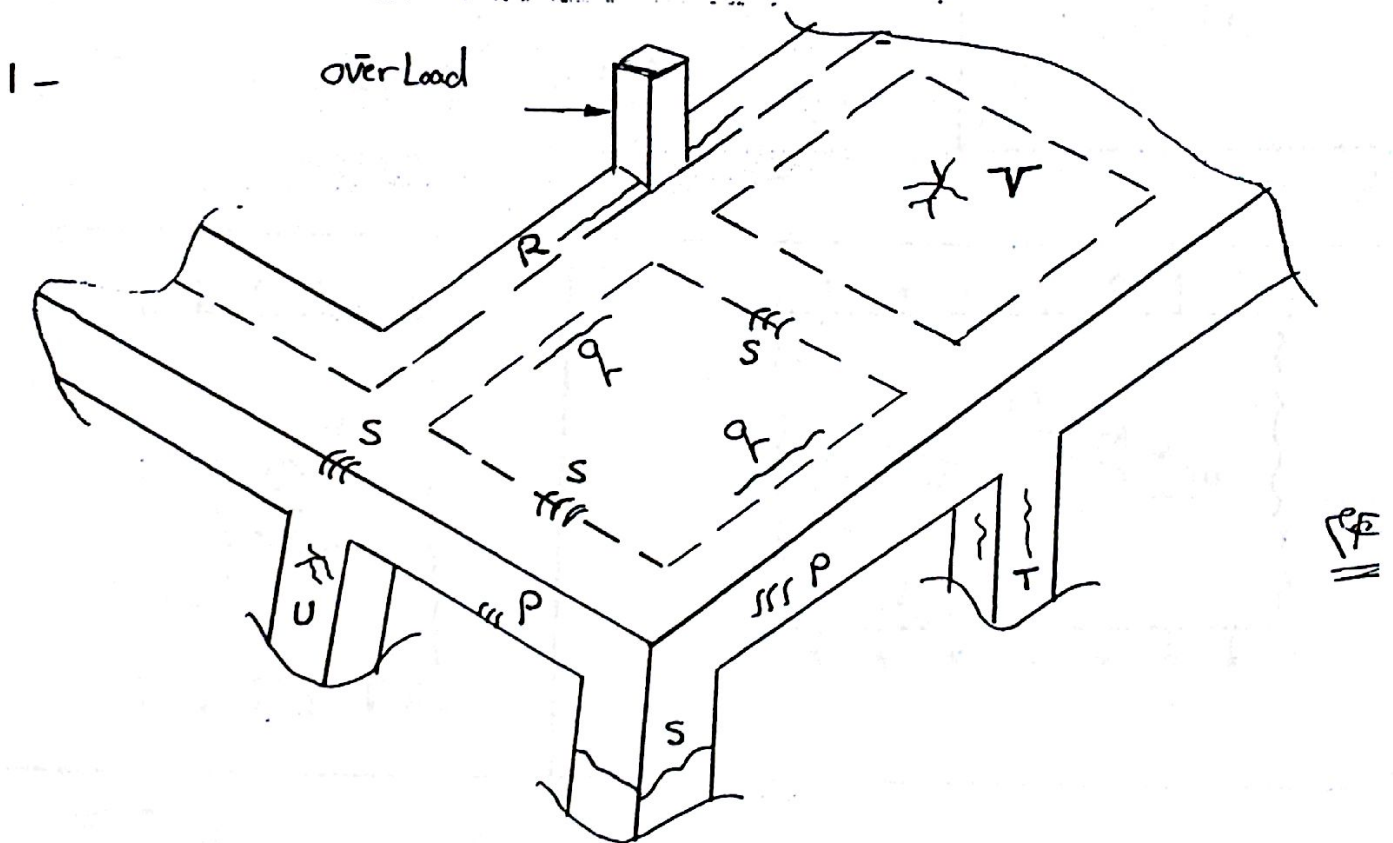


Part II - Fracture Mechanics

Question NO. 1

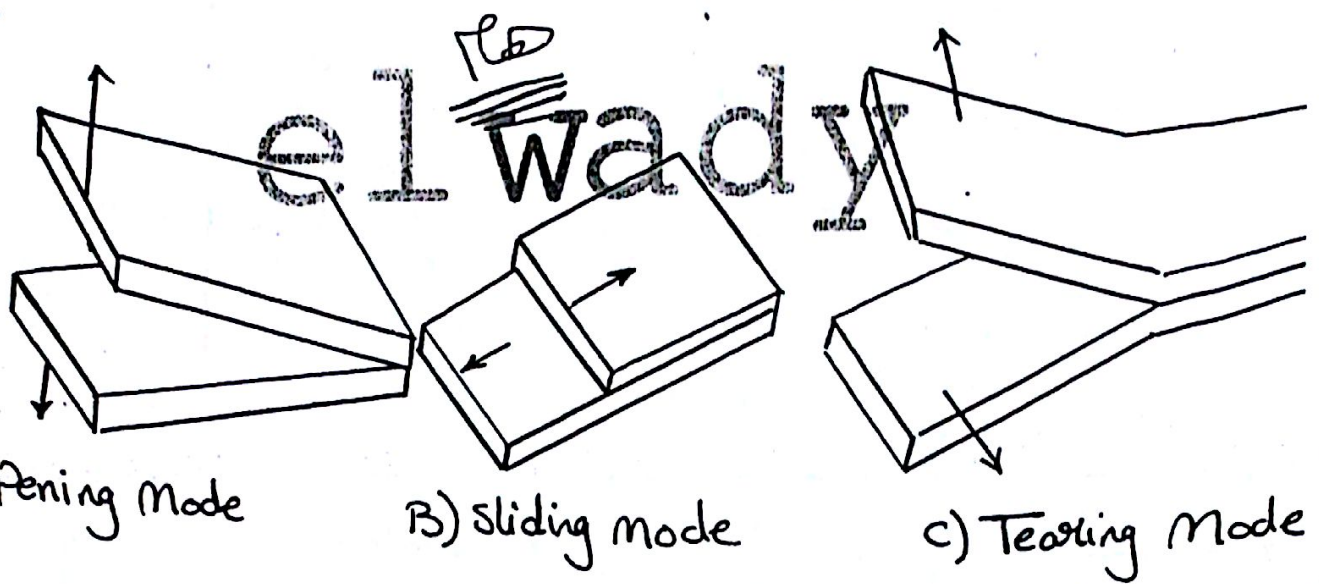
Draw the following with net sketches

1. Examples of structural cracks. (1)
2. The three types of relative movement of the two-crack surfaces. (2)
3. The definition of the critical toughness (K_{IC}). (3)
4. Circumferential stress distribution around an edge of circular hole in an infinite plate. (4)
5. Distribution of $\sigma_{\theta\theta}$ around elliptic hole in an infinite plate loaded perpendicular to the major axis. (5)
6. The criteria of stress cycles. (6)
7. Shape of complete reversed cycle. (7)
8. Shape of a pulsating cycle. (8)
9. The shape of S-N curve for determining the endurance limit. (9)
10. The effect of high temperature on material properties. (10)
11. Creep test setup. (11)
12. The creep-time curve. (12)
13. Failure mechanism by fatigue. (13)



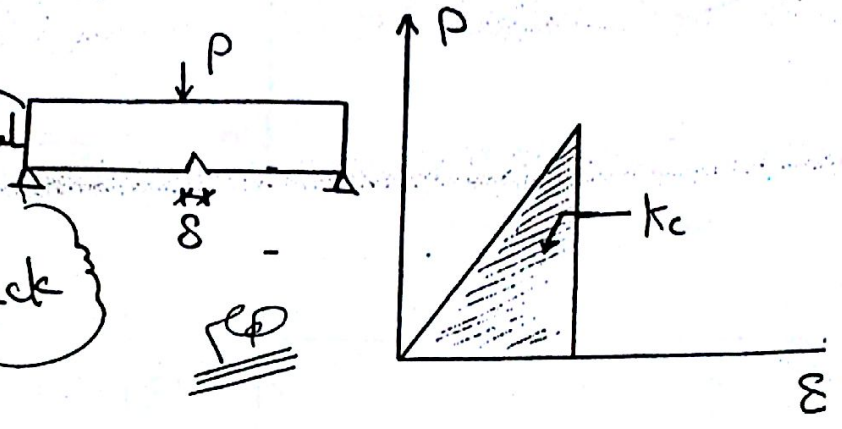
$P - q \rightarrow$ Inadequate Design.
 $R \rightarrow$ overLoad.
 $S \rightarrow$ Differential Movement.
 $T - U - V \rightarrow$ Executional Error.

50/9.1.6/CS
2-

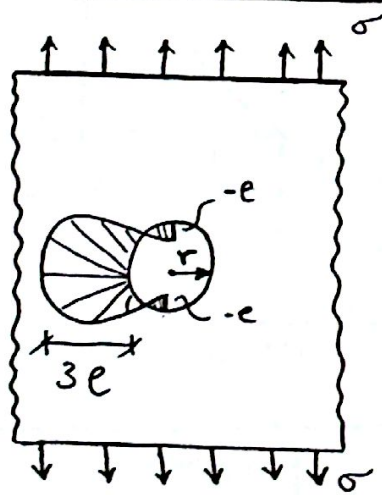


3-

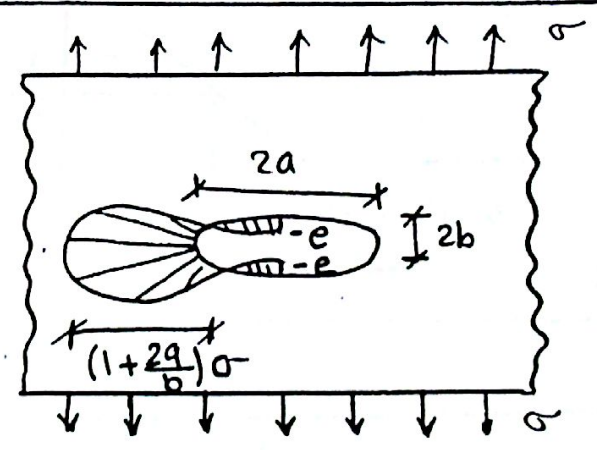
K_{IC} :- The ability of a material to absorb energy in the presence of crack



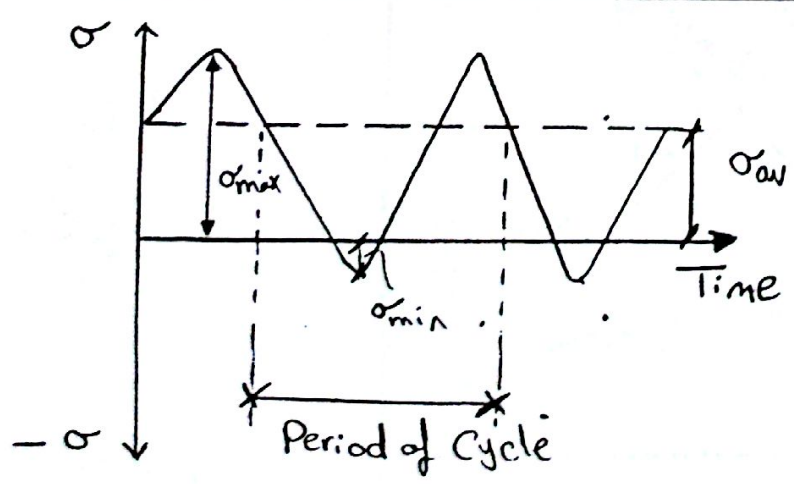
4- circular hole

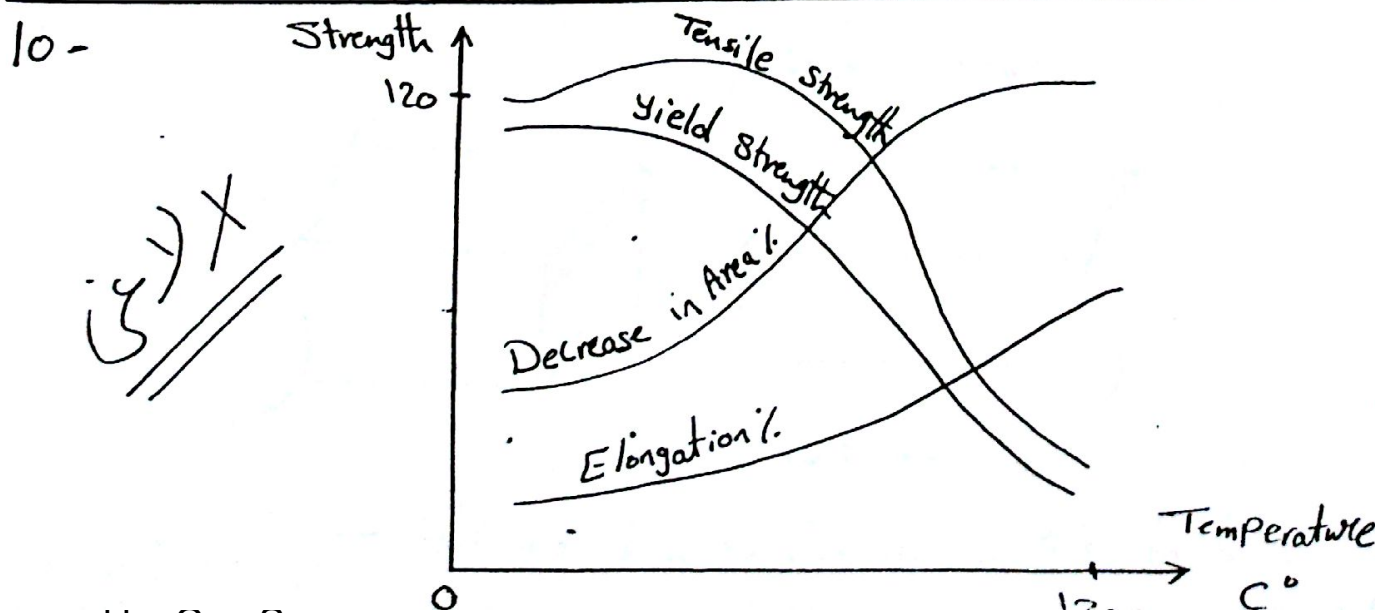
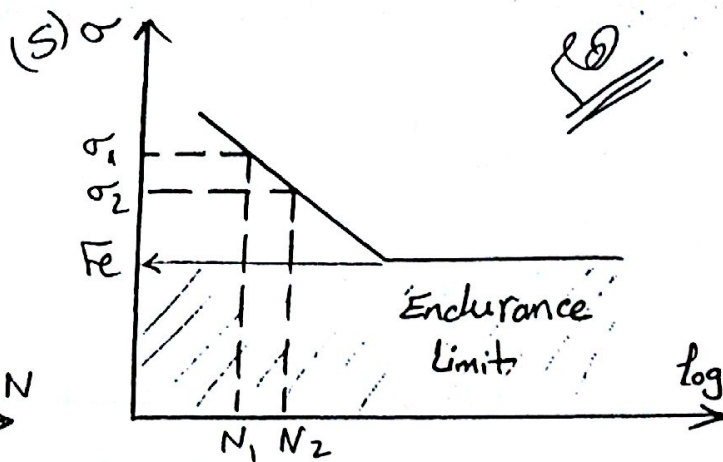
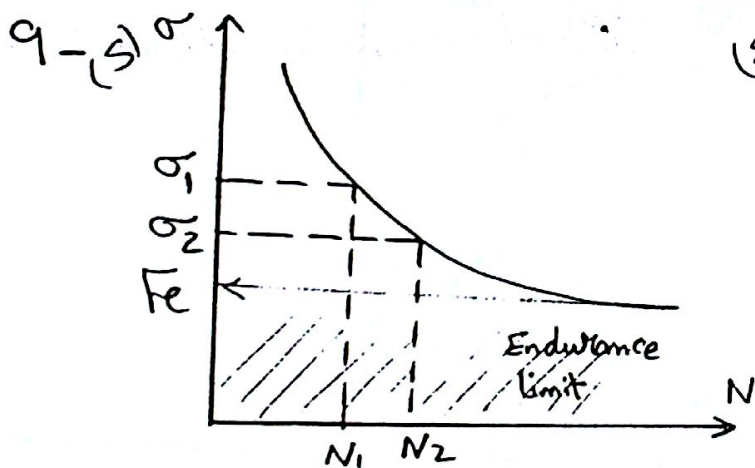
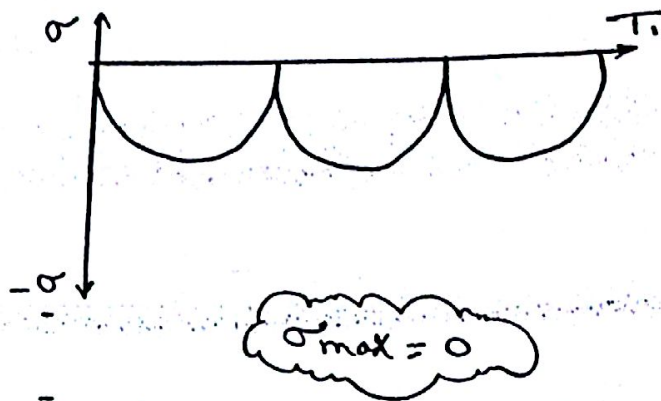
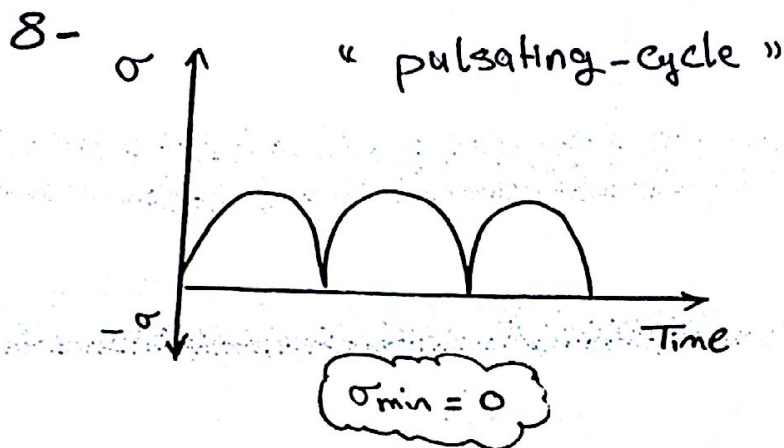
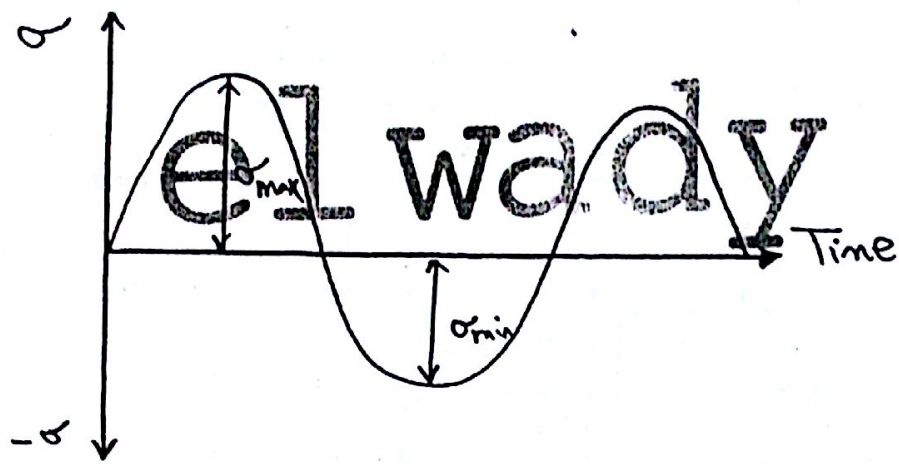


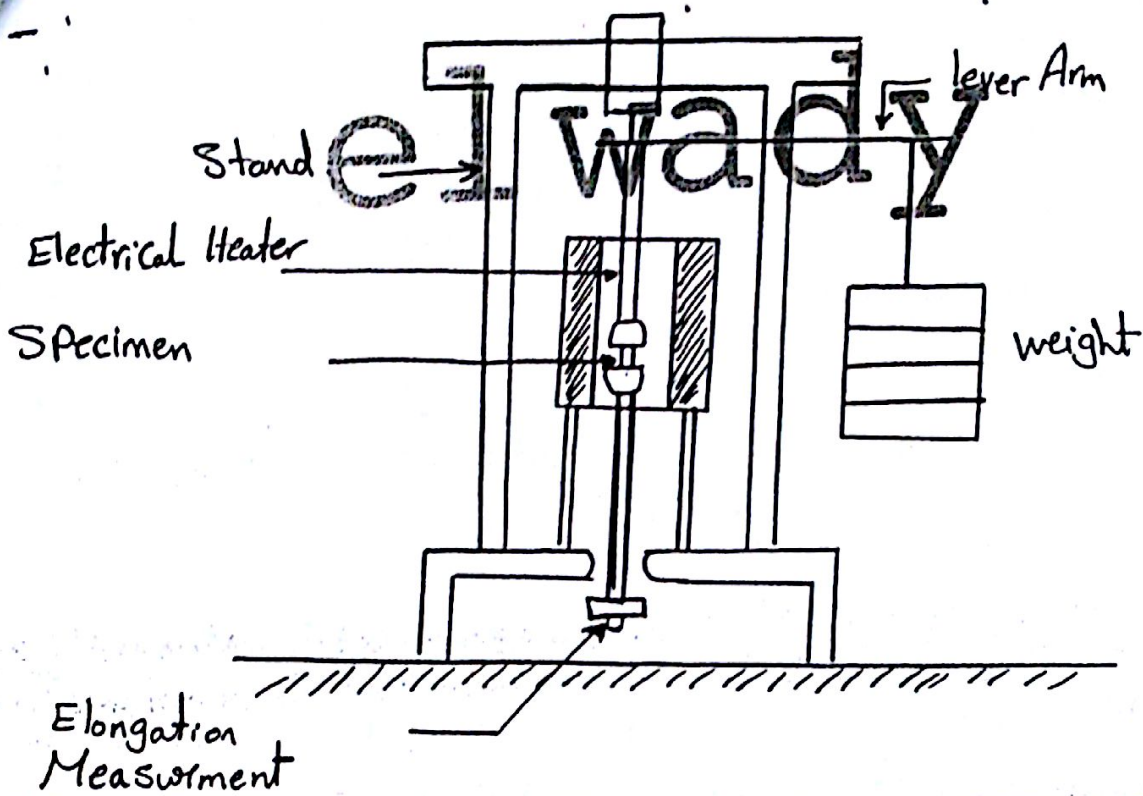
5-



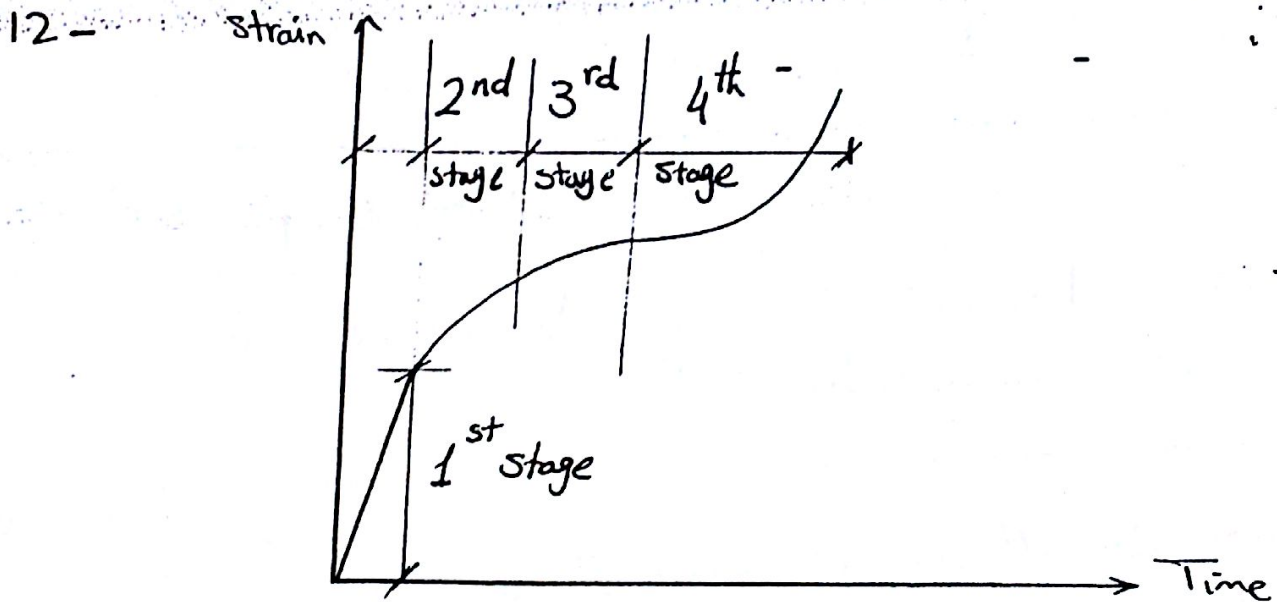
5-



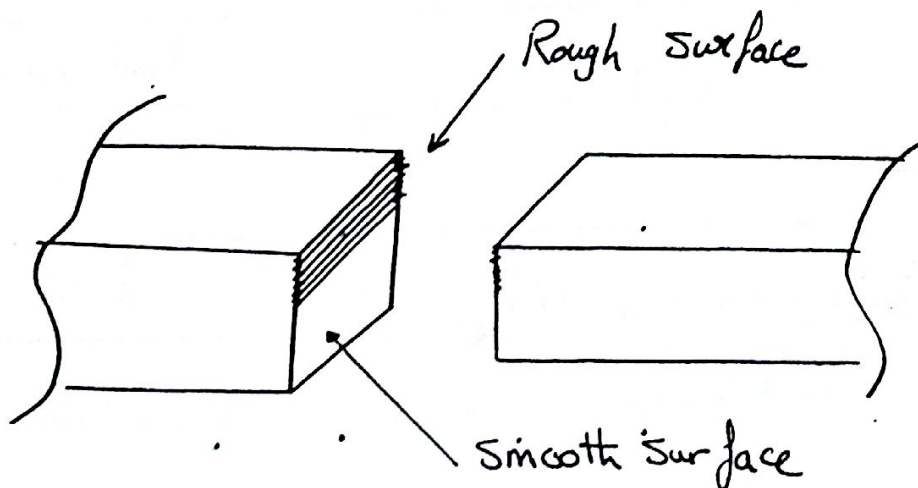




1/2/21



13 -



- Fatigue Failure is a Brittle Failure 4

elwady

Question No 2

Define the following:

- (1) fracture mechanics
- (2) Frequency of cycle.
- (3) Coefficient of asymmetry of a cycle (the skew).
- (4) Endurance limit.
- (5) Impact load.
- (6) Static load.
- (7) Creep.
- (8) The mean stress of a cycle.
- (9) The amplitude of a cycle.

1- Fracture Mechanics:-

- * it is the Methods used to Analysis the Stress and Strain Field Around Crack-tips in Loaded Structure.
- * هي طريقة تستخدم لتحليل الإجهادات والانفعالات حول رأس الشق.

2- Frequency of Cycle:-

- * The Number of Cycles Per second or minute
- * عدد الدورات بالنسبة للثانية أو الدقيقة.

3- The Skew:-

$$r = \frac{\sigma_{\min}}{\sigma_{\max}}$$

- * The Ratio between the min Stress to Max Stress.

ر

4- Endurance limit:-

أقصى إجهاد دوري لدورة إجهادات متكررة
أنه يتحملها.

5- Impact Load:-

انتقال قوة صدم مائتمة إلى جسم أثناء يقوه سريع
مباشرة مثل (أحمال قطار على كوبري - دة خوارزمو - الانفجارات وبعوض).

6. - Static Load :-

→ Where is No Mechanical Movement of structure
When Pressure is transformed to the body
> 3 times natural Period.

7 - Creep :-

it is deformation of an element and Constant strain with Time.

هو حدوث تشوهات (تخميم) للعنصر مع ثبات الإرتفاع مع الوقت.

8 - The mean Stress of cycle :-

$$\sigma_{av} = \frac{\sigma_{max} + \sigma_{min}}{2}$$

متوسط الجسبي للضغط، اقل اجهاد

ف

9 - The Amplitude of a cycle :-

$$\sigma_a = \frac{\sigma_{max} - \sigma_{min}}{2}$$

نصف الفرق بين أقصى اجهاد وأقل اجهاد

ف

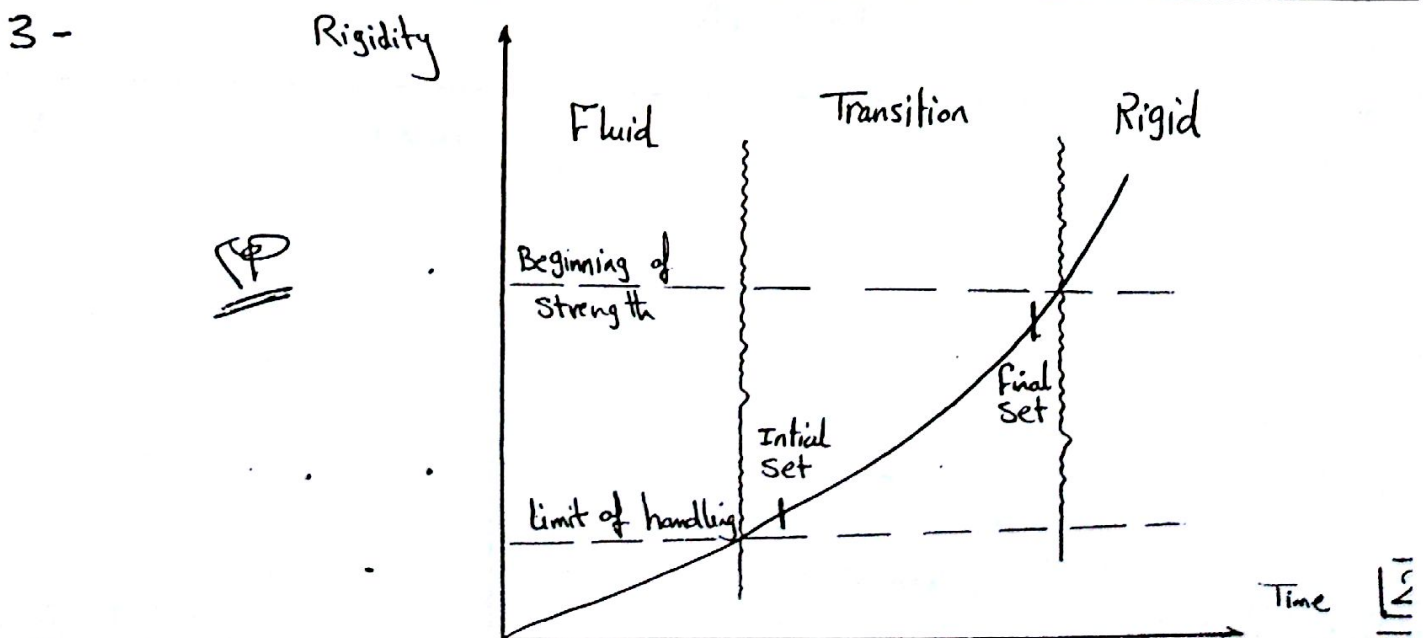
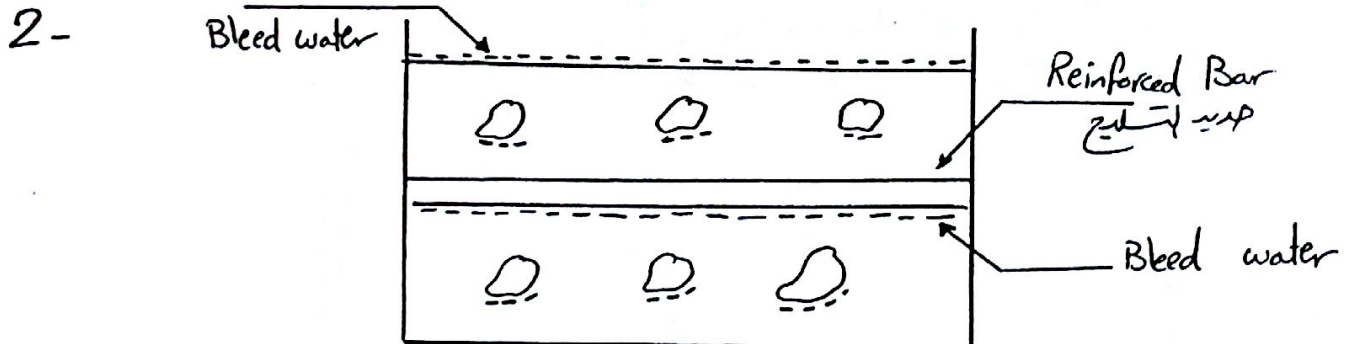
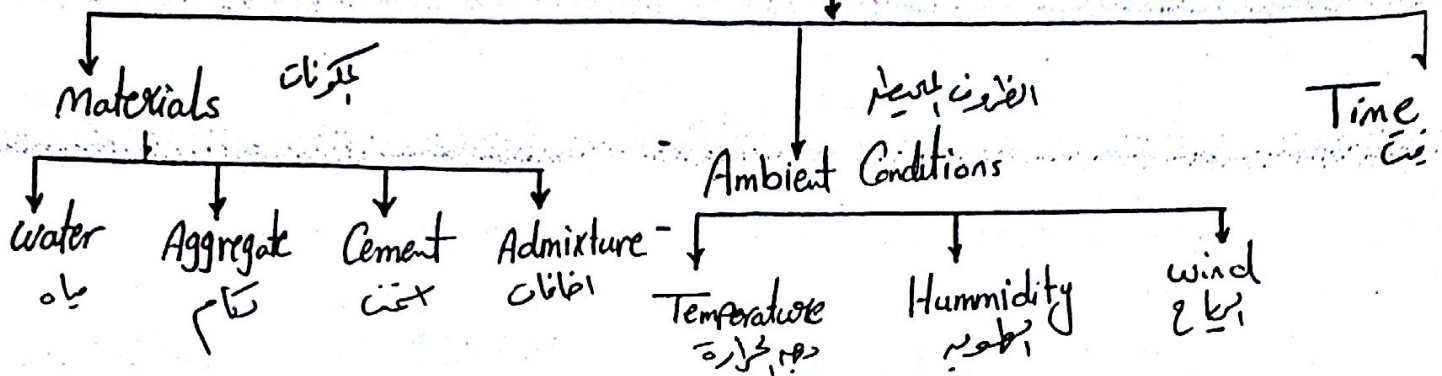
الفرق بين
أقصى اجهاد وأقل اجهاد

Question (1) (25% of max. grad)

Draw the following with net sketches (ان يكتل إلى الرسومات المرسومة بدون القلم الرصاص والمسطرة)

1. Factors affecting workability of concrete.
2. The different types of bleeding in concrete.
3. The process of setting and hardening of concrete.
4. Development of strength of typical concrete made with different types of Portland cement.
5. Examples of structural cracks. (Part II)
6. The influence of curing and time of curing on the development of strength.
7. The effect of height-diameter ratio of specimen on concrete compressive strength.
8. The types of elastic deformation.
9. The creep test setup. (Part II)
10. The Shape of standard specimens and setup for compression, splitting, and flexural tension.
11. Mechanism of fatigue Failure. (Part II)
12. Creep and creep recovery of concrete stored in water and in air.

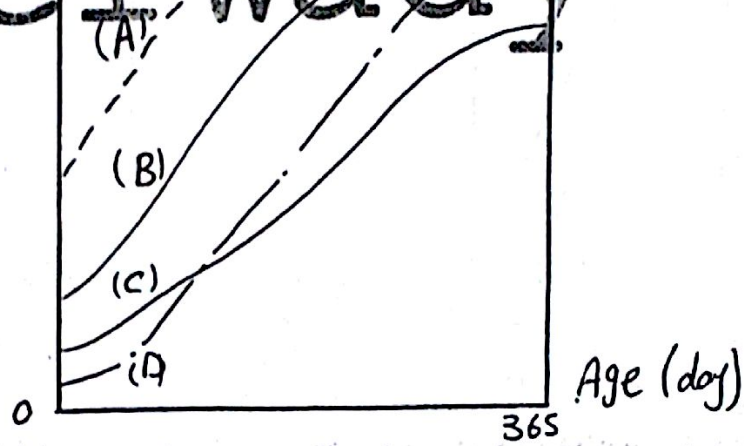
Factors Affecting Workability



4-
50/100

Compressive
Strength

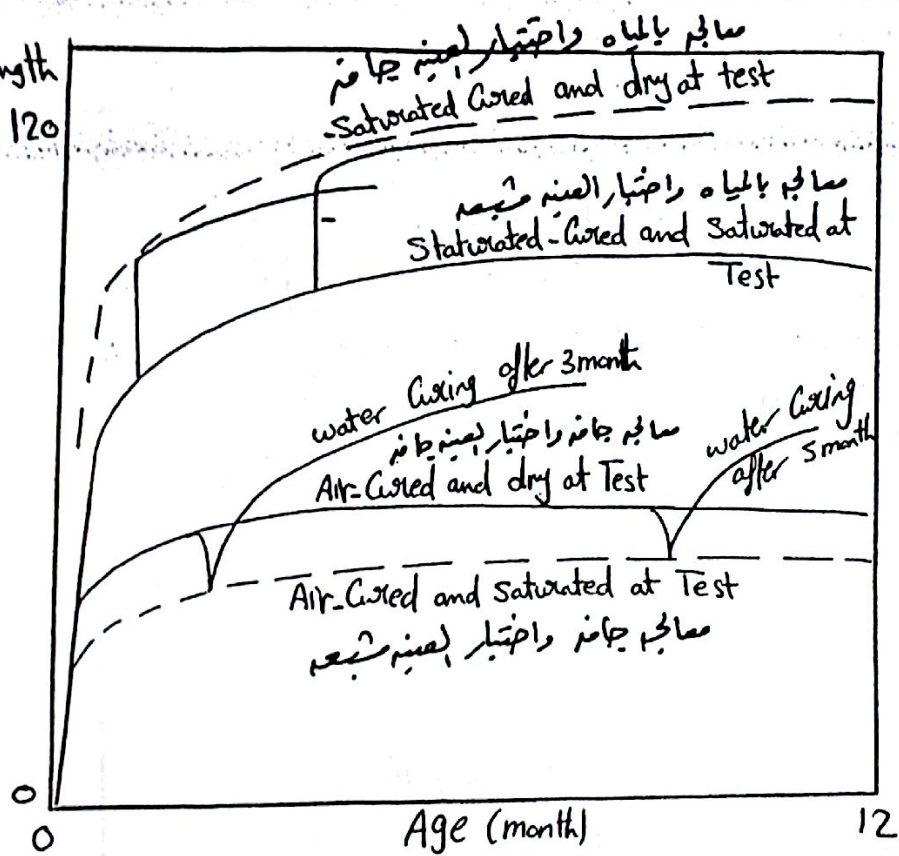
elwady



6-

Strength
120

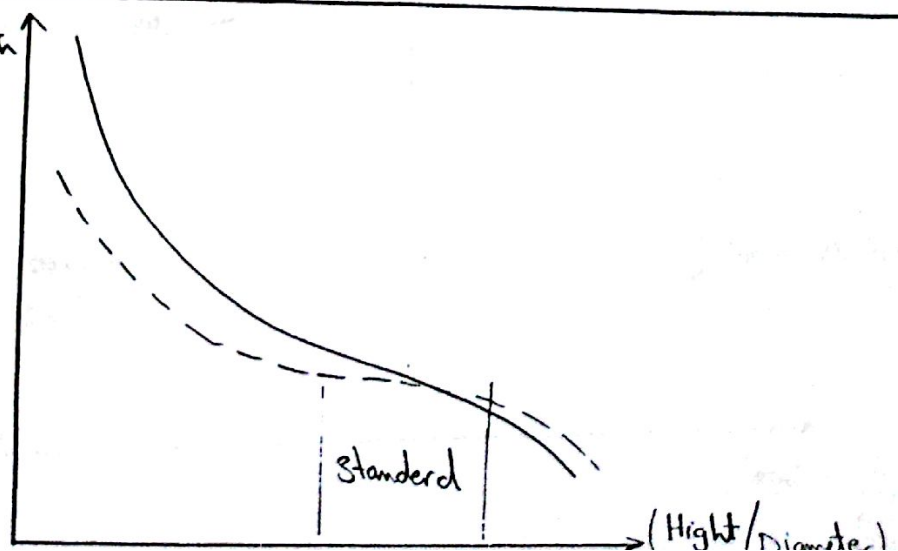
RP



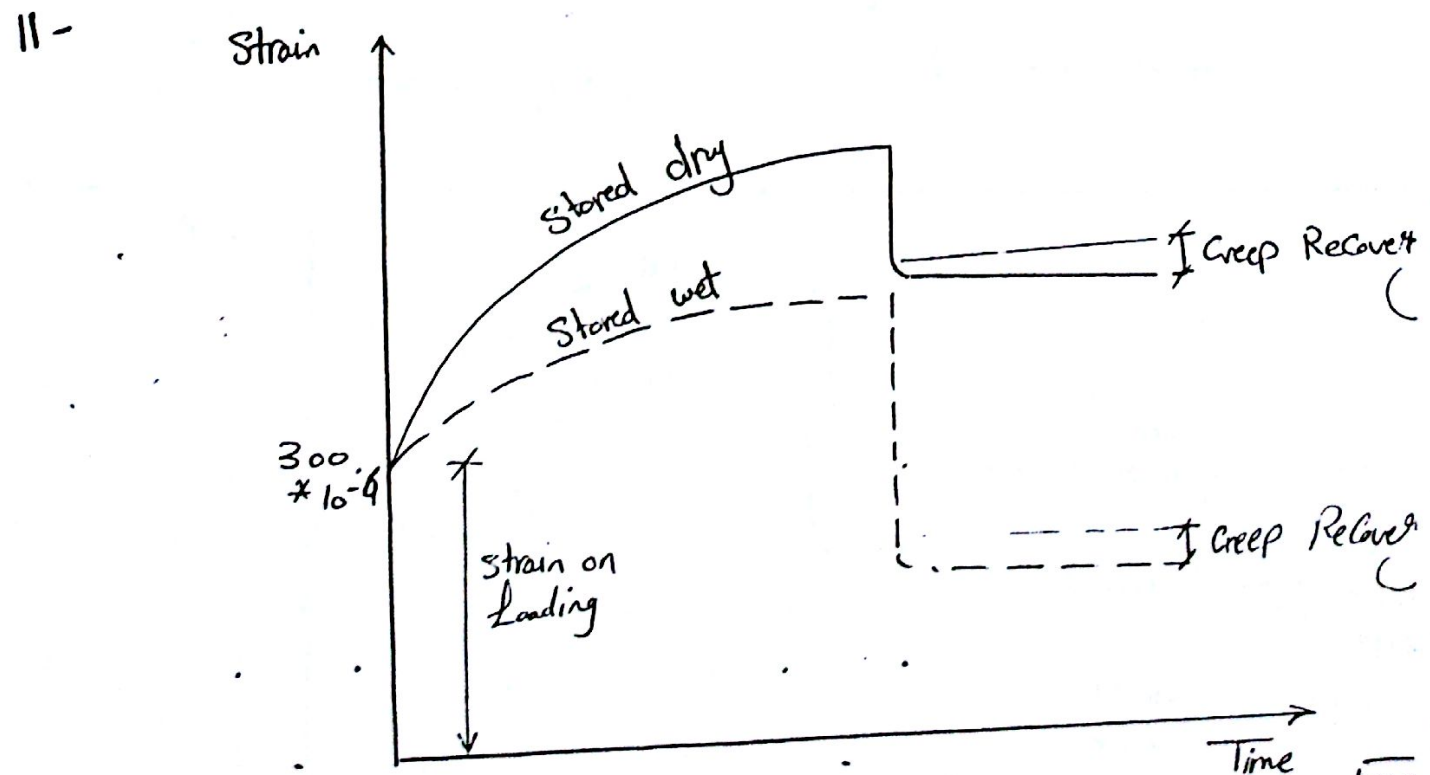
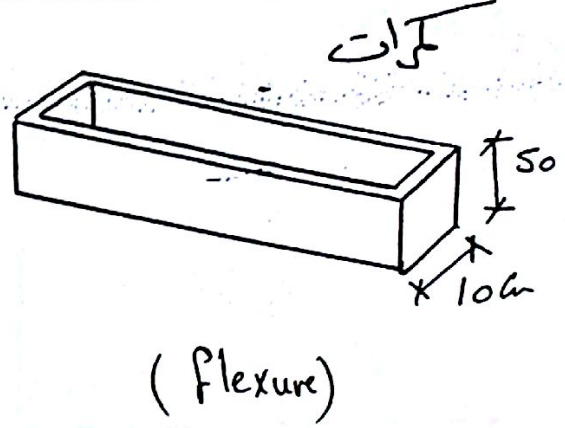
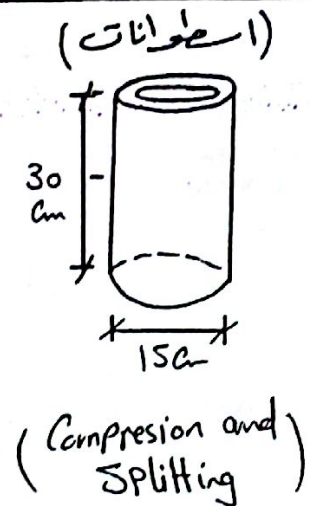
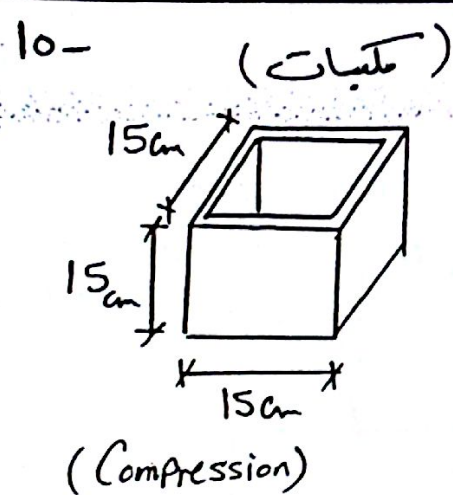
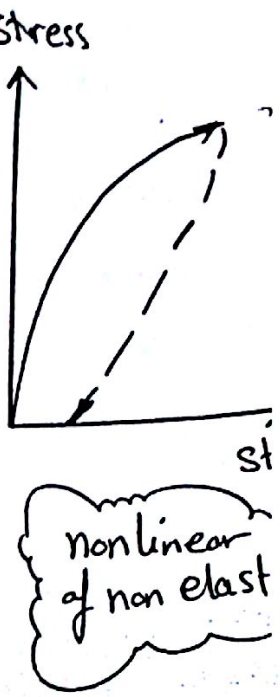
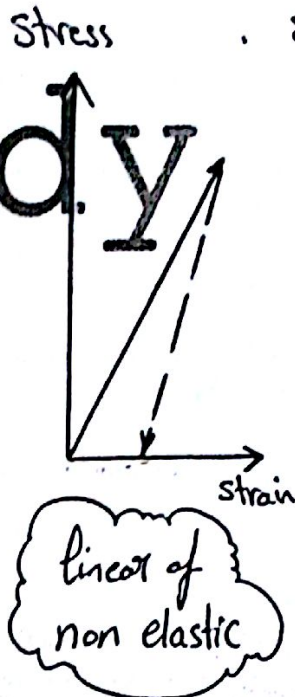
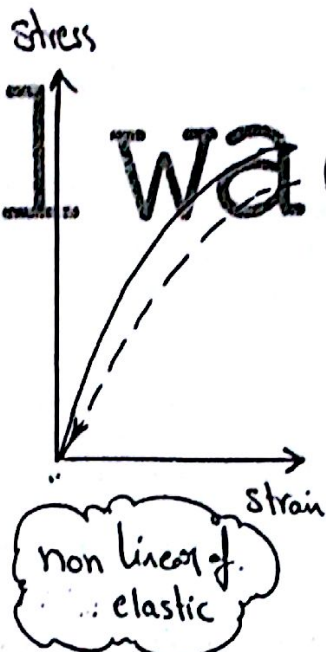
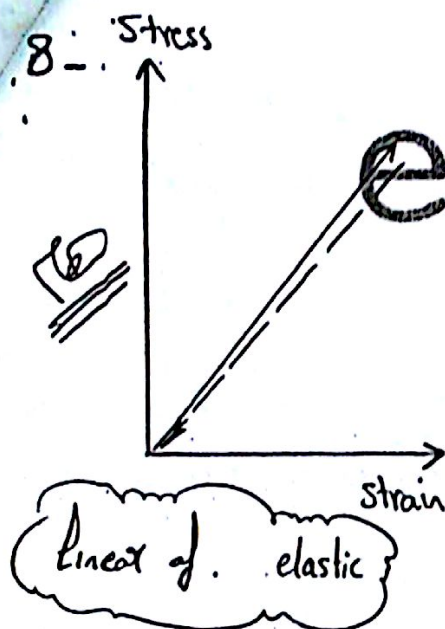
✓

7-

Strength



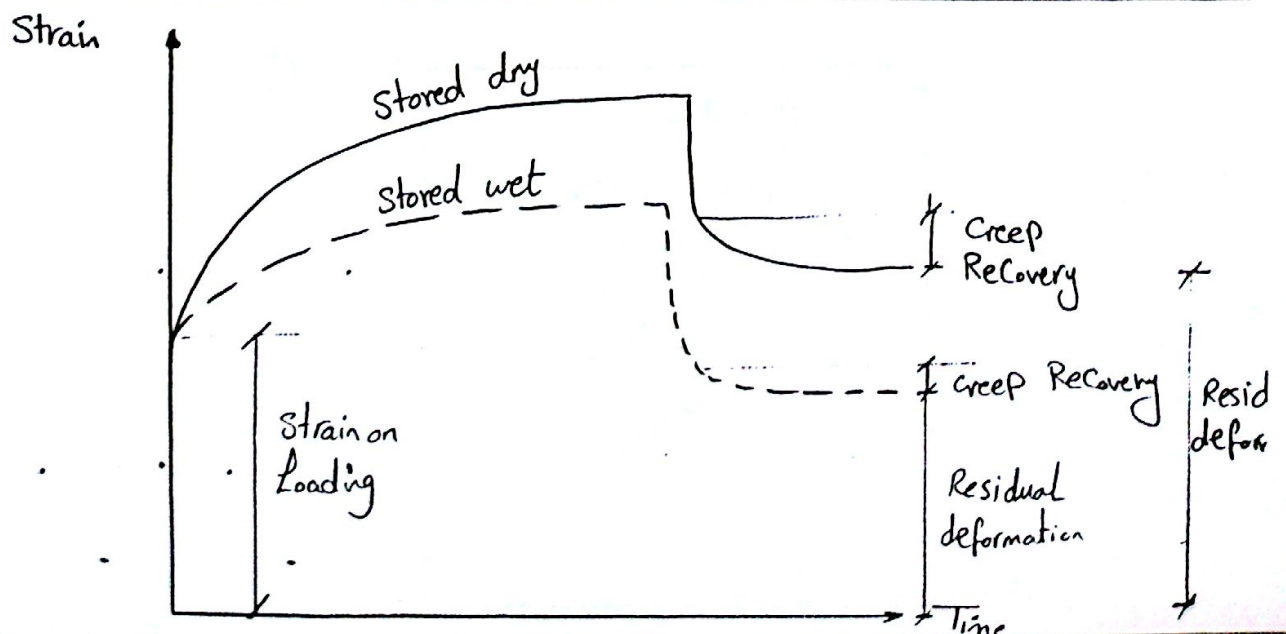
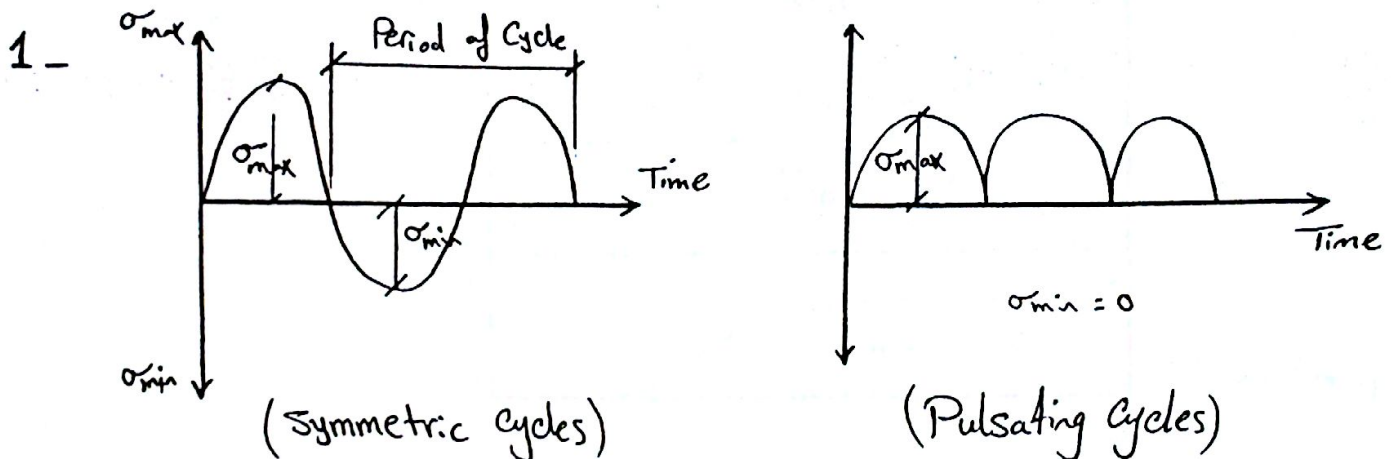
elasticity



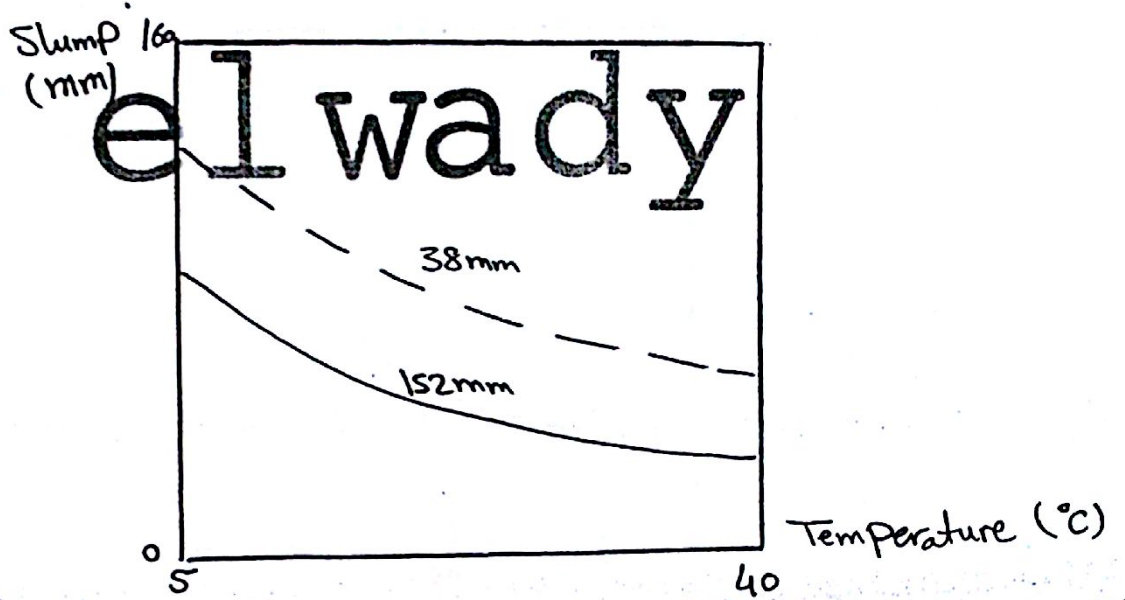
Q1	Idea (50)%	Steps (25)%	Calculations (15)%	Final Result (10)%	Mark (30)
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Draw the following with neat sketches (free hand drawings will not be evaluated)

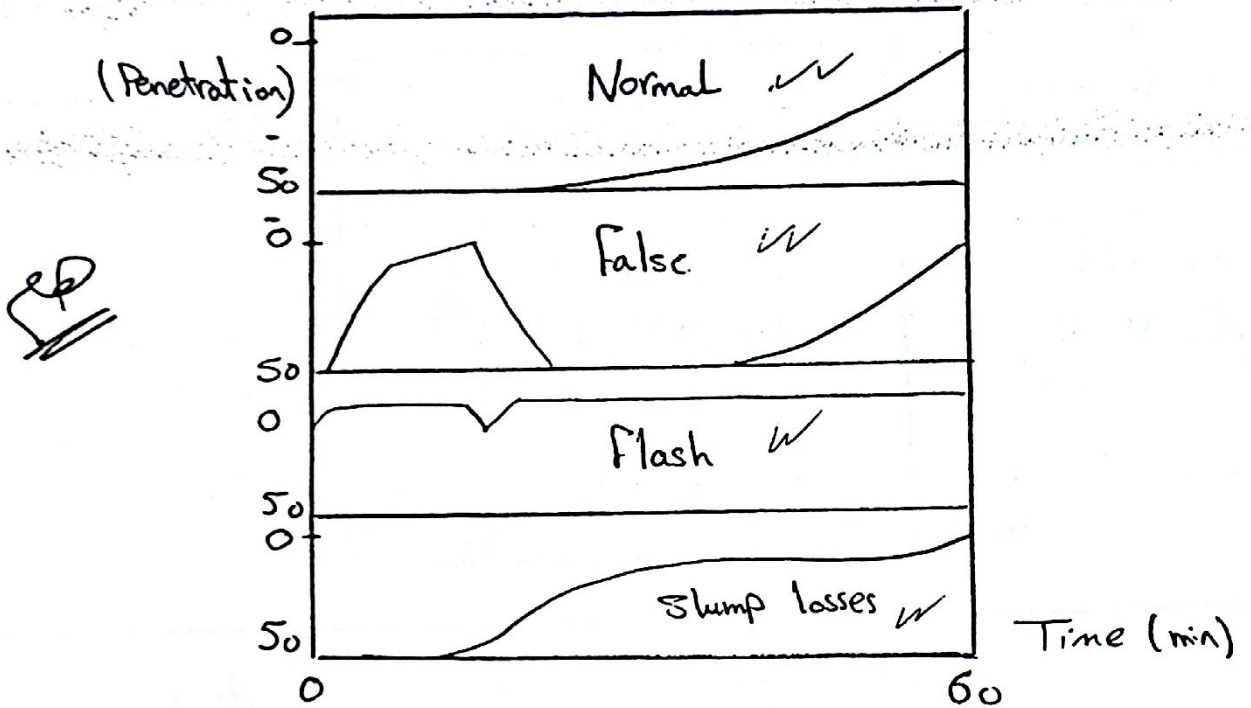
1. The shape of symmetric and pulsating cycles showing the basic criteria of the cycles. Part (II)
2. The strain - time curve showing all stages on drawing.
3. The influence of temperature on slump of laboratory mixed concrete with different maximum aggregate size.
4. Diagrammatic sketch of different types of set of cement, mortar, and slump loss of concrete.
5. Cube strength relationships for concrete made with Ordinary Portland Cement.
6. Examples of structural cracks (Part II)
7. Effect of height-diameter ratio on concrete compressive strength.
8. Graph showing the different types of the modulus of elasticity.
9. Effect of curing conditions on the strength of concrete.
10. The process of setting and hardening of concrete.
11. Variation of tangent modulus and poisson's ratio with stress level and rate of loading.
12. Graph showing the loss of workability of concrete with time.
13. Graph showing the effect of high temperature on material properties. (Part II)
14. Effect of modulus of elasticity of aggregate on relative creep of concrete.
15. Different types of bleeding of concrete.
16. Circumferential stress distribution around an edge of circular hole in an infinite plate. (Part II)
17. The three types of relative movements of the two-crack surfaces. (Part II)
18. The Ve Be apparatus.
19. Effect of cement fineness on the development of concrete strength.
20. The parameters affecting workability of concrete.



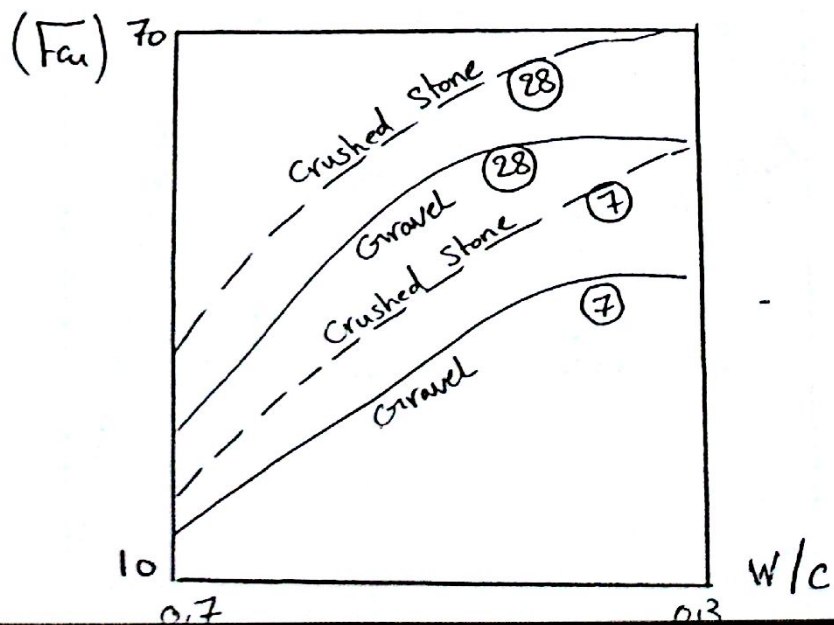
3- 19/5



4-

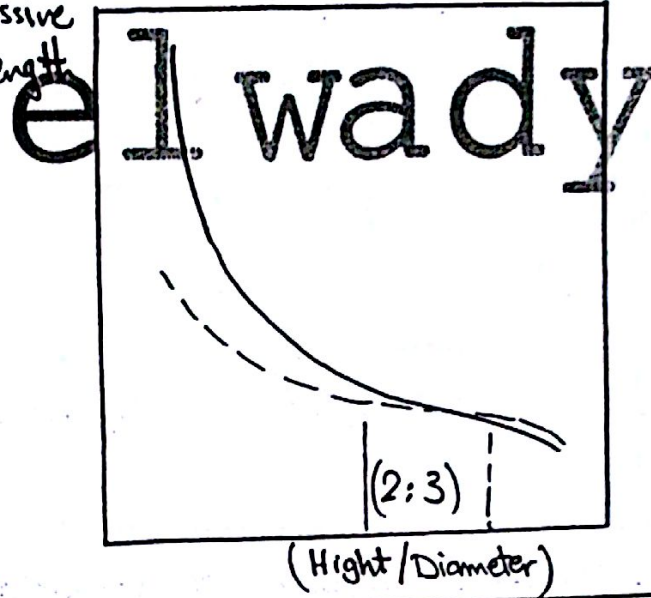


5-



7-
16/5

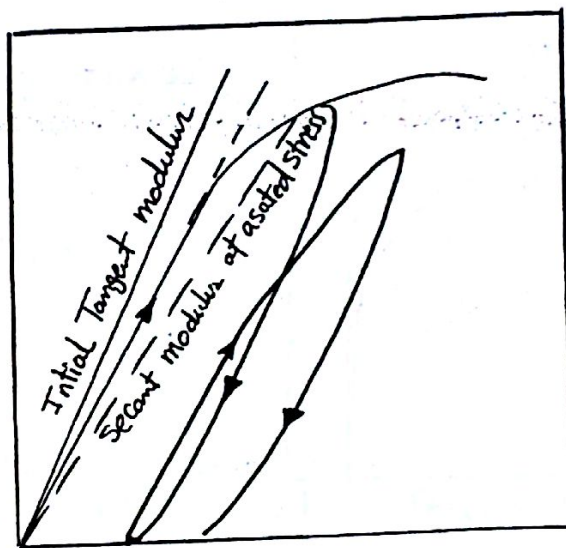
Compressive
Strength



8-

different type
of Modulus of
elasticity

Strain

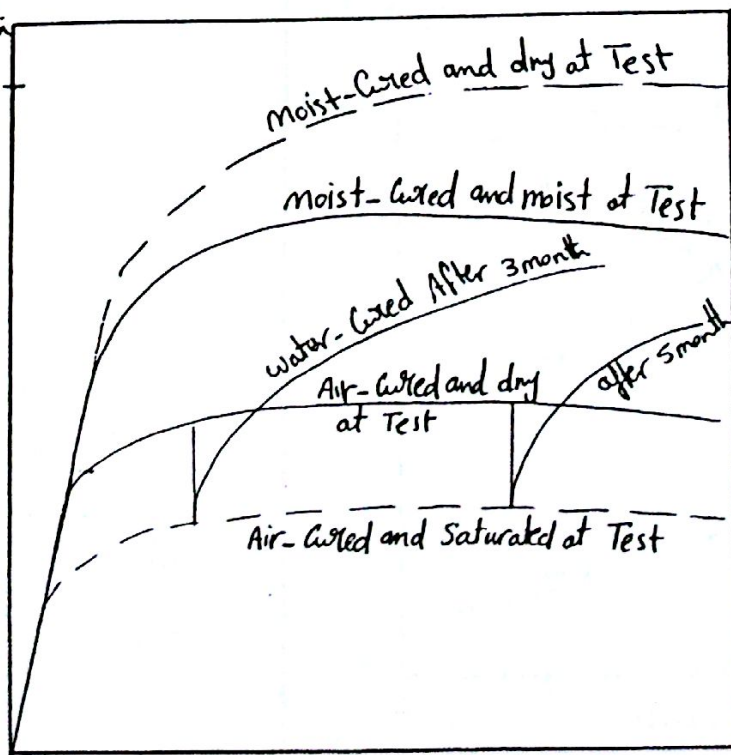


Stress

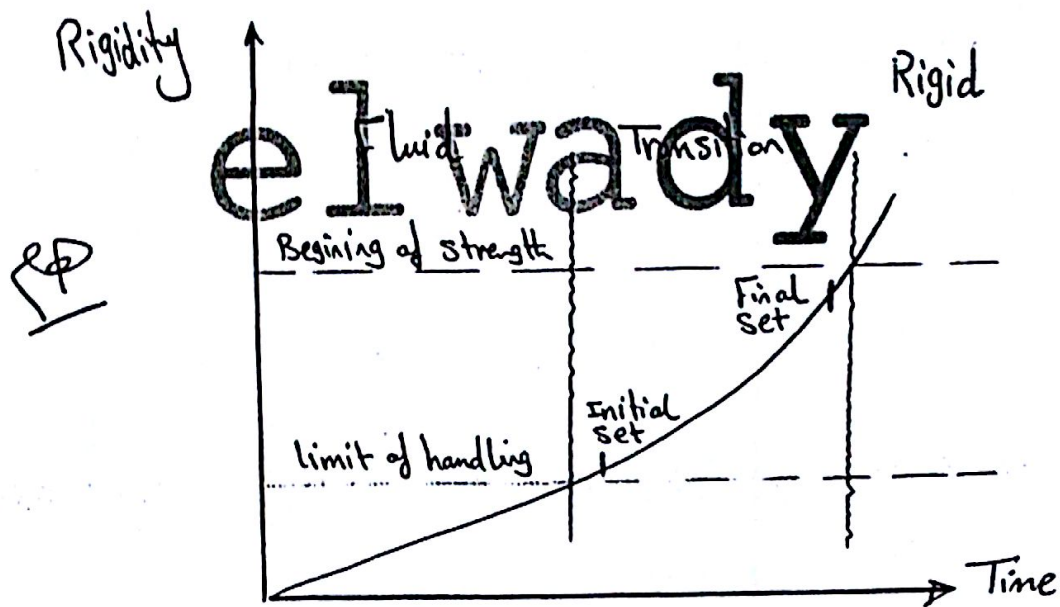
9-

2.

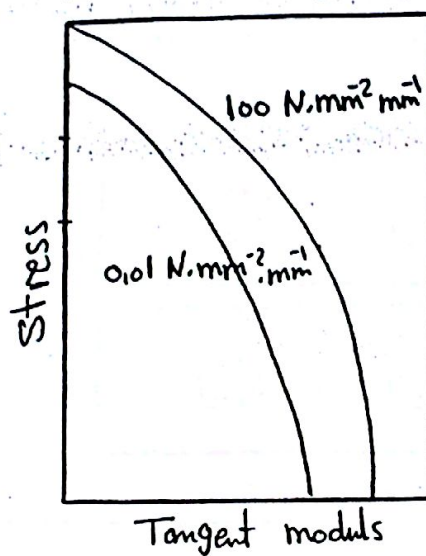
Strength
120



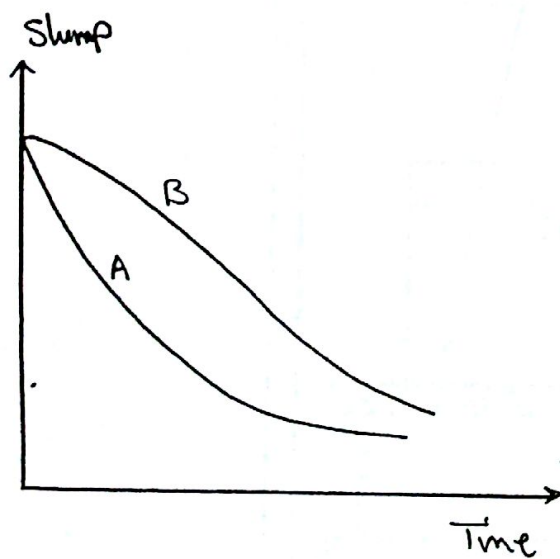
Age



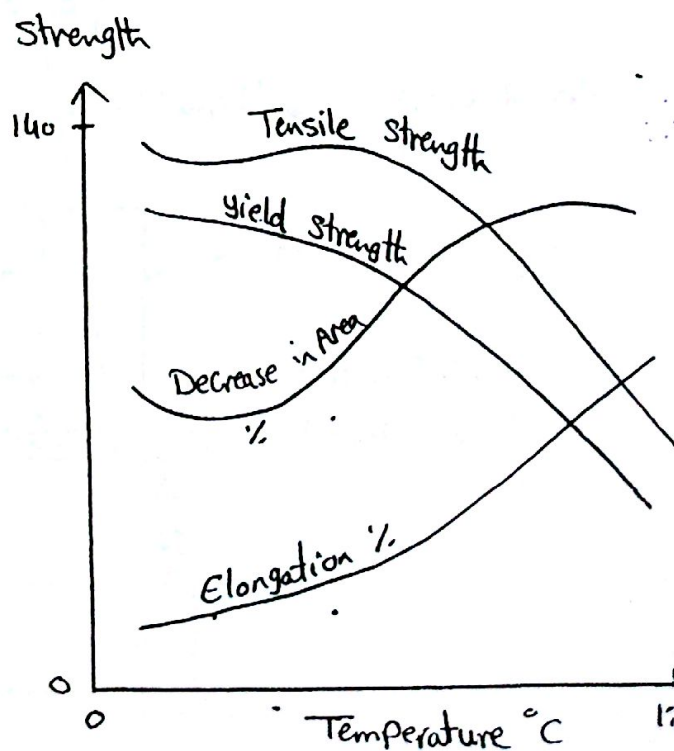
11- 1213



12-

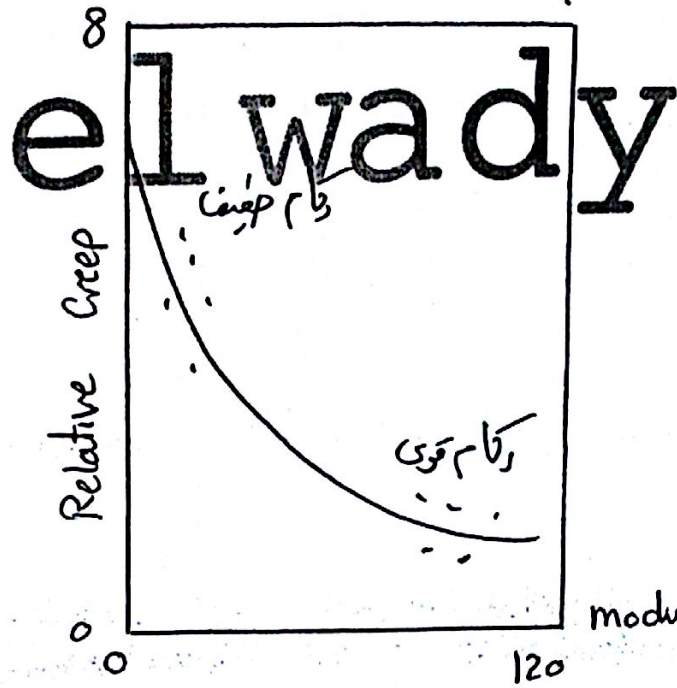


-13

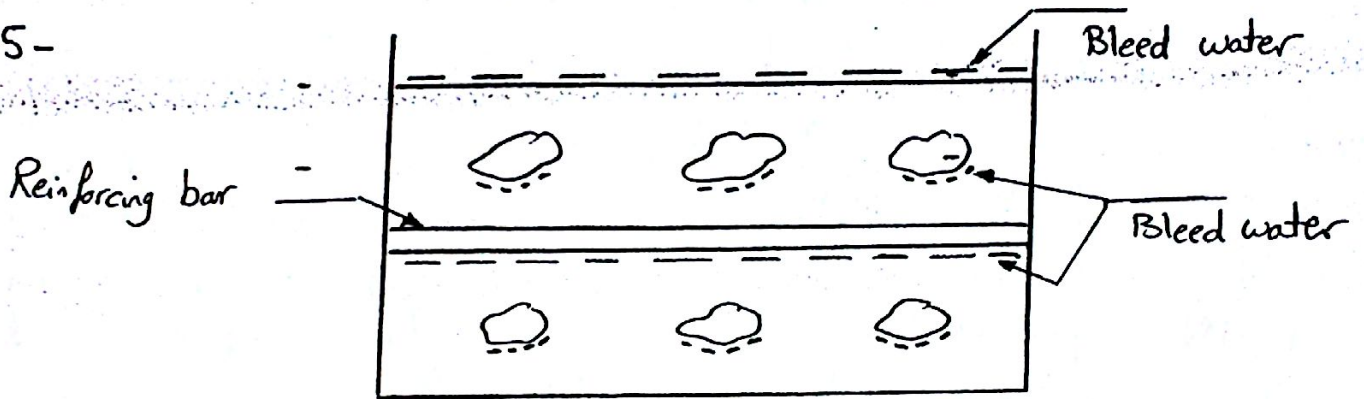


127

14-

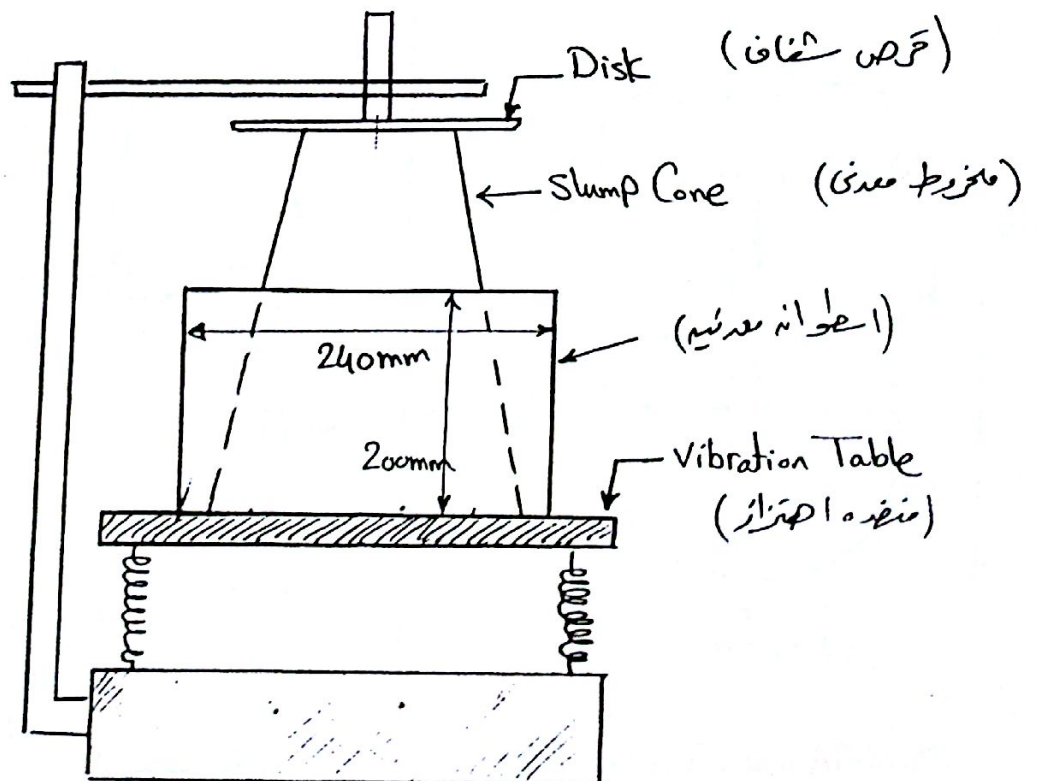


15-



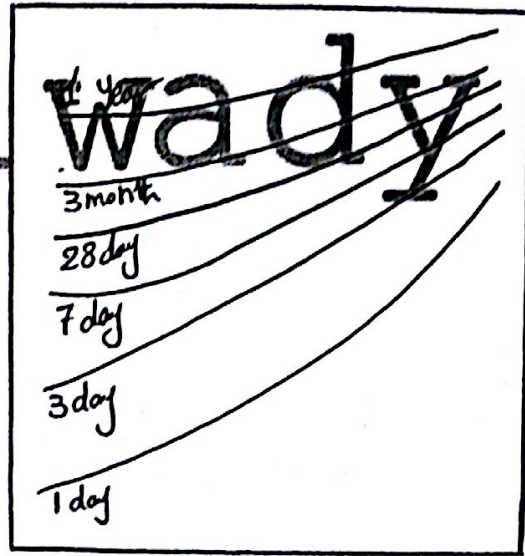
18-

Ve be



19-

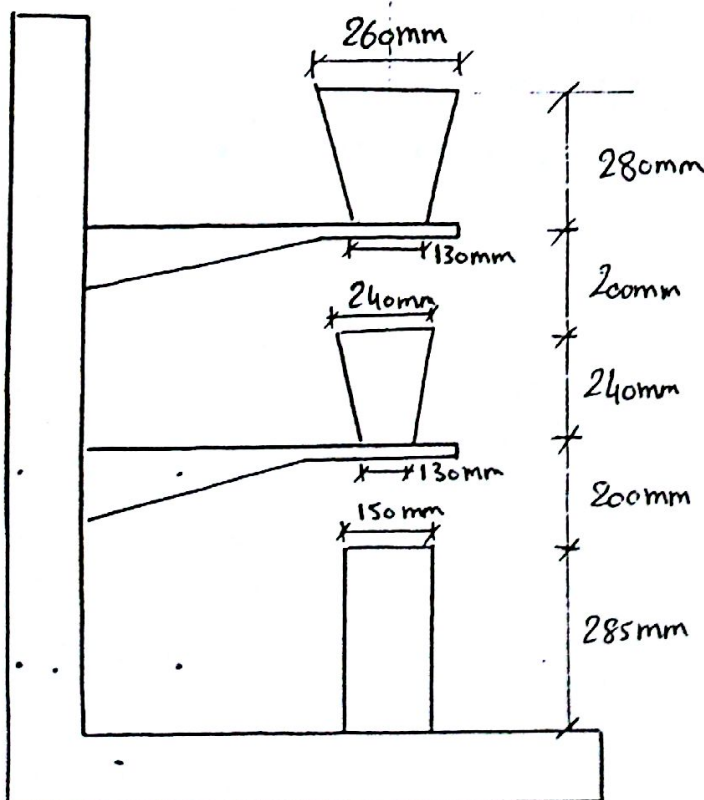
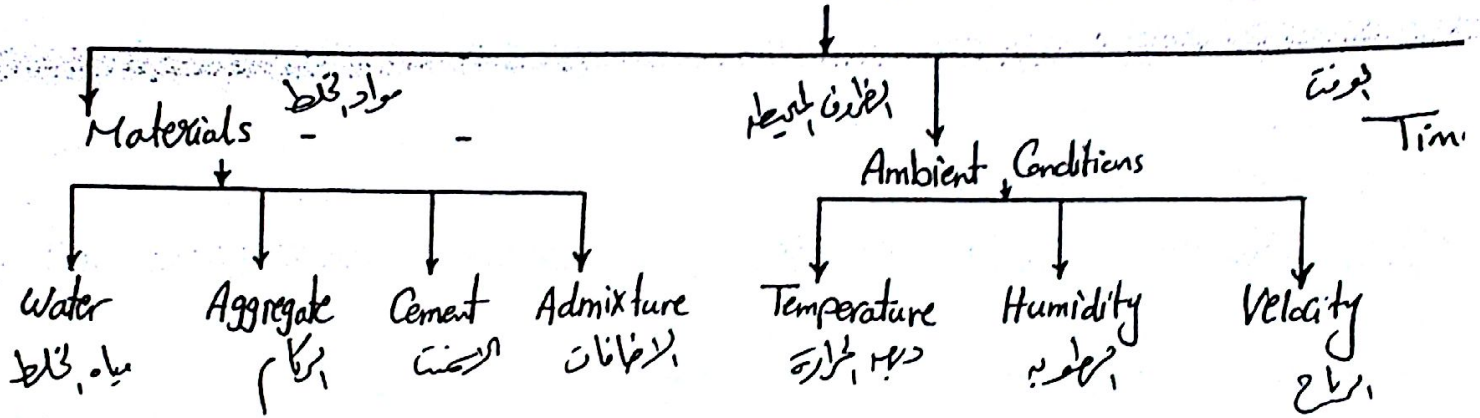
(Fcu) %
el wady



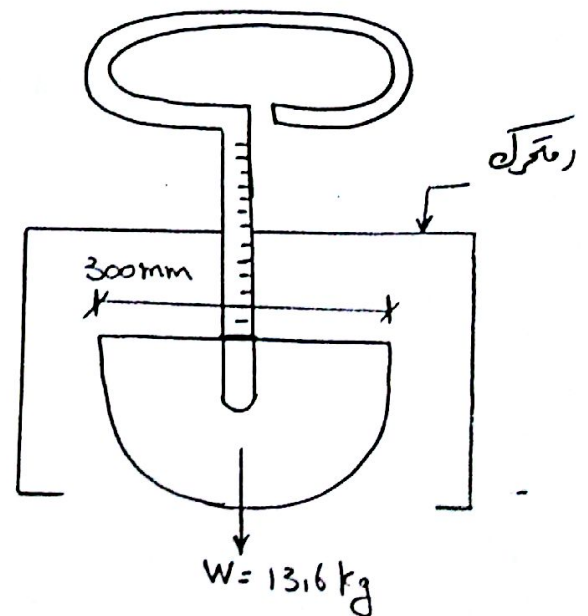
Fineness of cement 800

20-

Parameters affecting workability

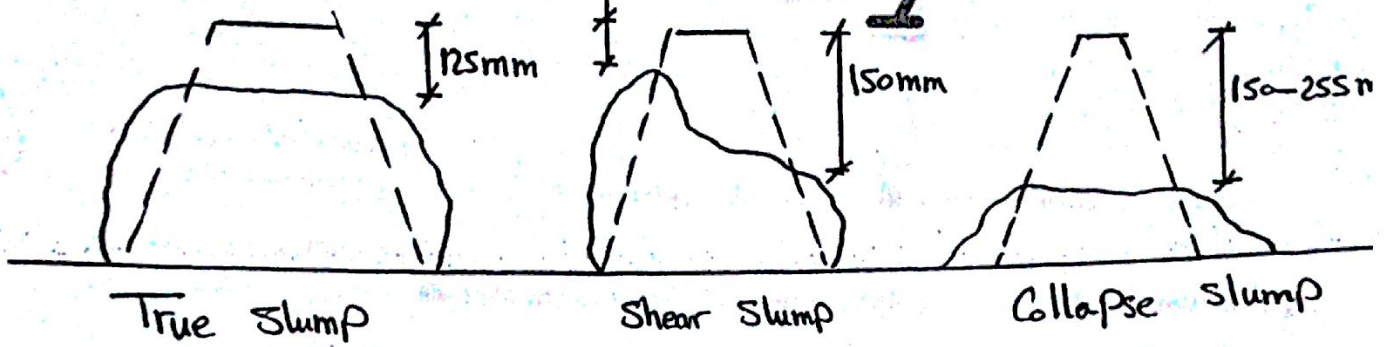


(Compacting Factor Apparatus)



(Kelly Ball Apparatus)

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(Types of Slump)

Q2	Idea (-)%	Steps (-)%	Calculations (-)%	Final Result (100)%	Mark (40)
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Choose the correct choice for each of the following statements in the attached answer sheet. The choice is correctly made by filling the circle in front of the correct letter, a, or b, or c, or d same as that ①.

1- Concrete is a man-made composite material composite of

- ☒ a- aggregate and cement past ☐ b- aggregate and cement ☐ c- cement and lime aggregate
☐ d- coarse aggregate and cement mortar

2- Final set corresponds approximately to

- ☒ a- the mid-point of stage 3 of C3S hydration ☐ b- the end of stage 3 of C3S hydration
☐ c- Approximately at the beginning of stage 3 of C3S hydration ☐ d- at any time of any stage

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3- Superplasticizers are

a- Boron admixtures

b- workability reducers

☒ c- water reducers

d- slag

4- False and flash set are

a- normal set

☒ b- abnormal set

c- cement additions

d- concrete setting

5- The strength of concrete is defined as

☒ a- the maximum load it can carry

b- compressive stress

c- tensile strength

d- durability

6- Concrete structures, except for road pavements, are normally designed on the basis of

☒ a- tensile strength

b- shear strength

c- concrete strength

d- compressive strength

7- The tensile strength in bending is known as

a- modulus of rupture

b- splitting strength

c- cube strength

☒ d- beam strength

8- Cements containing a relatively high percentage of C_3S , gain strength much more rapidly than those rich in

a- C_4AF

b- C_3A

☒ c- C_2S

d- C_3AF

9- The minimum water cement ratio required for full hydration is

a- 0.36

☒ b- 0.25

c- 0.5

d- 0.22

10- A partially compacted concrete will contain large voids and the concrete strength

a- will be high

☒ b- will drop

c- will be constant

d- will be more than 50MPa

12- Cracks initiated at the bottom of beams and slabs are due to

a- differential settlement

☒ b- inadequate design

c- overloading

d- poor concrete

13- One of the disadvantages of concrete is

a- the low shrinkage

b- the low toughness

☒ c- the low ductility

d- the low strength

14- Long-term requirements of concrete are

a- strength

b- stability

c- consistency and stability

☒ d- durability and strength

15- The higher the water-cement ratio

a- the higher is the workability

b- the higher is the strength

☒ c- the higher is the workability and the lower is the strength

d- the lower is the strength

16- The increase in the aggregate-cement ratio

a- will increase the workability

☒ b- will decrease the workability

c- will not affect the workability

d- will increase the water effect

17- Rounded coarse aggregate particles

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a- increases the strength

b- decreases the workability and decreasing the strength

c- decreases the strength

18- Aggregate with rough texture and angular shape

a- decreases the workability strength

b- decreases the strength

c- decreases the bond

d- increases the durability

19- The increased fineness of cement will reduce workability at a given w/c ratio as those cements have

a- high alkali content
c- small size particles

b- higher specific surface area and hydrate more rapidly
d- rounded particles

20- Aggregates

a- are limestone than concrete itself

b- are sandstones

c- are natural gravel and sand

d- stronger

21- The optimum aggregate size used for concrete lies in the range of

a- 10 and 50mm

b- 10 and 60mm

c- 9 and 13mm

d- 40 and 50mm

22- Aggregate

a- has a hard strength effect on concrete strength

b- has a little effect on concrete strength
d- increases the workability of concrete

c- has a significant

23- Standard curing requires

a- hot-humid conditions

b- 90% humidity and 20°C temperature
d- dry air

c- dry -hot

24- The higher the curing temperature of concrete

a- the lower is the rate of strength gain

b- lower is the final strength

c- the higher is the final strength

d- the higher is the early strength and the

d- the lower is the final strength

25- The basic specimens used for determining concrete compressive strength are

a- beams and prisms

b- mortar cubes

c- S shaped specimens

d- cubes, cylinders

26- The indirect tensile strength is

a- lower for dried concrete than saturated concrete

b- lower for saturated concrete than for dried concrete

c- higher for saturated concrete than for dried concrete

d- equal to 2% of concrete compressive strength

27- The faster the loading rate

a- the lower is the indicated strength

c- the higher is the shrinkage mechanism

b- the faster is the hydration rate

d- the higher is the indicated strength

28- The time-dependent strain is called

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a- shrinkage

b- durability

☒ c- creep

d- swelling

29- The modulus of elasticity is the ratio of load per unit area to

a- the plastic strain

b- the elastic deformation

c- linear strain

☒ d- the elastic

deformation per unit length

30- poisson's ratio of concrete is equal to

a- 1

b- 2

c- 0.5

☒ d- 0.2

31- For structural elements constrained with fixed end conditions, creep causes

a- excessive strains

b- excessive stresses

c- higher concentrated strains

☒ d- stress relaxation

32- In normal weight concrete, the source of creep is

☒ a- the hardened cement paste

b- the aggregate

c- the admixtures

d- the sand

33- The type of slump for medium-plastic concrete is

a- shear slump

☒ b- true slump

c- collapse

d- no slump

34- The higher the slump

☒ a- the higher is the Kelley ball penetration
lower is the compacting factor

b- the lower is the flow diameter

c- the

d- the lower is the workability

35- The most useful advantage of the Kelley ball test is that

a- it is easy to be handled

b- it is easily carried in both laboratory and the field

☒ c- it measures the workability of concrete in shuttering

d- non of these choices

36- Stability is

a- a long-term requirement of concrete

c- non of these choices

b- the basis of the hydration process

☒ d- one of the short-term requirements of concrete

37- Aggregate of particle size over 25mm

a- increases concrete strength

c- increase concrete workability

☒ b- increase the tendency for segregation

d- increase durability

38- Bleeding can be reduced by using

☒ a- cement with high fineness

b- aggregate with large size

c- high water content

d- sulfate resisting cement

39- The workability of concrete can be regained after

~~a- complete hardening~~

☒ b- false set

~~c- flash set~~

~~d- 120 minutes of mixing~~

40- False set is most often caused by

a- cement hydration

b- crystallization of lime

c- rapid set of fine aggregate

☒ d- crystallization of Gypsum

Question (3) (25% of max grad)

Copy all the following statements in your answer sheet in the same sequence and mark (✓) or (x) in front of each one. (Wrong answers will be evaluated negatively).


1. Tricalcium silicate is more effective than dicalcium silicate in the development of concrete strength. (✓)
2. Bleeding of concrete can be reduced by increasing the cement fineness. (✓)
3. For static loading, the faster the loading rate the higher the indicated strength. (✓)
4. In ultrasonic test, the presence of moisture gives apparent lower strength. (x)
5. The aggregate strength has little effect on concrete strength. (✓)
6. The effect of carbonation on concrete durability is significant only for plain concrete. (x)
7. The shrinkage of reinforced concrete is less than that of plain concrete. (✓)
8. Permeability is defined as the ability of concrete to draw water into its voids. (x)
9. The residual deformation of concrete stored wet is higher than that stored dry. (✓)
10. Air-dry concrete has significantly higher strength than saturated concrete. (✓)
11. Autogenous shrinkage is caused by losing of free water. ✓

Question (3) Copy all the following statements in your answer sheet in the same sequence and mark (✓) or (x) in front of each one. (Wrong answers will be evaluated negatively).

1. Initial set corresponds approximately to the mid-point of stage 2 of C3S hydration. (x)
2. Water-reducers are used to increase the workability of fresh concrete. (x)
3. The tensile strength of concrete is of importance in the design of concrete roads and runways. (✓)
4. The higher the cement fineness the lower the concrete strength. (x)
5. The long-term requirements of concrete are such as workability and stability. (x) short
6. The aggregate strength has little effect on concrete strength. (✓)
7. Judging the workability of concrete using the subjective assessment is based on the engineer experience. (✓)
8. Concrete is considered stable if it segregates after casting. (x)
9. Concrete is a man-made composite material composite of aggregate water, and admixtures. (x) 8 Cement
10. Consistency is one of the workability characteristics. (✓)
11. Air-entrainment admixtures increase concrete strength in all ages. (x)
12. The higher the water content the higher the workability. (✓)

Question (3) Copy all the following statements in your answer sheet then write down the correct choice in front of each statement (wrong answers will be evaluated negatively)

1. The higher the cement fineness a) the higher the workability b) the lower the workability c) the lower the rate of cement reaction d) the lower the strength
2. The modulus of elasticity is a) the load per unit area b) the ratio of stress to the ratio of load per unit area to the elastic deformation per unit length c) the ratio of stress to the ratio of load per unit area to the elastic deformation per unit length d) the stress per unit volume
3. One of the main causes of wear of concrete is a) abrasive material in water b) chloride attack c) sulphate attack d) high tensile stresses
4. Superplasticizers are a) water reducers b) cement replacements c) setting accelerators d) new cement types
5. Concrete consists of a) cement and coarse aggregate b) cement, aggregate and water c) cement, sand and water d) cement and water

Faculty of Engineering at Matruh	 HELWAN UNIVERSITY	Semester
Department: Civil Engineering		Academic Year 2012/2013
Course Name: Characteristics & Strength of Materials (2)		Exam Type (Mid/Term): Term
Course Code: 4213A		Date of Exam: 13/1/2013
Level: 2nd year		Time Allowed: Three Hours
		Maximum Mark: 90 degrees

NOTE: Exam is in (1) paper (2) pages

Q1	Idea (50)%	Steps (50)%	Calculations (-)%	Final Result (-)%	Mark (30)
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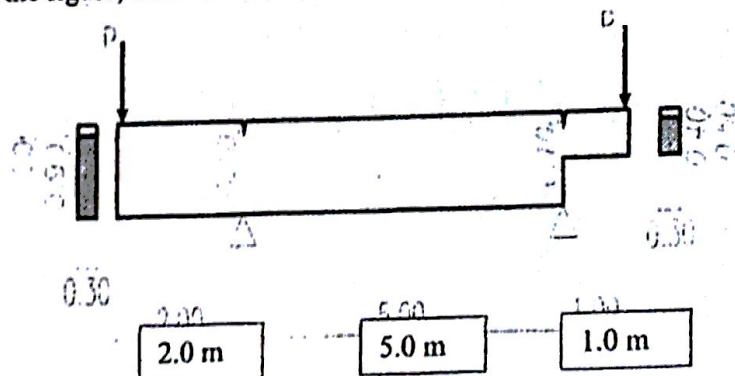
Draw the following with net sketches (ALL DRAWINGS MUST BE DONE ACCURATELY WITH RULER AND PENCIL OR THEY WILL NOT BE EVALUATED)

1. The factors affecting workability of concrete.
2. The effect of coarse aggregate content on workability of concrete.
3. The effect of cement fineness on concrete strength.
4. The effect of chemical composition of cement on the development of concrete strength.
5. Diagrammatic sketch of different types of set of cement, mortar, and slump loss of concrete.
6. The process of setting and hardening of concrete.
7. The loss of workability of concrete with time.
8. Diagrammatic sketch of the ultrasonic device.
9. The effect of specimen size on apparent 28-days compressive strength of concrete.
10. Different modulus of elasticity of concrete.
11. Typical illustration of deformation of concrete subjected to constant load.
12. The effect of curing and conditions on concrete strength development.

Q2	Idea (50)%	Steps (25)%	Calculations (15)%	Final Result (10)%	Mark (20)
----	------------	-------------	--------------------	--------------------	-----------

1. For the beam shown in the figure, determine the fracture load (P) if the material toughness is $3 \text{ t.cm}^{3/2}$.

λ	$f(\lambda)$
0.10	1.02
0.20	1.06
0.30	1.10



2. Calculate the maximum and the minimum stresses acting at a circular hole in an infinite plate stressed at its ends by a tensile stress 200 kg/cm^2 . Indicate the positions of the maximum and the minimum stresses on a simple drawing of the hole.

Q3	Idea (50)%	Steps (50)%	Calculations (-)%	Final Result (-)%	Mark (15)
----	------------	-------------	-------------------	-------------------	-----------

1. Define the following: Endurance limit - Frequency - Skew - Range - Creep
2. Explain the Creep test.
3. Explain the Creep-Time relationship curve?
4. Explain the S-N diagram?
5. Explain the Stress-deflection test?

Q4	Idea (50)%	Steps (50)%	Calculations (-)%	Final Result (-)%	Mark (20)
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Discuss the following:

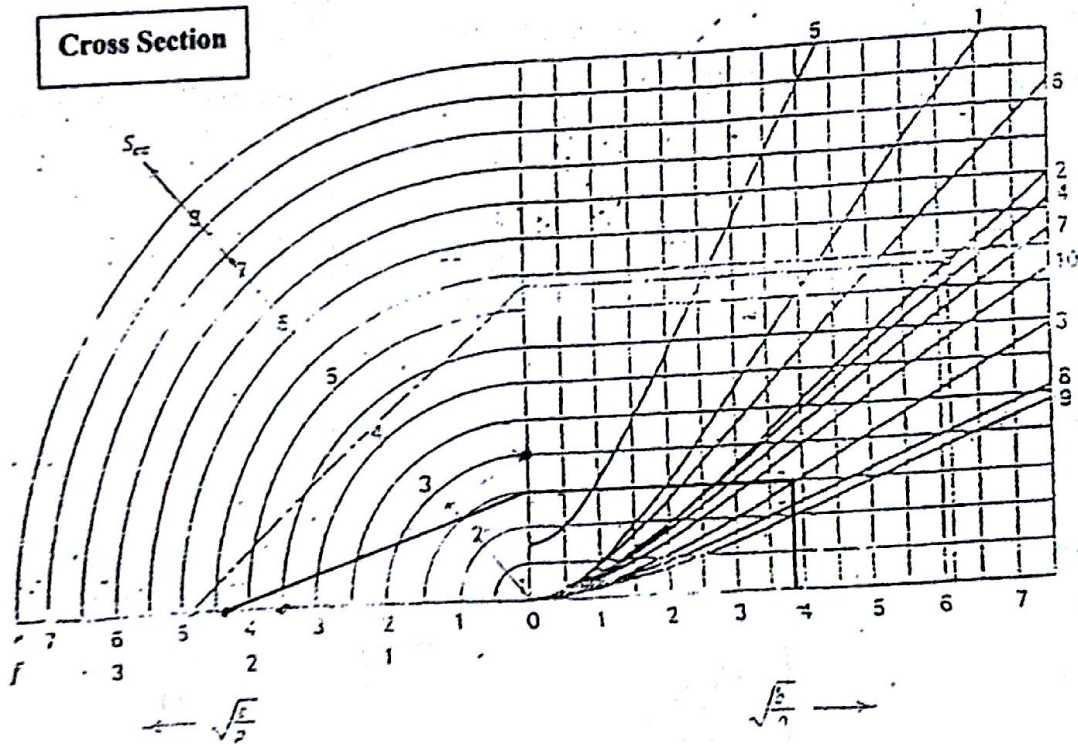
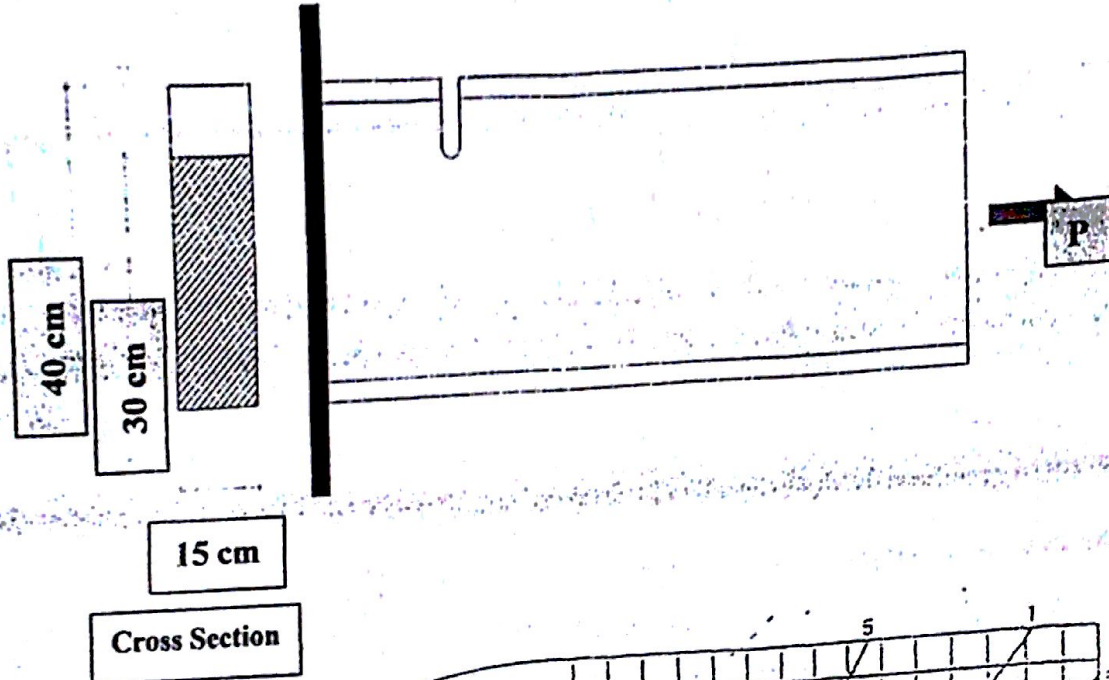
1. The role of cement in reducing the bleeding.
2. The factors affecting segregation of concrete.
3. The effect of air entraining admixture on concrete workability.

elwady

4. The prevention of abnormal setting of concrete.

Q5	Idea (50)%	Steps (50)%	Calculations (--)%	Final Result (--)%	Mark (15)
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For the Cantilever Beam shown in the figure, determine the Fracture Load P if the yield stress is 3.6 t/cm^2 . Using Neuber's diagram, $\rho = 2.0 \text{ cm}$.



2,2

3,9

BEST WISHES

Prof/ Tarek Aly
Lecturer/ Wael Refat

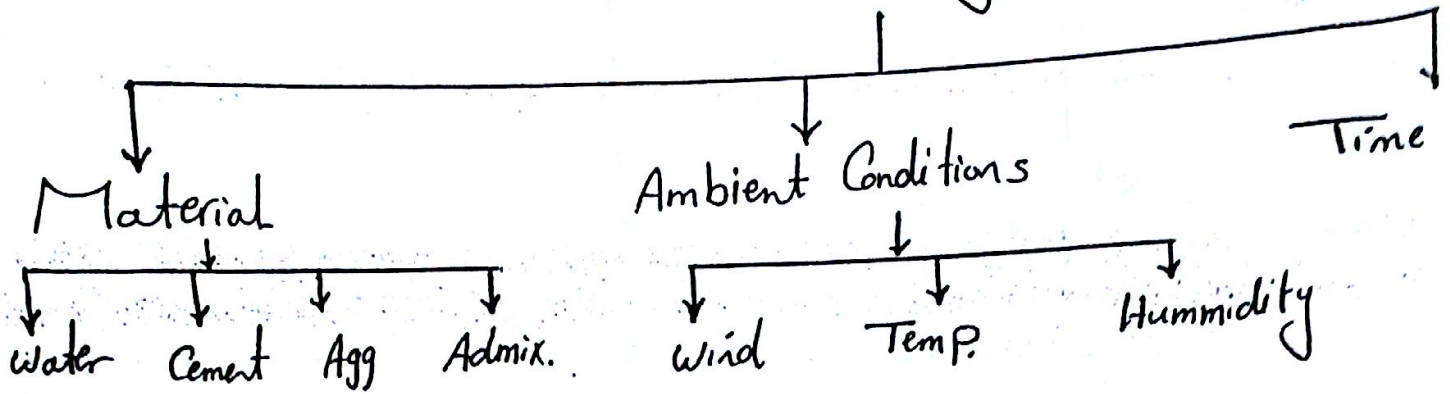
Final 2013

Q1 :-

elwady

①

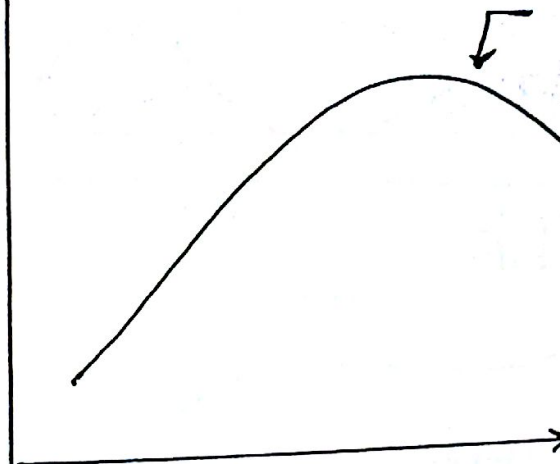
Factor Affecting workability



②

workability

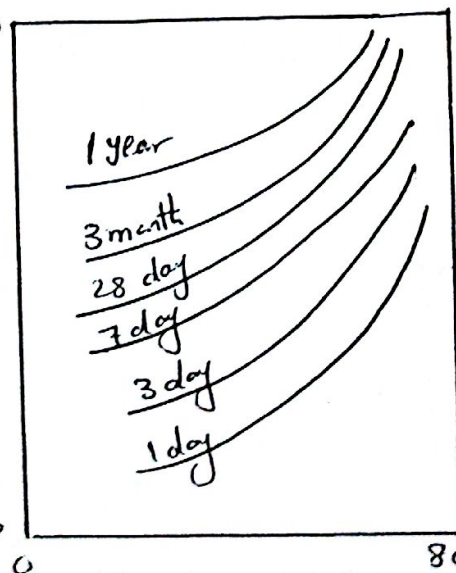
Optimum Coarse Agg



③

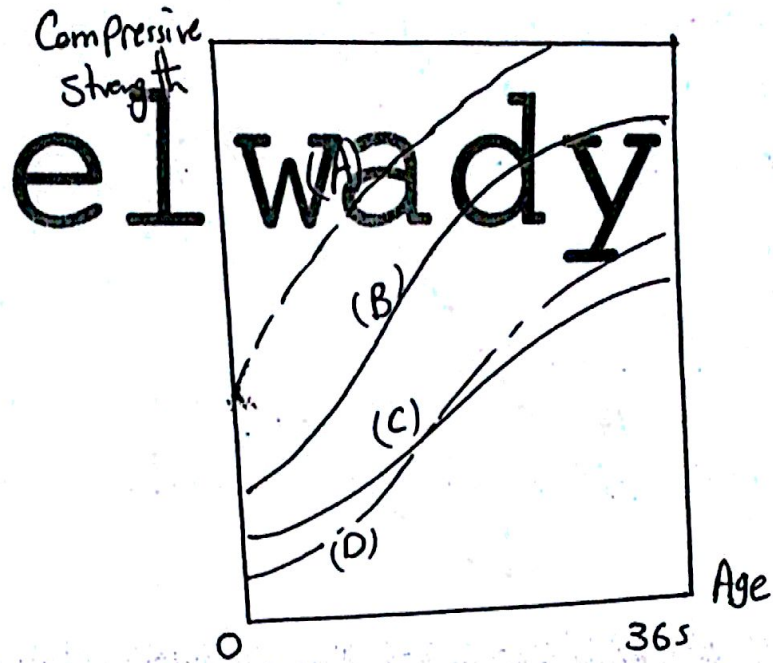
F_{cu}

70



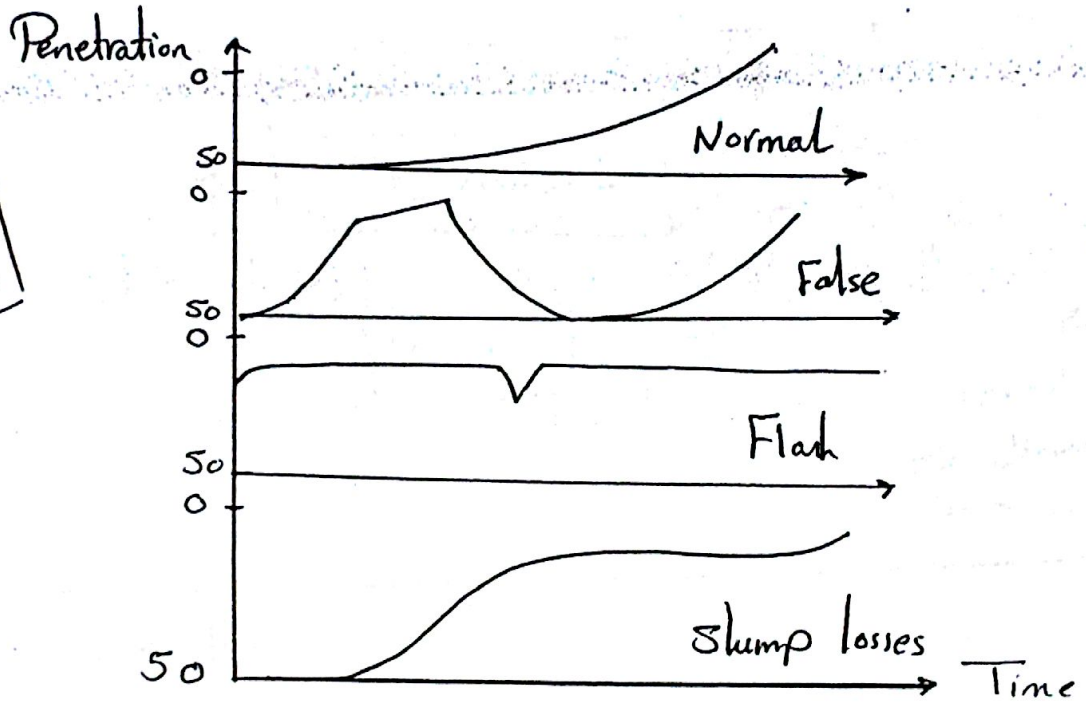
Fineness of Cement

1)



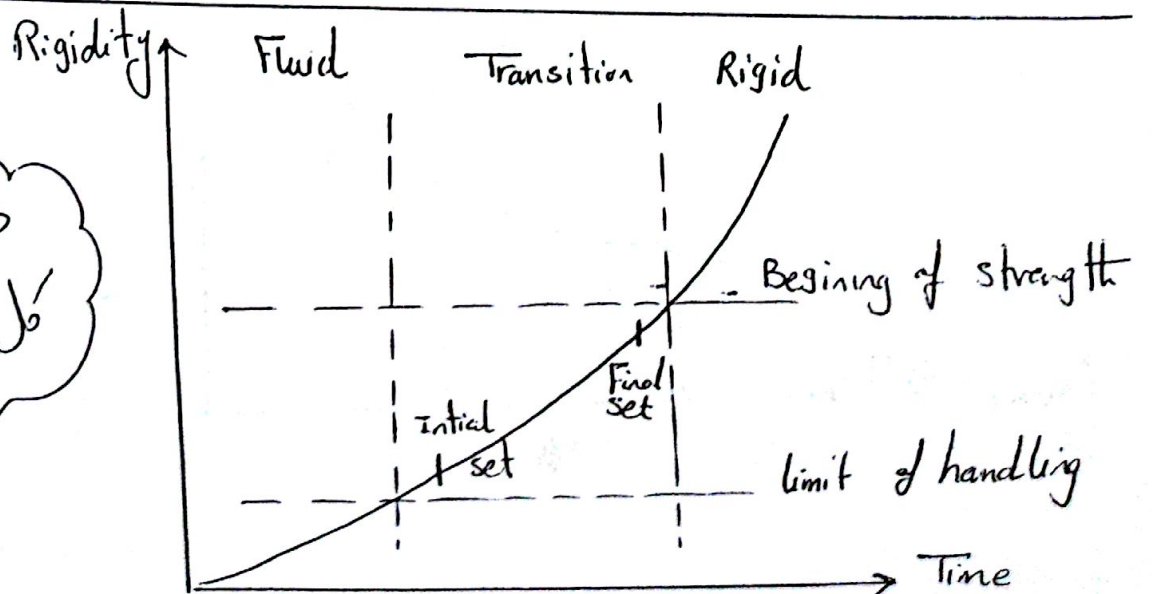
5)

كل ما في الدنيا
كل ما في الدنيا



6)

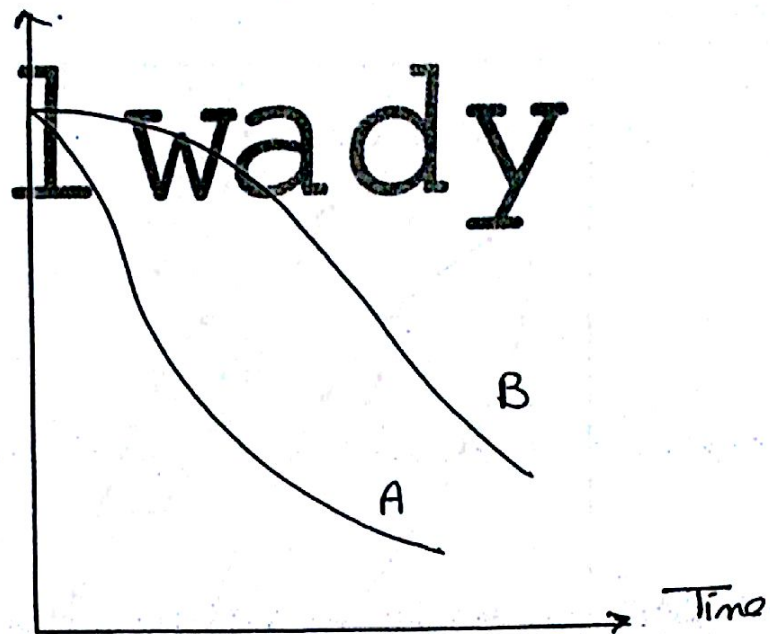
كل ما في الدنيا
كل ما في الدنيا



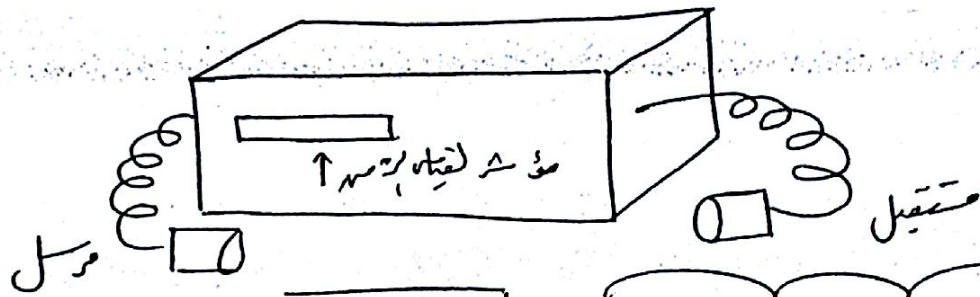
f)

slump

elwady



8

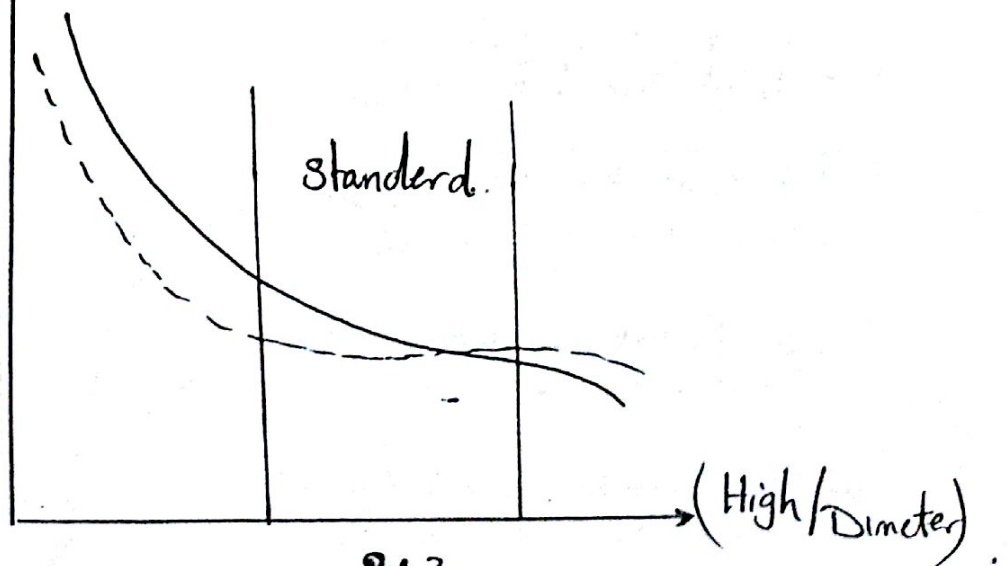


$$V = \frac{L}{T}$$

$V \rightarrow$ الجهد
 $L \rightarrow$ الحث
 $T \rightarrow$ زمن انتقال الجهد

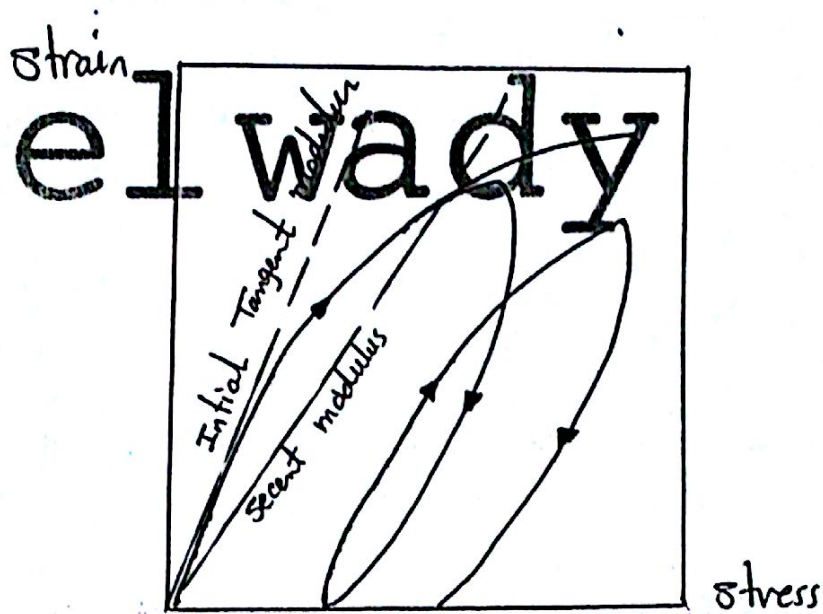
9

Strength



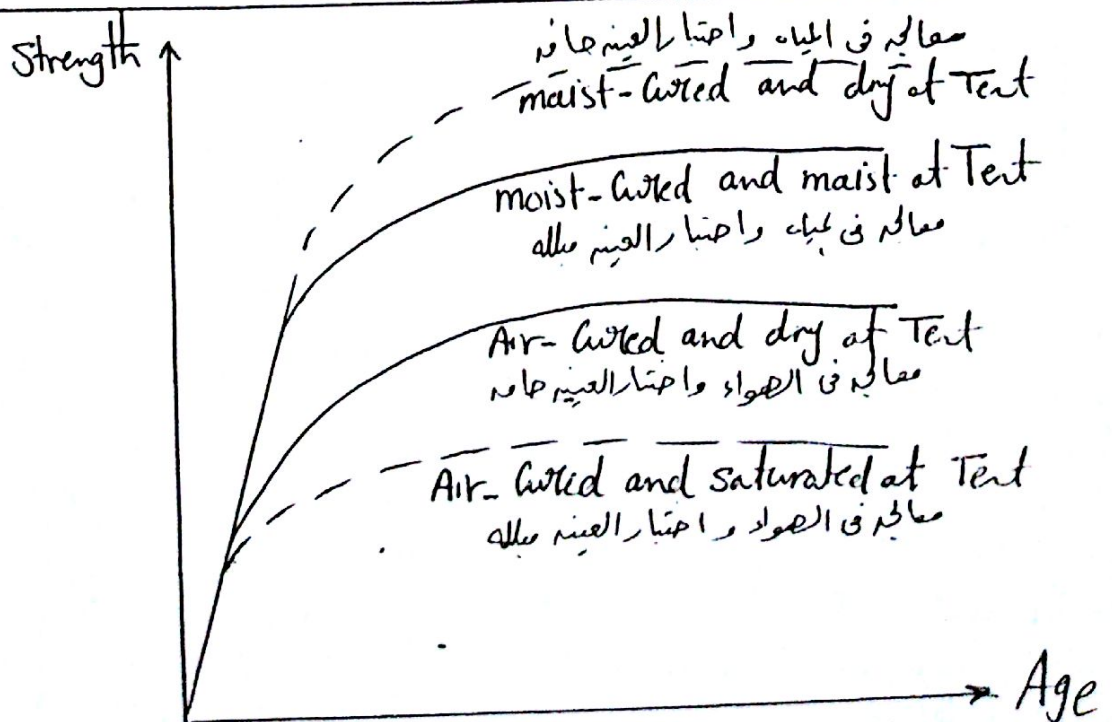
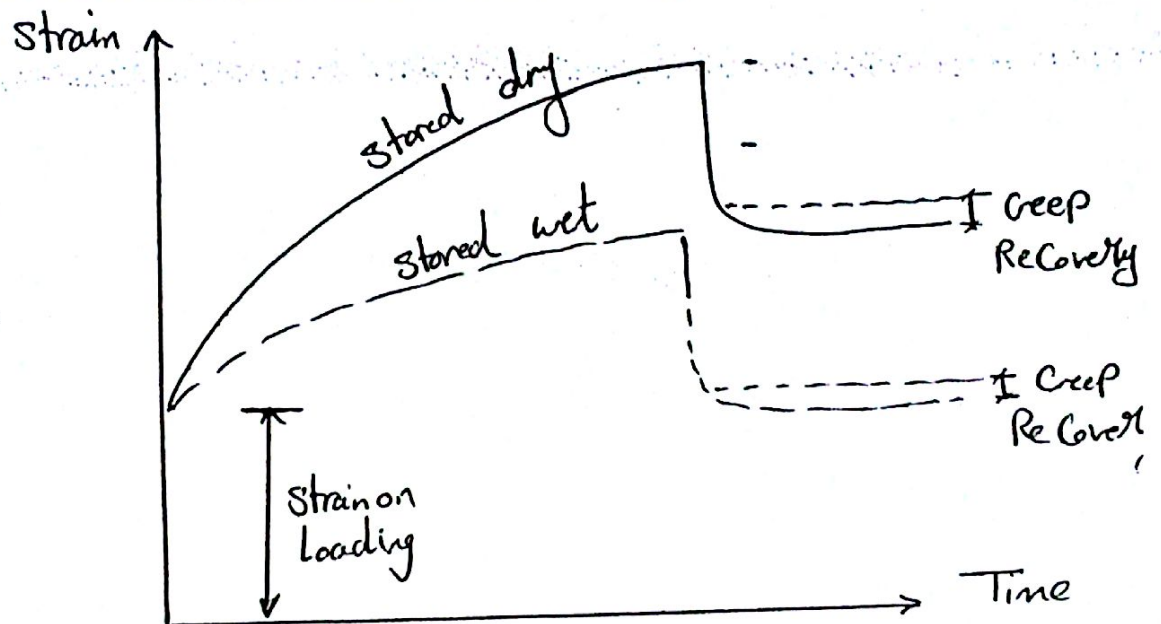
2:3

10)



11)

in p. 14



in p. 14