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Examination Answer Books

Candidate's Exam Number: _____

Book No.

Total Books
Handed In:

Complete, fold and seal
(see note 1 below)

SURNAME: McIntyre

FORENAME(S): Lewis Fergusson

Programme Title: Test Range Engineering

Year/Level/Stage: BEng

Examination Paper Title: Structural Mechanics

Examination Paper Ref No.: M3X0066

Desk Letter/Number: _____

Date: 20/05/2017

Time: 9.00 am/pm

Room Name or No.: MT 202

Instructions to Candidates:

- 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.
- Commence each answer on a fresh page.
- Do all rough work in the answer book and cross through it.
- No part of this booklet is to be torn out.
- Supplementary answer books if used must:-
 - bear the candidate's name (concealed, where appropriate), reference number and paper title;
 - be numbered consecutively;
 - be fastened together by the tags available from the invigilator.
- Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the exam room.
- 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.

Summary of Marks

Question Numbers Answered	1st Examiner	2nd Examiner (optional)	3rd Examiner (optional)
1a	12/12		
1b	4/8		
2a	8/12		
2b	4/8		
TOTAL	28/40		
RESULT	70%		

$$1a) \quad V = \frac{11.12 + a(2.91a - 0.64)}{(1 - 0.93a)}$$

$$3 = \frac{11.12 + a(2.91a - 0.64)}{(1 - 0.93a)}$$

$$3(1 - 0.93a) = 11.12 + a(2.91a - 0.64)$$

$$3 - 2.79a = 11.12 + 2.91a^2 - 0.64a$$

$$0 = 11.12 + 2.91a^2 - 0.64a - 3 + 2.79a$$

$$0 = 2.91a^2 + 2.15a - 1.88$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\frac{-2.15 \pm \sqrt{2.15^2 - 4 \times 2.91 \times -1.88}}{2 \times 2.91}$$

$$\frac{-2.15 \pm 5.15}{2 \times 2.91}$$

$$= \frac{-2.15 \pm 5.15}{2 \times 2.91}$$

$$= 1.25 \text{ \& } 0.52$$

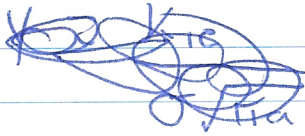
$$a = a/w$$

$$a = a \times w$$

$$a = 0.52 \times 25 \times 10^{-3}$$

$$a = 0.013 \text{ m}$$

$$K_{Ic} \geq \sigma \sqrt{Y \sqrt{t/a}}$$



$$K_{Ic} \geq 150 \times 3 \times \sqrt{\pi \times 0.013}$$

$$K_{Ic} \geq 90.94 \text{ MNm}^{-3/2}$$

90.5 ✓

2

b) Visual - as stated visually measure crack length.

Adv - Simplistic method

Dis - difficult to determine start of the crack and monitor the crack

1

Pot drop - this method looks for a voltage drop ~~across~~ across the material

Adv - Accurate method for measuring

Dis - provides unrealistic crack depth due to arcing

1

Acoustic - process of acoustically detecting the crack and measuring the length

Adv - Good at determining crack start

Dis - difficult to calibrate

1

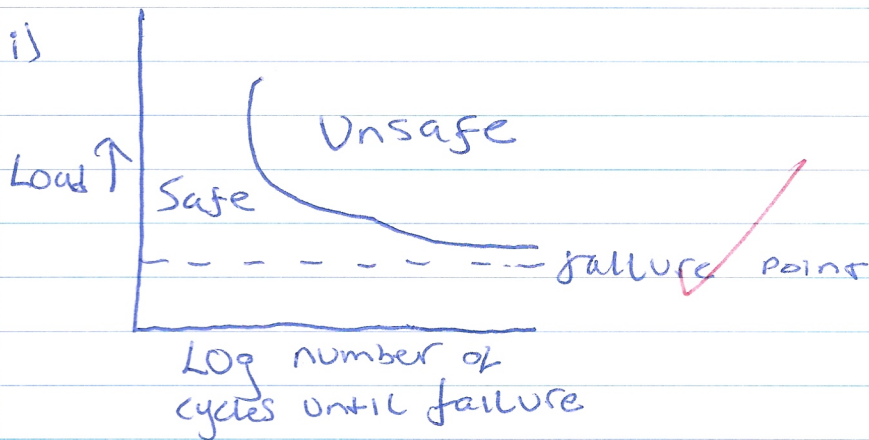
A crack may bow due to the plastic zone size at the tip of the material, the plastic zone size is larger at the ~~tip~~ tip giving greater ductility and this allows the material to bend rather than crack. When the crack is in the middle of the material the plastic zone size is smaller which means the crack

1

4/8

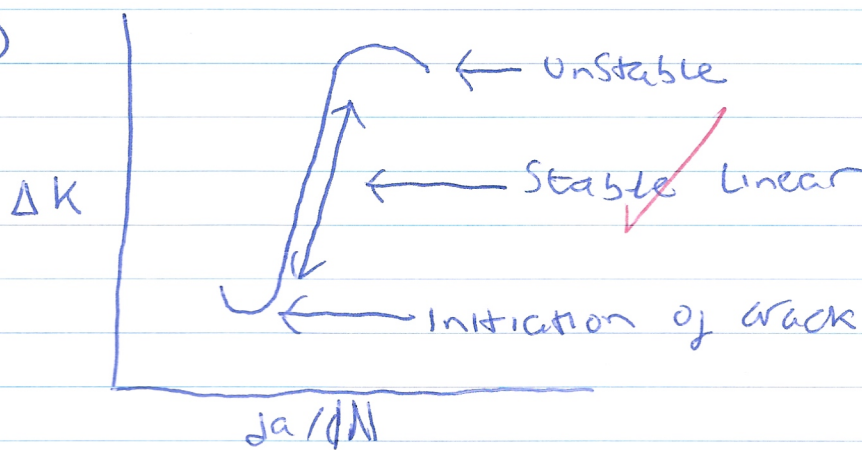
would increase in size quicker as the plastic zone size is smaller.

2a) i)



3

ii)



3

The S-N curve is carried out in a cantilever test this test allows you to provide a universal load pressure at 360° while this test is good for allowing to compare between materials it does not provide you with a realistic failure point as it is carried out against a perfect specimen where as in real life the specimen wouldn't be finished perfectly and would be subject to environmental factors.

2

8/12

- b) ~~Finishing~~ ~~Finishing~~ all edges to reduce stress spots causing the material to build up stress in certain areas causing failure to happen sooner. $1\frac{1}{2}$
This method is cheap to undertake and relatively straight forward to complete.

Changing operating procedures may also help minimise failure through fatigue by starting and finishing process slower which allows the material not receive high amounts of stress during these times, potentially prolonging the life of the material. $1\frac{1}{2}$

Coating the material will provide it with resistance against corrosion ~~from~~ from environmental factors ensuring it lasts longer this is due to environmental factors being applied to the material which corrode it and when load is applied the surface is already weakened and may have reduced its tolerance to failure. 1

$\frac{4}{8}$