



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Examination Answer Books

12 Pages

Instructions to Candidates

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: Brimecombe

FORENAME(S): Joshua Grant

1	Student Number	1701440
2	Title of Examination Paper	CAE + Stress Analysis
3	Module Code	MSX02064
4	Date and Time of Examination	09/5/19 12:00
5	Examination Venue	1Q301F
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
Q1 a	
b	
c	
d	
e	
Q2 a	
b	
c	
Q3 a	
b	
Total	21½

(Gweler yr ochr arall am y fersiwn Cymraeg)

35.8%

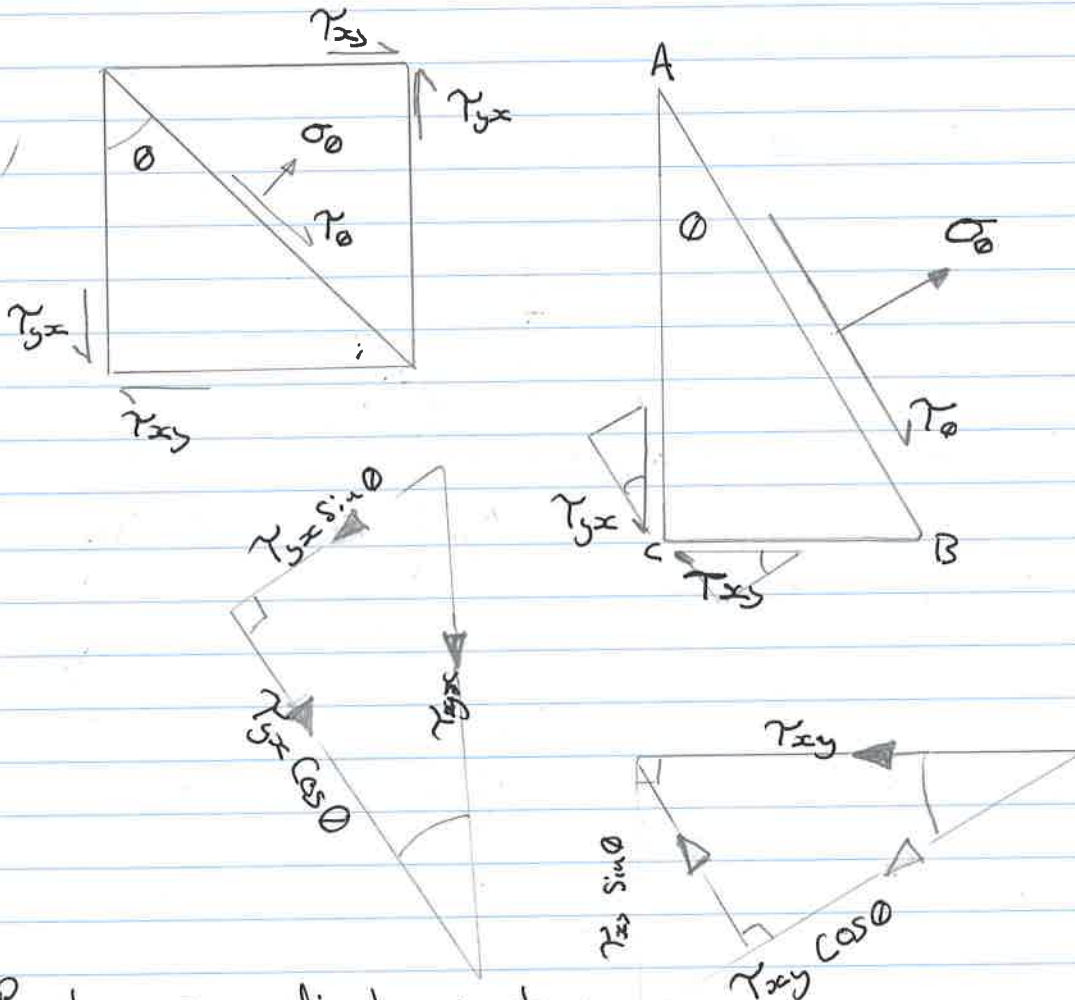


2

- a. • Principal stress is the maximum amount of internal stress as a result of a stress element.
 • Principal plane is the plane at which the maximum stresses act upon.

(21)

b.



- i.) Resolve perpendicular to plane AB

$$\sigma_0 = \tau_{yx} \sin \theta + \tau_{xy} \cos \theta$$

$$\sigma_p = \tau_{xy} (\sin \theta + \cos \theta)$$

$$\sigma_0 = \tau_{xy} \sin 2\theta$$

(3)

(16)

ii) Resolve Parallel to Plane (AB)

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

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

← ?

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

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

(2)

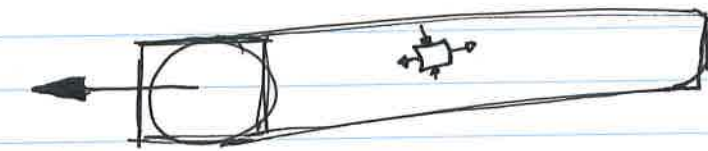
Resolve

Resolve

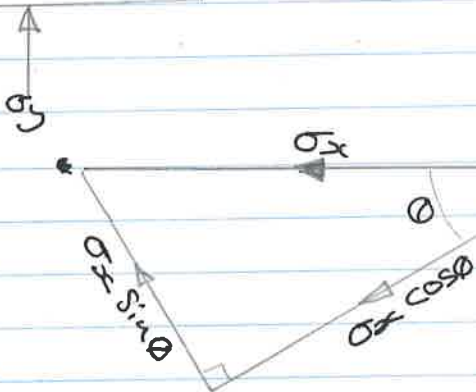
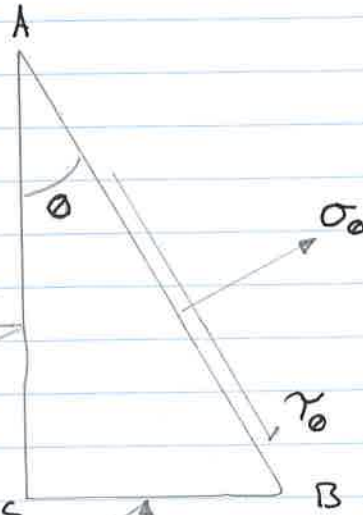
$$SA = 800 \text{ mm}^2$$

$$\sigma_x F = 45 \text{ kN}$$

$$\theta = 20^\circ$$



$$\sigma_x$$



Resolve perpendicular to plan AB

$$\sigma_\theta + \sigma_y \sin \theta = \sigma_x \cos \theta$$

$$\sigma_\theta = \sigma_x \cos \theta - \sigma_y \sin \theta$$

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

$$\sigma_\theta = \frac{1}{2} (45 \times 10^3 + 0) + \frac{1}{2} (45 \times 10^3 - 0) \cos 2(20)$$

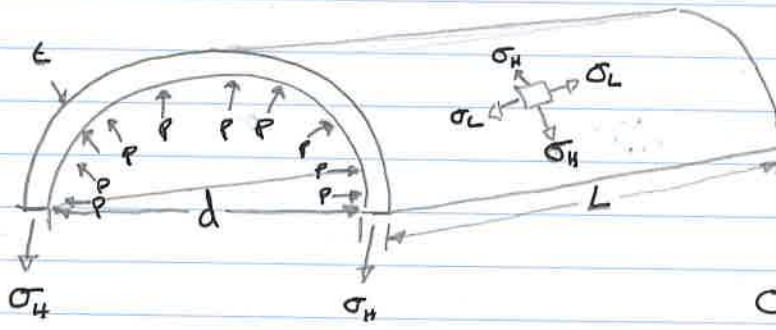
$$\sigma_\theta = 39735.999997 \text{ UNITS}$$

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

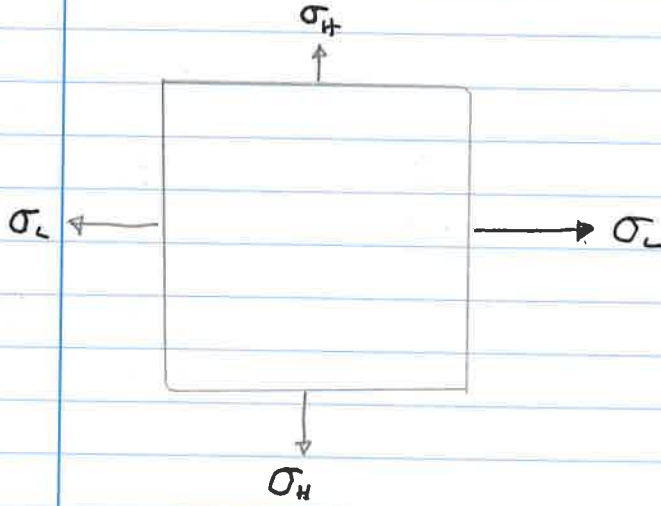
$$\tau_\theta = \frac{1}{2} (45 \times 10^3 - 0) \sin 2\theta$$

$$\tau_\theta = 14462.72122 \text{ UNITS}$$

3

1.
a

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

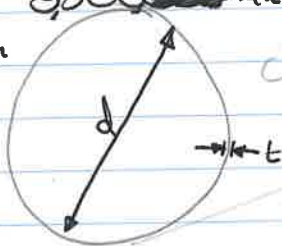


b.)

Thin cylinder

$$d = 3.5 \text{ m} = 3500 \text{ mm}$$

$$t = 0.5 \text{ mm}$$



$$\sigma_{H \text{ Max}} = 200 \text{ MPa}$$

equation:

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

$$\sigma_H = \frac{\rho g h d}{2t}$$

$$P = \rho g h$$

$g = 9.81 \text{ m/s}^2$

~~$$\sigma_H(2t) = \rho g h d$$~~

$$\sigma_H(2t) = \rho g h d$$

$$\frac{\sigma_H(2t)}{\rho g d} = h$$

i)
$$h = \frac{200 \times 10^6 (2 \times 0.5)}{1.03 \times 9.81 \times 3500} \quad \text{@ sea level}$$

$$\rho = 1.03$$

$$h = 5655.30 \text{ m} \approx 20,000 \text{ feet}$$

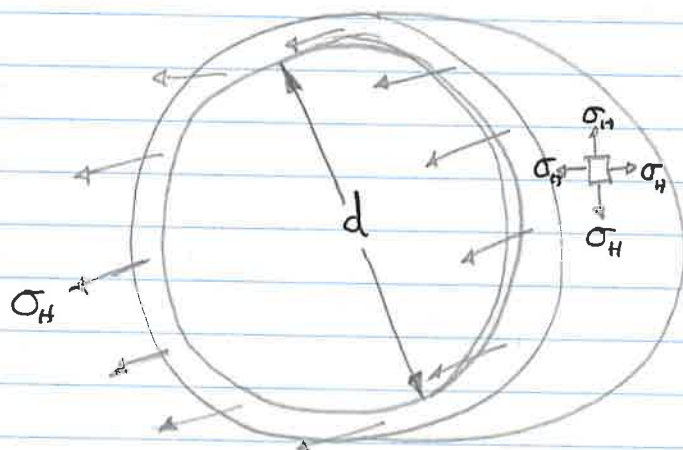
ii)
$$h = \frac{200 \times 10^6 (2 \times 0.5)}{0.768 \times 9.81 \times 3500}$$

$$h = 7584.58 \text{ m} \approx 25,000 \text{ feet}$$

c. By pressurizing the fuselage to 8000 feet or ~~in~~ ^{a change} internal pressure of 0.262 kg/cm^2 it enables the fuselage to cope with ^{external} pressures of an extra 5,000 feet.

BUT WHY?

d.



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

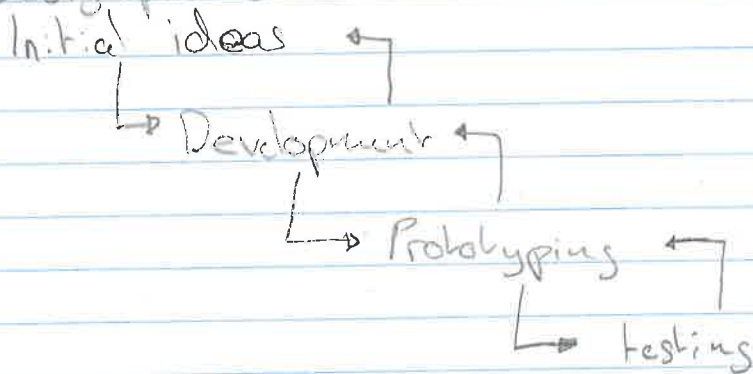
X

- e. In oil storage facilities Spherical tanks are used to store fluids at higher pressures as the stresses on the tank is therefore lower. Cylindrical containers are used for lower pressure fluids as these take up less area in the facility. A ^{reason} ~~reason~~ the pressure of the fluid may be relevant

(3)

- 3a The design process works on a development level and the design is developed through several stages which the ideas are passed through. Several iteration of this process are conducted before a final design is taken through to manufacture

Design process on basic scale



Whereas, an analytical process uses advance CAE optimisation tools to perform similar processes in a more efficient way. This ends in quicker overall sequence that allows the product to be produced in a way that meets pre-set criteria and specifications.

(2)

- b. As shown above during the design. A phase the traditional design process is interactive in the way the design is passed back and forwards between the processes. Whereas, the analytical process uses tools like topology to create bodies and optimise their form and function, in

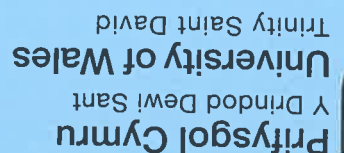
terms of the available space for the product or part, whilst taking into consideration and optimising for specific solutions to problems such as; removing unnecessary material to reduce weight whilst adding material to stress paths to gain specific preset values for stiffness calculated from load patterns.

/4

Question No.

Examiner's





12 Tüdalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plygwch ef a'i seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi! gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgrifennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnw llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn, rhaid ei gyflwyno yn gyfan.

7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllywr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chanaiteir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchiadau.

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	

[illegible]

(See the other side for English version)

CYFENW:

ENW(AU) CYNTAF:

Llenwch, plygwrch a selwch
(gweler nodyn 2 isod)