

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

FORENAME(S): Nicholas David

12 Pages

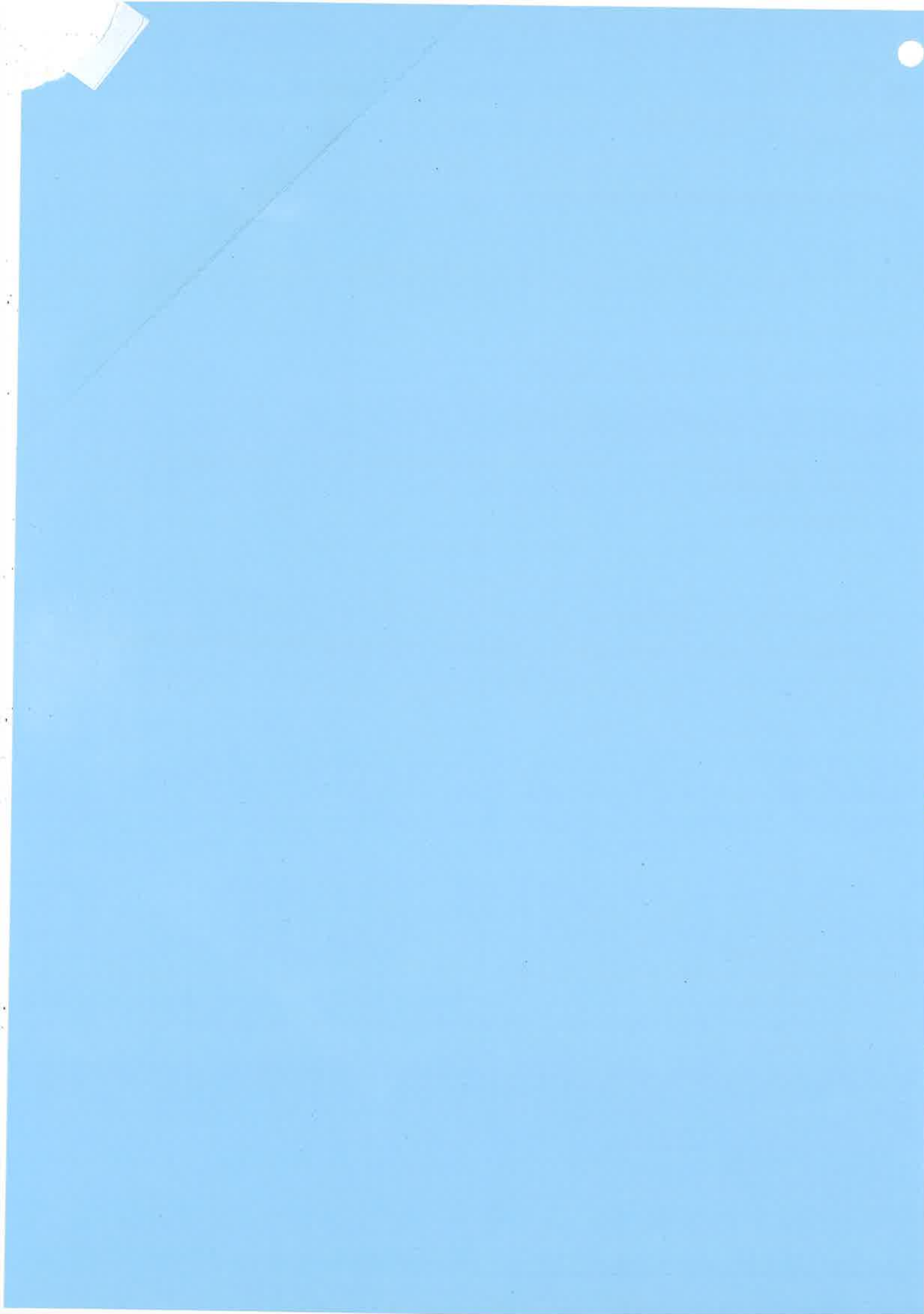
1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense 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	1702567
2	Title of Examination Paper	CAE & Stress Analysis
3	Module Code	M5X02064
4	Date and Time of Examination	9/5/2014 17:00
5	Examination Venue	310
6	Seat Number	6047
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	20
2	20
3	14
Total	54

(Gweler yr ochr arall am y fersiwn Cymraeg)

90%



1a) Internal force $= P \times L \rightarrow \text{pressure} \times \text{effective area}$

$$\text{Total resistive hoop force} = 2\sigma_H \times L \times t$$

$$P \times L = 2\sigma_H \times L \times t$$

$$\sigma_H = \frac{P}{2t}$$

1b) i) $\sigma_H = 200 \times 10^6$ $d = 3.5\text{m}$ $t = 0.5 \times 10^{-3}$

$$\sigma_H = \frac{P \times d}{2t} \quad P = \frac{\sigma_H \times 2t}{d} = \frac{200 \times 10^6 \times 2 \times 0.5 \times 10^{-3}}{3.5}$$

$$= 57.14 \text{ kPa}$$

@ Sea level $P = 101 \text{ kPa}$

$$101 - 57.14 = 44 \text{ kPa}$$

$$44 \text{ kPa} = 20000 \text{ feet}$$

1bii) @ 8000 feet $P = 75.3 \text{ kPa}$

$$75.3 - 57.14 = 18.16 \text{ kPa}$$

$$18.16 \text{ kPa} = 35000 \text{ feet}$$

1c) This means that the plane can fly higher with less stress. Flying ^{higher} has less dense air so the plane is more efficient as there is less air resistance.

1d) Internal ~~pressure~~ ^{Force} $= P \times \text{area} = P \times \frac{\pi d^2}{4}$

$$\text{Total resistive force} = \sigma_H \pi d t$$

$$\frac{P \pi d^2}{4} = \sigma_H \pi d t$$

$$\sigma_H = \frac{P d}{4t}$$

1e) The reason for this is that sphere containers can take higher pressures than cylinders. However, they ~~can~~ ^{take up} more area than cylinders do. So depending on the space available and the pressure they need to withstand a sphere can be more beneficial than a cylindrical container.

Question No.,

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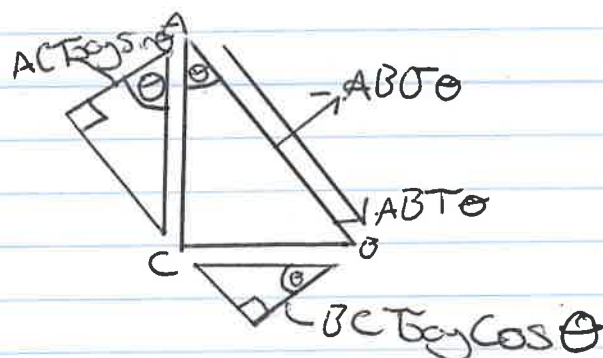
Arholwryn unig

ff y Cwestiwn

2a) The principal stress is the maximum or minimum stress which acts on a plane. The plane it acts on is called the principal ~~stress~~ plane.

3

2b.)



$$\cos \theta = \frac{AC}{AB}$$

$$\sin \theta = \frac{BC}{AB}$$

$$AB \sigma_\theta = AC \tau_{xy} \sin \theta + BC \tau_{xy} \cos \theta$$

$$\sigma_\theta = \frac{AC}{AB} \tau_{xy} \sin \theta + \frac{BC}{AB} \tau_{xy} \cos \theta$$

$$\sigma_\theta = \cos \theta \tau_{xy} \sin \theta + \sin \theta \tau_{xy} \cos \theta$$

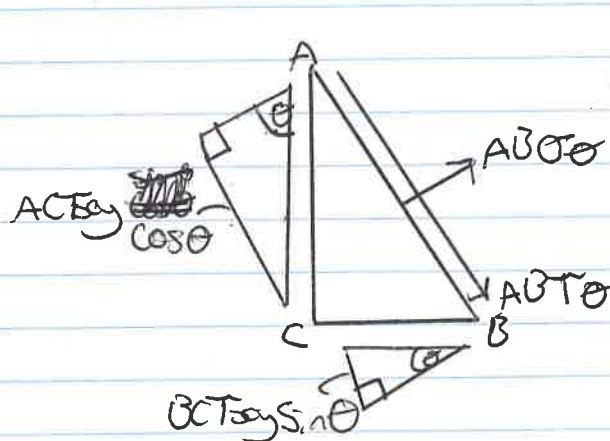
$$\sin \theta \cos \theta = \frac{1}{2} \sin 2\theta$$

$$\sigma_\theta = \frac{1}{2} \tau_{xy} \sin 2\theta + \frac{1}{2} \tau_{xy} \sin 2\theta$$

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

5

2bii)



$$\cos \theta = \frac{AC}{AB}$$

$$\sin \theta = \frac{BC}{AB}$$

$$AB \tau_\theta = BC \tau_{xy} \sin \theta - AC \tau_{xy} \cos \theta$$

$$\tau_\theta = \frac{BC}{AB} \tau_{xy} \sin \theta - \frac{AC}{AB} \tau_{xy} \cos \theta$$

$$\tau_\theta = \sin \theta \tau_{xy} \sin \theta - \cos \theta \tau_{xy} \cos \theta$$

$$\tau_\theta = \tau_{xy} \sin^2 \theta - \tau_{xy} \cos^2 \theta$$

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

5

2c)

$$\text{stress} = \frac{F}{A} = \frac{45 \times 10^3}{800 \times 10^{-6}} = 56.25 \text{ MPa assume this is } \sigma_x$$

$$\begin{aligned} \sigma_\theta &= \frac{1}{2}(\sigma_x + \sigma_y) + \frac{1}{2}(\sigma_x - \sigma_y)\cos 2\theta \\ &= 0.5(56.25) + 0.5(56.25)\cos(40) \\ &= 49.67 \text{ MPa} \end{aligned}$$

$$\begin{aligned} \tau_\theta &= \frac{1}{2}(\sigma_x - \sigma_y)\sin 2\theta \\ &= 0.5(56.25)\sin(40) \\ &= 18.08 \text{ MPa} \end{aligned}$$

(7)

3a) A Design problem is much more generic than an analysis problem. Generally a design problem will have ~~multiple~~ ^{multiple} solutions whereas an analysis problem will only have one. A design problem will ~~usually~~ ^{usually} be solved iterative or cyclic but an analysis problem will be solved sequential

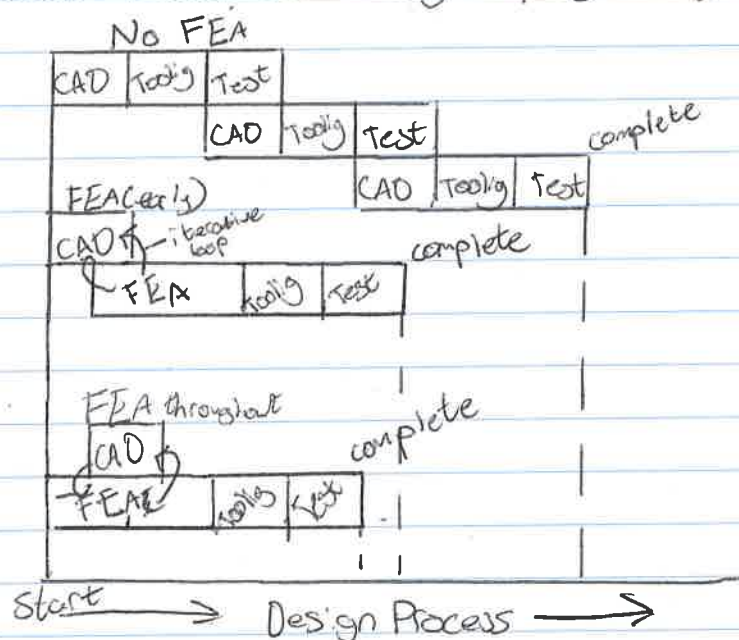
/3

3b) A design problem will be solved and then tested. This means that something may be found which could be changed so they could go back a stage to solve that issue so it will go around in a circle. An analysis problem is much more precise so there is only one answer so there is no need to go back and repeat steps.

/5

3c) One is the design process cycles. This goes in stages of Define the problem, ~~Plan~~ Gather relevant information, Create multiple solutions, Analyse & select solution, and test and implement solution. This has its advantages as it is iterative so if anything needs improving it can be later on. This is also more of a generic model for a larger project. ~~Star~~ - new page

3



With no FEA there are advantages as in that you ~~do~~ may not need to bring experts in to carry out the FEA reducing costs. However the negative on the other hand, it takes longer and it may end up increasing the number of prototypes made

which will incur extra costs.

Having FEA early in the process is beneficial as this means that it saves significant time than without FEA and reduces prototyping costs. This could also mean that you could get an end solution which is less overengineered than if guesswork or physical testing was used. However, it could potentially incur an extra cost of getting a person who knows how to use FEA as well as the program itself.

Using ~~continuous~~ FEA right from the start is a benefit as it has the same advantages of early FEA but it ~~can~~ can reduce the duration even further. However again this could incur extra costs of FEA but for more time than early FEA.

* This has its disadvantages as it's going in a circle it could be endlessly improving which could take a very long time.

3

Question No.

Examiner Only

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Examiner Only



12 Tüdalen

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|---|---|--|
| 7 | Nifer y Llyfrau Atebion
a gyflwynwyd | |
| 6 | Rhif Sedd | |
| 5 | Lleoliad yr Arholiad | |
| 4 | Dyddiad ac Amser yr
Archoliad | |
| 3 | Cod y Modwl | |
| 2 | Teitl y Papur
Arholiad | |
| 1 | Rhif Myfyriwr | |

Rhestrwch nïau'r cwestiynau a ymgeisiwyd gennyh	
At Dibenion y Swyddfa	

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

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