

Candidate's Exam Number:

**Total Books
Handed In:**

Programme Title: QINETIQ BENG

Year/Level/Stage: 6

Examination Paper Title: STRUCTURAL MECHANICS M3X0066

Examination Paper Ref No.: M3X0066 Desk Letter/Number: _____

Desk Letter/Number:

Date: 20/05/2017 Time: 9.00 am/pm Room Name or No.: MT 202

Room Name or No.: M1 202.

Summary of Marks

1. Please give the information requested above and enter your name in the space provided at the top right of this page. If your answers are to be marked under a scheme whereby the examiners will not know your identity, fold over and seal down the top right-hand corner of the page (using the gummed label provided) in order to conceal your name.
2. Commence each answer on a fresh page.
3. Do all rough work in the answer book and cross through it.
4. No part of this booklet is to be torn out.
5. Supplementary answer books if used must:-
 - (a) bear the candidate's name (concealed, where appropriate), reference number and paper title;
 - (b) be numbered consecutively;
 - (c) be fastened together by the tags available from the invigilator.
6. Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the exam room.
7. Your answers must be legibly written **IN INK**.
The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.

Question Numbers Answered	1st Examiner	2nd Examiner (optional)	3rd Examiner (optional)
1a	10/12		
1b	6/8		
3a	7/10		
3b.	6/10		
TOTAL	29/40		
RESULT	72.5%		

1)a)

$$Y = \frac{[1.12 + \alpha(2.91\alpha - 0.64)]}{(1 - 0.93\alpha)}$$

 $\therefore$

$$3.0 = \frac{[1.12 + \alpha(2.91\alpha - 0.64)]}{(1 - 0.93\alpha)}$$

Add α

2

$$3 = \frac{[1.12 + (2.91\alpha^2 - 0.64)]}{(1 - 0.93\alpha)}$$

mult. bottom

2

$$(1 - 0.93\alpha)3 = (1.12 + (2.91\alpha^2 - 0.64)) \quad \text{mult. out}$$

$$3 - 2.07\alpha = 1.12 + 2.91\alpha^2 - 0.64\alpha$$

 $\therefore$

$$\begin{array}{ccc} 2.91\alpha^2 + 1.43 - 1.88 \\ \uparrow \quad \quad \uparrow \quad \quad \uparrow \\ a \quad \quad b \quad \quad c \end{array}$$

$$\therefore -1.43 + \frac{1.43^2 - 4 \times 2.91 \times -1.88}{2 \times 2.91}$$

$$= \underline{\underline{0.59}}$$

the - dose not work.

$$\alpha = a/w \quad \therefore a = \alpha \times w \quad \underline{\underline{a = 14.75 \text{ mm}}}$$

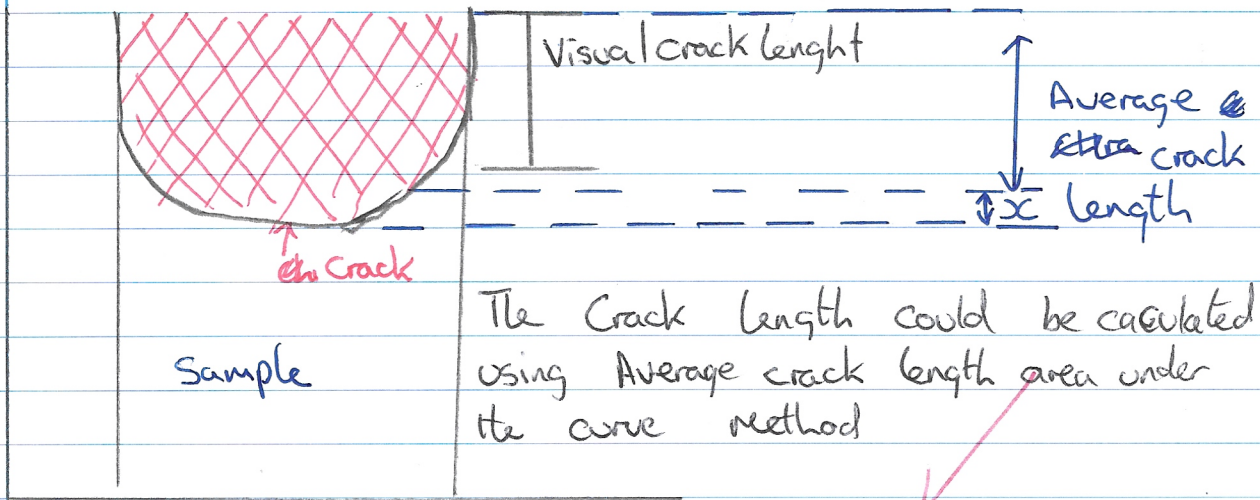
error continued

2

$$K_{Ic} = \sigma Y \sqrt{\pi a} \quad \therefore K_{Ic} = 150 \times 3 \sqrt{\pi \times 0.01475}$$

$$\therefore \sigma = \frac{K_{Ic}}{Y \sqrt{\pi a}} \quad \sigma = \frac{K_{Ic}}{Y \sqrt{\pi a}} = \underline{\underline{96.86 \text{ M/mm}}}$$

1

Q1)
b)

other test that could be considered would be.

Visual surface inspection

but this is ~~extreme~~ extremely difficult to see the crack depth as the image above shows it.

Potential Drop

This is accurate, but need calibrating against a known notch.

Acoustic Testing

Good for finding the point of the crack, but is difficult to calibrate

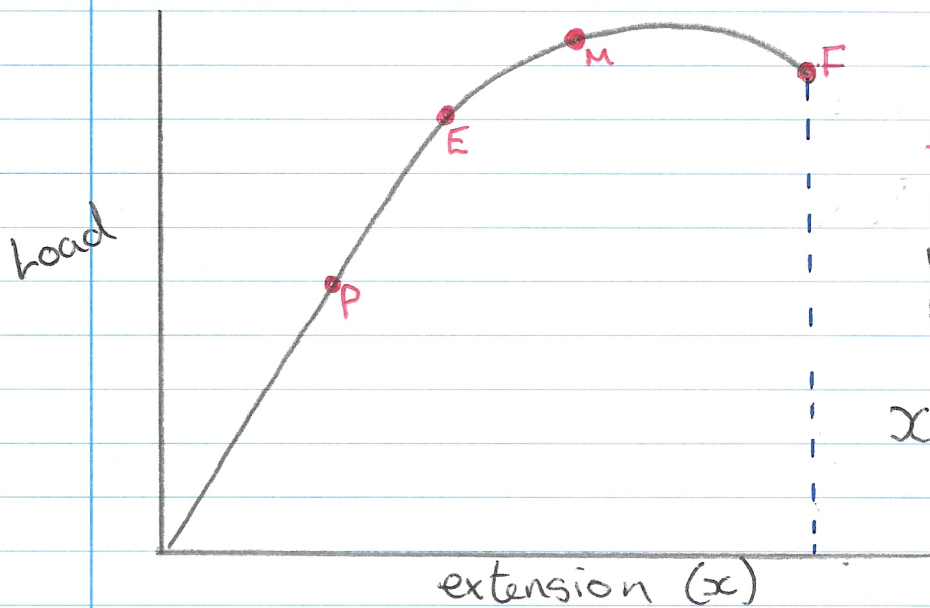
Ultrasonic

Probably the most reliable test, but is very expensive

The crack would bow as the material plastic zones would be smaller in the middle of the sample and larger on the outside, causing the crack to propagate out,

Q3)

a)



P = Proportion Limit.

~~P = Proportional Limit~~

E = Elastic Limit or Yield

M = Ultimate tensile strength

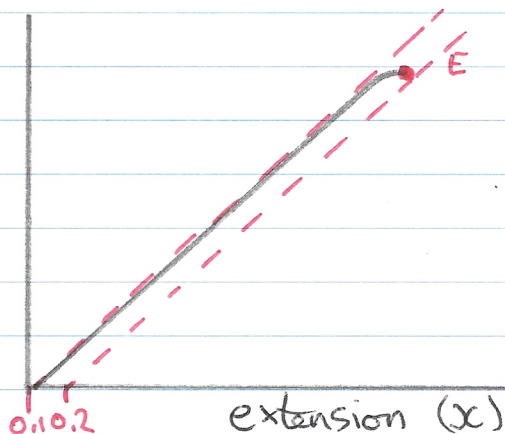
F = Point of failure.

$$\sigma = \frac{M}{CSA}$$

UTS

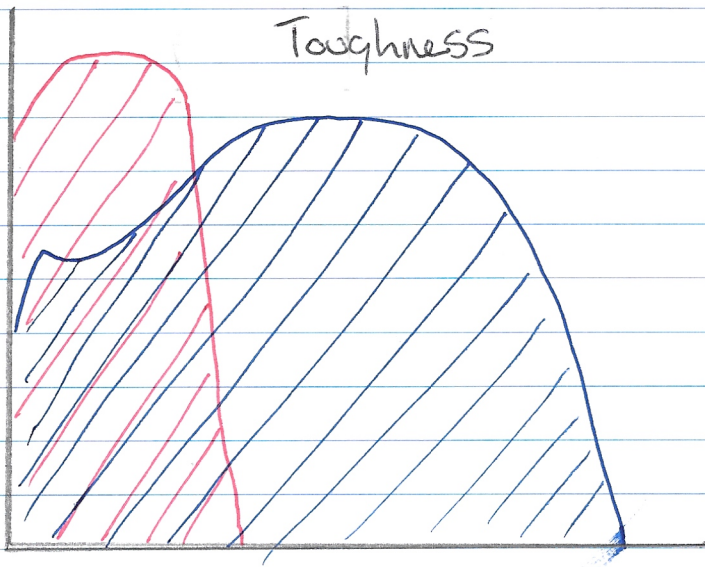
UTS The ultimate tensile strength M on the Graph is calculated by dividing the value of M by the Cross sectional area of the sample under test

The Elastic Limit E or Yield is calculated by



Proof stress of 0.2%
It is the point at which the material reaches its Elastic Limit under load by which it will still go back to its original form once the load is removed. It is within 0.2% of its original length.

Q3

a) Area under the curve

The area under the curve gives and accurate assessment of the material in that the larger the area the Tougher the material

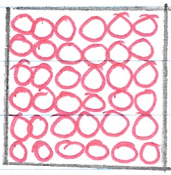
Elongation.

This is the measurement in % of how the material or the capability of the material to be drawn into wire.

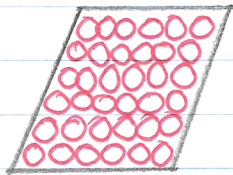
Reduction in area

The image above shows two different material. The material in Red has a high toughness than the material in blue but looking at the reduction in area it can be said that it has lower ductility properties. So while it is tougher it would shatter.

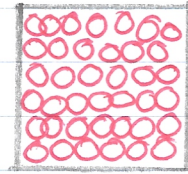
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Q3
b)Tensile testing structural changes

elastic
deformation
No load



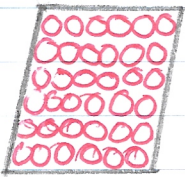
elastic
deformation
load applied



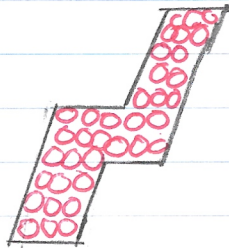
elastic deformation
load removed

2

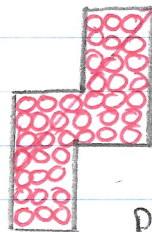
In the case of elastic deformation, the ~~elastic~~ ^{material} will ~~deform~~ once a load is applied but once the load is removed it will go back to its original formation



Plastic
deformation
No load



Plastic deformation
load applied



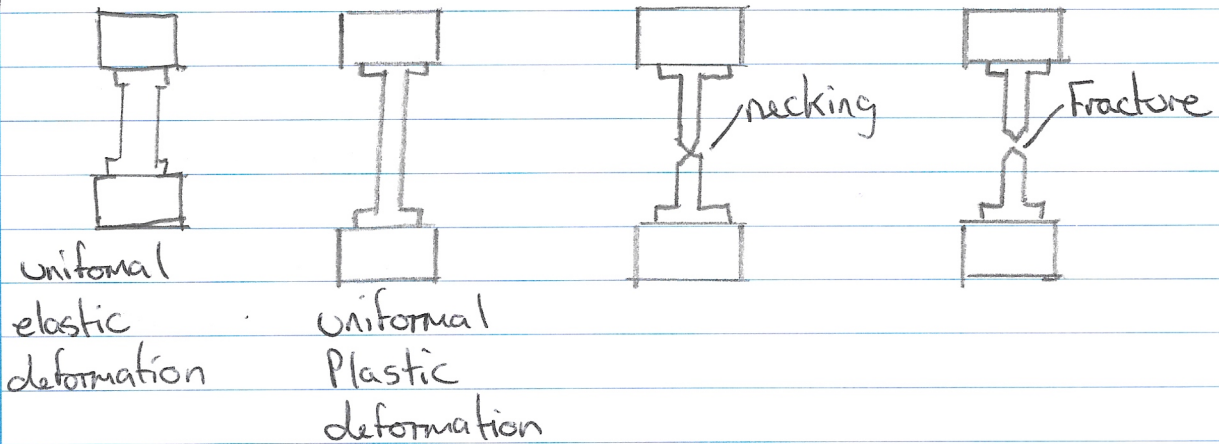
Plastic deformation
load removed

2

In the case of Plastic deformation if the load is applied and passes the UTS of the material this will cause it to slip. once the load is removed the material will reform but not back to its original state.

tensile testing is done using a ~~uniformed~~ ^{uniformed} sample placed under load until failure. The speed of the testing can have a detrimental effect on the result. the faster the test the better the results. however even tho the ~~samples~~ ^{samples} are constructed to a set of standard you can never be sure that they are all the same.

Q3
b) During tensile testing



The material goes through the elastic and Plastic deformation until reaching its UTS. as the drawings show to get an accurate test the loading and speed in which its applied must be consistent across industry.

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