

**Complete, fold and seal
(see note 2 below)**

12 Pages

FORENAME(S): KAI

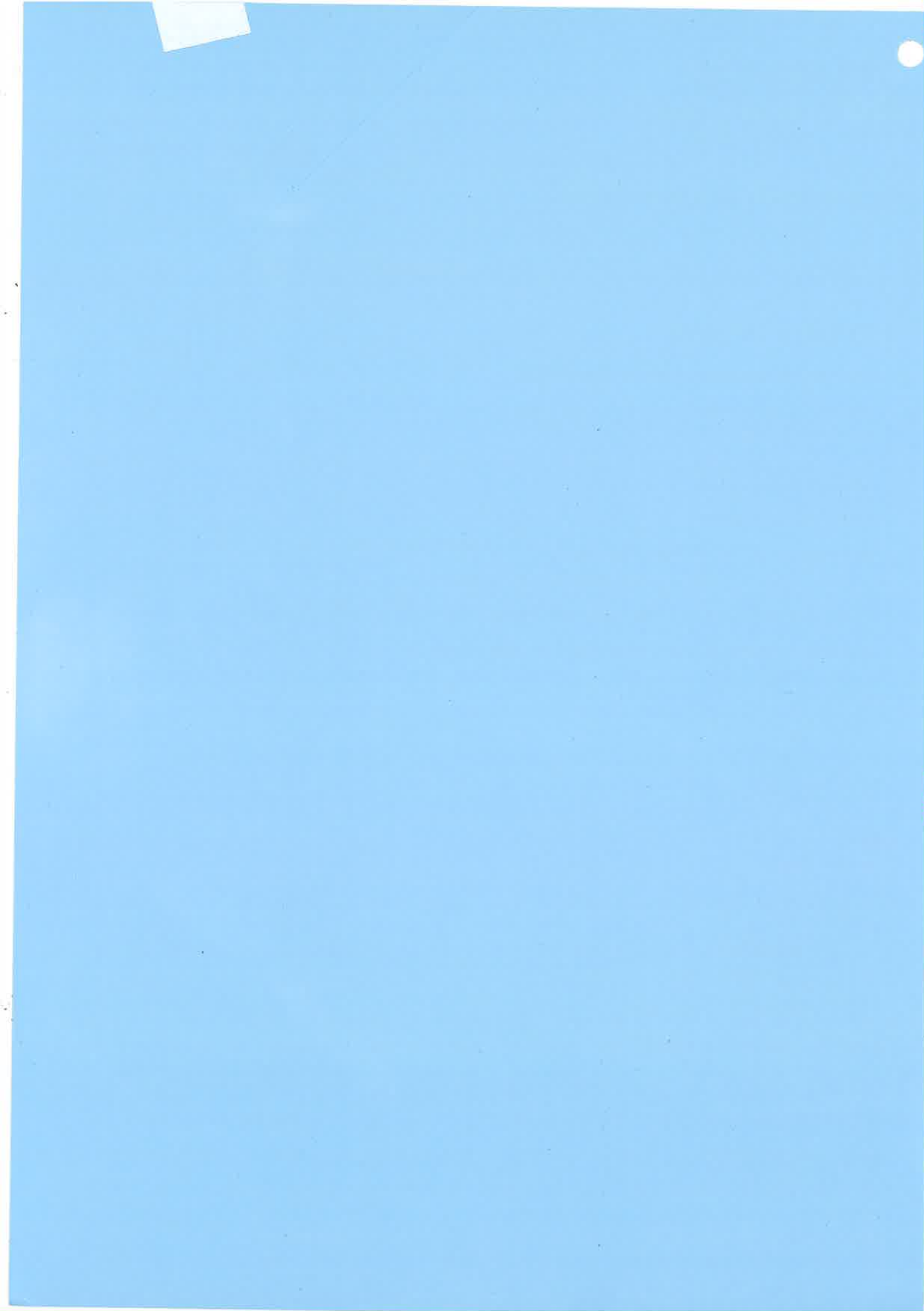
1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	P151918
2	Title of Examination Paper	CAE + stress analysis
3	Module Code	M5X02064
4	Date and Time of Examination	09/05/19
5	Examination Venue	1Q
6	Seat Number	4058
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

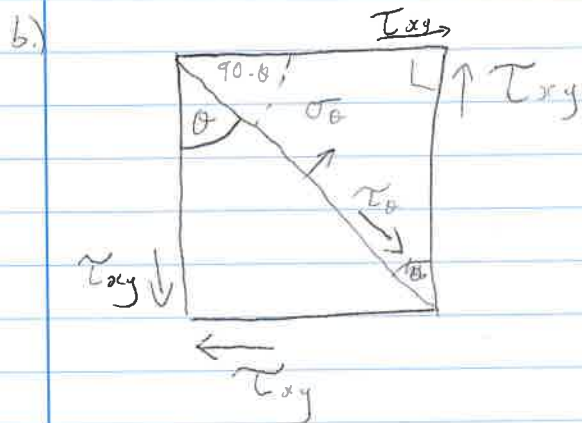
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Q2.

a.) Principle stress : ~~direct~~ $\sigma = \frac{P}{A}$

Principle plane :



$$\sin \theta \cos \theta = \frac{1}{2} \sin 2\theta$$

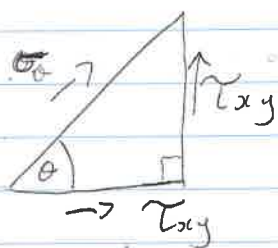
$$\sin^2 \theta - \cos^2 \theta = -\cos 2\theta$$

i. Normal stress on a plane inclined at an angle θ

$$\sigma_\theta = \tau_{xy} \sin 2\theta$$

$$\sin \theta \cos \theta = \frac{1}{2} \sin 2\theta$$

$$\sigma_\theta = \frac{1}{2} (\sigma_x + \sigma_y) + \frac{1}{2} (\sigma_x - \sigma_y) \cos 2\theta$$



$$\sigma_\theta = \sqrt{(\tau_{xy})^2 + (\tau_{xy})^2}$$

$$\sigma_\theta = 2\tau_{xy}$$

$$\tan^{-1} \left(\frac{\tau_{xy}}{\tau_{xy}} \right) = \theta$$

$$\theta = 45^\circ$$

For

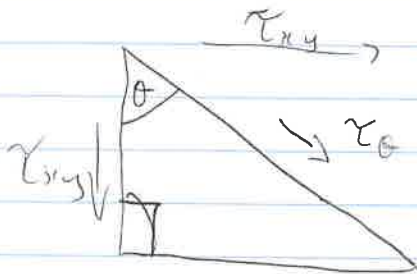
ii.)

$$\tau_o = -\tau_{xy} \cos 2\theta$$

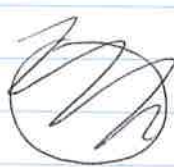
$$\sin^2 \theta - \cos^2 \theta = -\cos 2\theta$$

$$\tau_o = \frac{1}{2} (\sigma_x - \sigma_y) \sin 2\theta$$

$$\tau_o = \sqrt{\sigma_x^2 + \sigma_y^2}$$

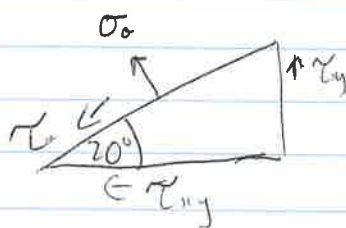
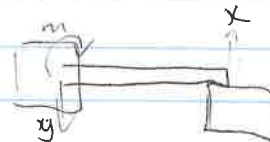


C.)



$$A = 800 \text{ mm}^2$$

$$0.8 \text{ m}^2$$



$$\sigma_o = \frac{1}{2} (\sigma_x + \sigma_y) + \frac{1}{2} (\sigma_x - \sigma_y) \cos 2\theta$$

$$\sigma_o = \tau_{xy} \sin 2\theta$$

$$\sigma_o = \tau_{xy} \sin (20)$$

Q3

a) Design problem : calibration

Analysis problem : calculation

X0

b.) designs can ~~undergo~~ ^{be made} to account for several situations and purposes, adjusted multiple times for small incremental improvements hence ~~it~~ ~~the~~ they have multiple iterations.

Analysis problems are built over previous ones

(2)

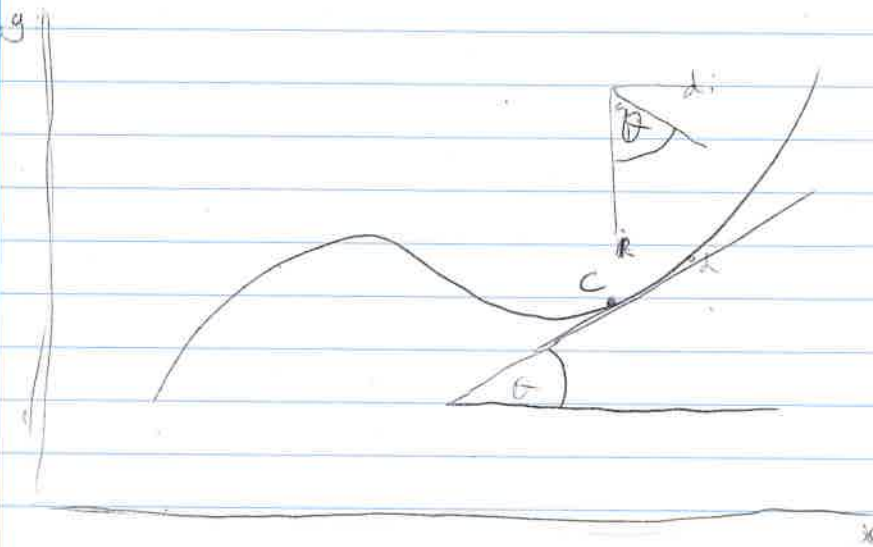
c.) ~~and~~ A focus on CAD design process can be good for multiple design iterations. However lack of analysis will make iterations less likely to work or may not be able to release a proper tested design on time

design process focused ~~on~~ on FEA analysis benefits optimization of a design and should changes be required, it can be made using the same program, which hastens the progress.

(2)

Q 4.

a.)



$$\frac{1}{R} = \frac{dy}{dx}$$

$$E_i y = M$$

$$y = \frac{M}{E_i}$$

$$E_i \frac{dy}{dx} =$$

gradient optimization is good for calculating deflection within object and its point of deflection

b.)

c.)

SBD Shear body diagram

FBD Free body diagram

MBD moment body diagram

gradient optimization

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