



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.**

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

SURNAME: James

FORENAME(S): Ryan
DAVID

1	Student Number	0751093
2	Title of Examination Paper	CAG & Stress Analysis
3	Module Code	M5202064
4	Date and Time of Examination	9.5.19
5	Examination Venue	1. Q. 310
6	Seat Number	G046
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	18
2	16
3	7
Total	41

(Gweler yr ochr arall am y fersiwn Cymraeg)

68.37

Q1 a)

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

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

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

(4)

16 b) $\sigma_H = 200 \times 10^6 \text{ Pa}$
 $D = 3.5$
 $t = 0.5 \times 10^{-3}$

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

$$P = 57.14 \times 10^3 \text{ Pa} = 57.1 \text{ KPa}$$

~~$$57.1 \times 10^3 \text{ Pa} = 57.1 \times 10^3 \text{ Pa}$$~~

~~$$= 57.1 \times 10^3$$~~

$$101 - 57.14 = 43.85 \times 10^3 \text{ Pa}$$

6i b)i) from table = 20,000 feet

(4)

$$75.3 \times 10^3 - 57.14 = 18.157 \text{ KPa}$$

6ii bii) $= 49,000 \text{ feet} \rightarrow 40,000 \text{ feet}$

(3)

c) if the pressure is lowered at higher altitudes this reduces the pressure difference between inside and outside and as pressure is directly proportional to hoop stress from $\sigma_H = \frac{P d}{2 t}$ the lower difference lowers the stress.

BUT WHY?

(0)

1 d)

$$\sigma_H = \frac{Pd}{4t}$$

$$F \leftarrow = F \rightarrow$$

$$\sigma_H \cdot A = P \cdot A$$

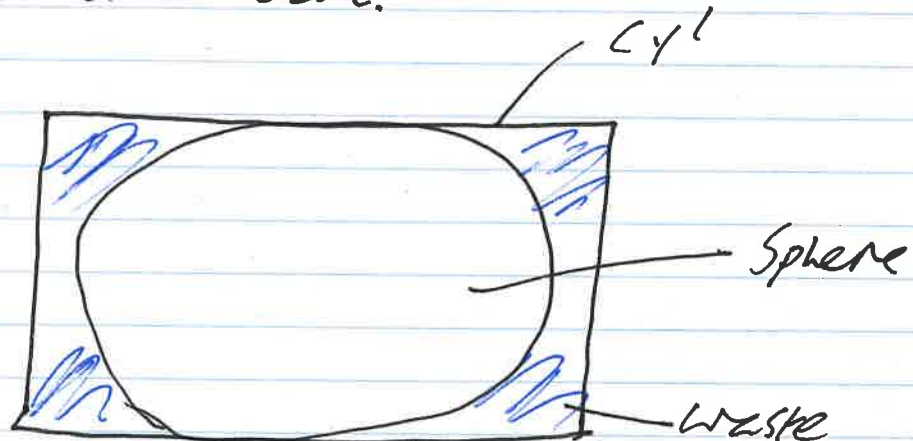
$$\sigma_H d \pi t = P \frac{\pi d^2}{4}$$

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

$$\sigma_H = \frac{Pd}{4t}$$

1e)

e) ignoring any Joints a sphere will always have half the hoop stress of a cylinder (as it is divided by 4 instead of 2). So a sphere is stronger per thickness in the hoop direction (although a cylinder has the same longitudinal as a sphere's hoop.). The foot print of a cylinder is smaller ~~as can be seen~~ than a sphere for the same volume of a cylinder is larger for the same footprint as a sphere as can be seen by the wasted blue.

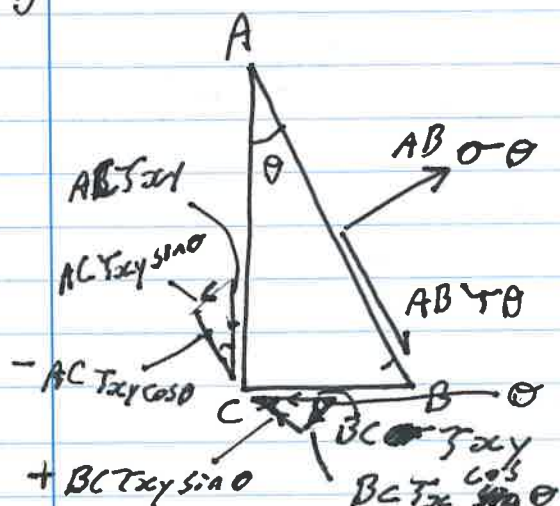


2a

The principle stress is the resultant stress from all the complex stresses. It has a magnitude and direction so it is a vector. For our problems there are 2 so it is 2D.

(1)

2b



Soh C/Lh Toc

$$H = AB$$

$$D \neq BC$$

$$A = AC$$

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

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

from trig rules

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

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

2bi)

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

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

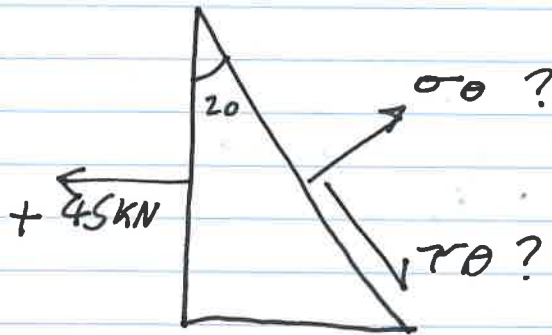
$$\tau_\theta = (\sin^2 \theta - \cos^2 \theta) \tau_{xy}$$

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

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

~~AB tau_theta = BC tau_xy sin theta - AC tau_xy cos theta~~

2 c)



$$\theta = 20^\circ$$

$$\sigma_x = 45 \times 10^3$$

$$\sigma_y = 0$$

$$\tau_{xy} = 0$$

From formulae sheet

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

$$\sigma_\theta = \frac{1}{2} (45 \times 10^3) + \frac{1}{2} (45 \times 10^3) \cos 40^\circ$$

$$\sigma_\theta = 39.74 \text{ kN}$$

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

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

$$\tau_\theta = \frac{1}{2} (45) \sin 40^\circ$$

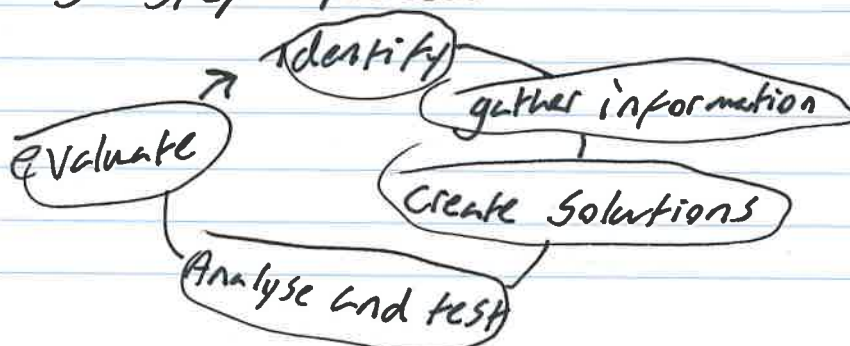
$$\tau_\theta = 14.462 \times 10^3 \text{ N}$$

$$\tau_\theta = 14.5 \text{ kN}$$

Q3.a) A design problem: ~~involves~~ involves creating a solution for an identified problem.

An analysis problem will involve checking if for example a solution is adequate or results correlate with testing. analysis will be checking if something meets requirements and if the assumptions made are relevant and match ~~the~~ the actual brief.

Q3b) design can run in a loop like the 5 step process



during this process problems can be solved in the loop and ~~make~~ the whole task can go back through solving additional problems found.

Analysis's there are usually very strict things that are being checked which are 'kicked off sequentially' e.g. does it meet regulations, does the test data correlated with prototype testing, is the tooling within budget.

(3)

3C. The 5 step p

~~The 5 step~~ The 5 Step process previously mentioned shows a good order to run through a problem during the design process. It is brief & idea. ~~doesn't give~~

~~CAE led reduces tooling and~~
CAD led

3C 1

CAD	Tooling	prototype	Test	CAD	Tool	Test	Tool	Test
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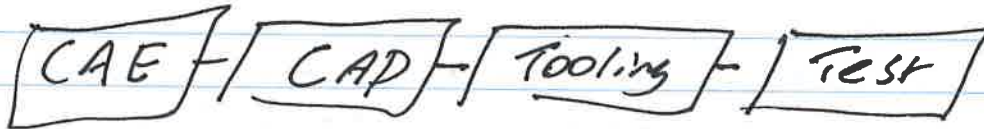
Cad led has a cheap initial start and it fast to show a customer the concept but as tooling and testing is the most expensive this leads to many expensive prototypes to get the end result

3C 2

CAD	CAE	~~Tooling~~	Tooling	Test
-----	-----	--------------------	---------	------

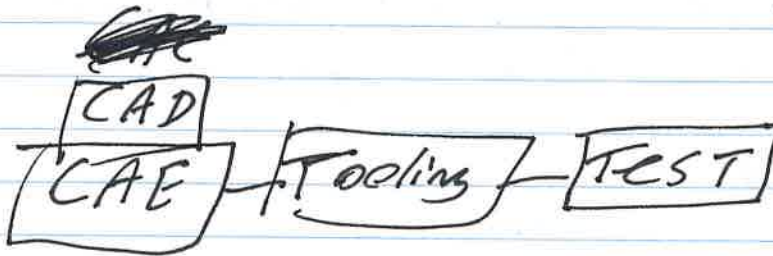
Implementing CAE After an initial concept reduces the amount of tooling and testing but the changes in CAE would have to be approved by the customer

3C3



CAE led has a slightly more expensive start as CAE engineers are more expensive but the customer will see a more accurate representation earlier that is correct.

3C4



Combining CAD with CAE has a faster completion time and the customer will see a better looking design than a just CAE concept before tooling but this is more expensive again.

3

Question No.

Examiner Only

Question No.

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Question No.

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Question No.

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(gweler nodyn 2 isod)

CYFENW:

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

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