



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	1805149
2	Title of Examination Paper	CAE & STRESS ANALYSIS
3	Module Code	M5X02064
4	Date and Time of Examination	9th MAY
5	Examination Venue	IQ 310
6	Seat Number	G018
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
15	1
13	2
11	3
Total	39

Complete, fold and seal
(see note 2 below)

SURNAME: Tian hao ↖

FORENAME(S): Huang E

(Gweler yr ochr arall am y fersiwn Cymraeg)

65%



Question 1

a. $\therefore F \uparrow = P \times d \times L$

$$F \downarrow = \sigma_H \cdot t \times L \times 2$$

$$\therefore \sigma_H \cdot t \times L \times 2 = P \times d \times L$$

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

$\therefore$ So the hoop stress (σ_H) is given like that.

b. (i) $\therefore \sigma_H \leq 200 \text{ MPa}$

$$\therefore \frac{Pd}{2t} \leq 200 \text{ MPa} \Rightarrow P \leq \frac{200 \text{ MPa} \times 2 \times 0.5 \text{ mm}}{2.5 \text{ m}} \approx 57 \text{ kPa}$$

So, if the cabin is sealed at sea level, according to Table 1

$$P_{\text{inside}} = 101 \text{ kPa} \quad \therefore P_{\text{outside}} > 101 - 57 = 44 \text{ kPa}$$

$\therefore$ according to table 1

the maximum altitude is 20000 feet.

(ii). if the cabin is pressurized to an equivalent pressure of 8000 ft.

$$P_{\text{inside}} = 75.3 \text{ kPa} \quad \therefore P_{\text{outside}} > 75.3 - 57 = 18.3 \text{ kPa}$$

$\therefore$ according to table 1

the maximum altitude is 40000 feet.

c. We can see that if plane cabins ~~pressurizing~~ is pressurized to an ~~equivalent~~ lower pressure than it is at sea level, the plane cabin can fly higher, maybe even twice than before, so ~~if~~ if the material and the structure ~~is~~ haven't changed, we can change the pressure inside to make the plane fly higher. **AND?**

d. $\therefore F \uparrow = P \times \frac{\pi d^2}{4}$

$$F \downarrow = \sigma_H \cdot \pi d \times t$$

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

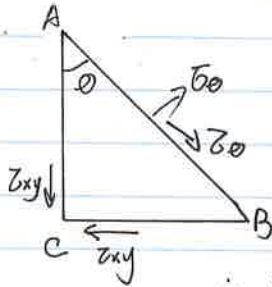
$$\therefore \sigma_H = \frac{Pd}{4t}$$

e. When oil is stored in cylindrical containers, it can store more oil, ~~while oil stored in~~ but its hoop stress is twice bigger than it is stored in spherical tanks. So, if the oil is stored in spherical tanks, ~~it~~ it can be stored in a lower outside pressure, sometimes it means a higher altitude.

Question 2

- a. ~~###~~ If a part ~~having~~ have complex stress, there will be a plane inside the part, on the plane, ~~th~~ there will be no shear stress, it's only normal stress which is ~~vertical~~ vertical to the plane. And the plane is called 'Principal Plane'. the normal stress is called 'Principal Stress'. It's ~~means~~ means in this direction, it's only tensile or press. no ~~st~~ cut.

- b. (i). Take the right part to analyse.



$$\therefore F \nearrow = \sigma_{\theta} \cdot AB$$

$$F \downarrow = \tau_{xy} \cdot AC \cdot \sin \theta + \tau_{xy} \cdot BC \cdot \cos \theta$$

$$\text{and } AB \sin \theta = BC, AB \cos \theta = AC$$

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

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

$\therefore$ the normal stress on a plane inclined at the angle θ is give by that.

- (ii). Take the same part as part (i).

$$\therefore F \downarrow = \tau_{\theta} \cdot AB + \tau_{xy} \cdot AC \cos \theta$$

$$F \nearrow = \tau_{xy} \cdot BC \sin \theta$$

$$\text{because } BC = AB \sin \theta, AC = AB \cos \theta$$

$$\therefore \tau_{\theta} \cdot AB + \tau_{xy} \cdot AB \cos^2 \theta = \tau_{xy} AB \sin^2 \theta$$

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

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

$\therefore$ the shear stress on the same plane is give by $\tau_{\theta} = -\tau_{xy} \cos 2\theta$

c. $\therefore \sigma_x = \frac{F}{A} = \frac{45 \text{ kN}}{800 \times 10^{-6} \text{ m}^2} = 56.25 \text{ MPa}$, $\sigma_y = 0$

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

$$= \frac{1}{2} \times 56.25 + \frac{1}{2} \times 56.25 \times \cos 40^\circ$$

$$= 49.67 \text{ MPa}$$

$$\tau_{\theta} = \frac{1}{2} (\sigma_x - \sigma_y) \sin 2\theta = \frac{1}{2} \times 56.25 \times \sin 40^\circ = 18.08 \text{ MPa}$$

$\therefore$ the normal stress is 49.67 MPa, the shear stress is 18.08 MPa.

Question 3

a. Design problem is more vaguely than Analysis problem. Analysis problem only have one answer, while the solution to Design problem is a system having specified properties, should meet different needs, there may be many devices to meet that need. Solving the Design problem is an iterative process, thus the solution to design problem is continual refinement. It may be the case when you implement the solution to Design problem, it may be not safe, too expensive or may not use. Hence, Design activities are cyclic and iterative, while solve analysis problem is primarily sequential.

b. Analysis problem have only one answer, you just need to analysis the problem, and then try to figure it out, so it's a primarily sequential process.

While the solution to Design problem is a system having specified properties, should meet different needs, there may be many devices to meet that need, so there isn't only one answer, and each solution is just make the system or the component better, to try to make it's performance to meet the need, so solving the Design problem is an iterative process, the solution to design problem is continual refinement.

And when you apply your solution to Design problem, it may be not safe, too expensive or may not use, so you need to come back and find the solution again, or try to solve these problem, so, Design activities means you need to try and try to ~~meet~~ meet the requirement, it's cyclic and iterative.

c. Design process should be carried out in these steps.

STEP 1: Define the problem. It includes ① Establish customer need. ② Develop the problem statement. ③ Criteria for success.

STEP 2: Gather the information. It includes ① Is the problem real or is the statement accurate. ② Is there a need to solve the problem or is the problem have been solved. ③ What the solutions to solve the problem now. ④ What's wrong with these solutions to solve this problem now. ⑤ What's right to solve this problem now.

⑥ What company are making the solution to solve this problem. ⑦ What the economic factors to solve this problem. ⑧ How much would the customer pay for the solution.

⑨ Other important things should be considered.

STEP 3: Generate multiple solution. It includes for things:

- ①. creative phase involving brainstorming
- ②. 'synthesis' of the new ideas to solve the problem.
- ③. Design team should be free to take risks.
- ④. People from different disciplines should be involved.

STEP 4. Analyse and select the solutions.

it includes:

- ①. Functional analysis
- ②. Mechanical analysis
- ③. Economic and Market analysis.
- ④. Industry analysis
- ⑤. Safety analysis.
- ⑥. Some other factors.

STEPS. Test and implement the solution.

it includes.

- ①. Prototyping and test in real condition
- ②. Documentation
- ③. Apply for patent to protect the Design.

3

Question No.

Examiner's

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Question No.

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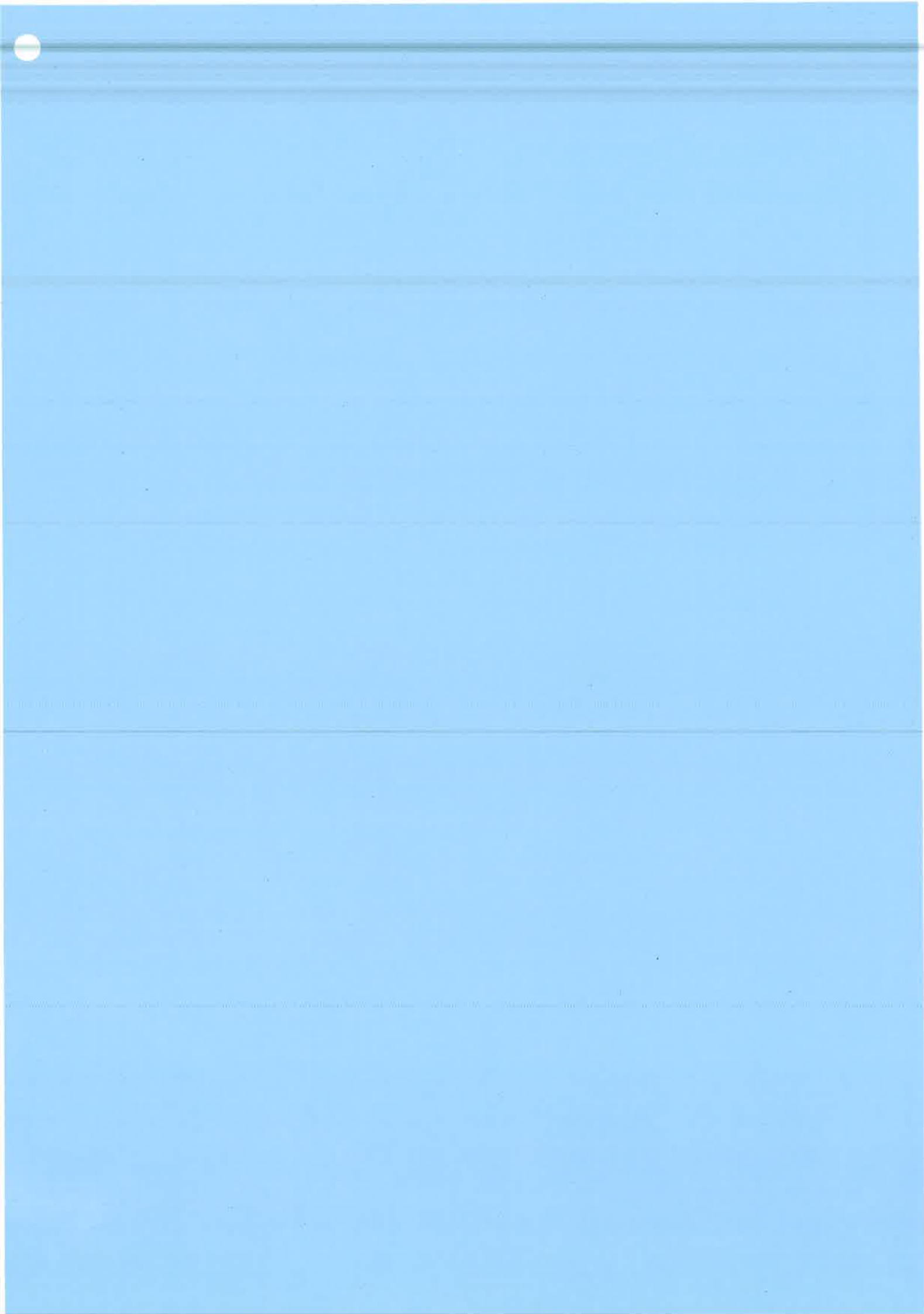
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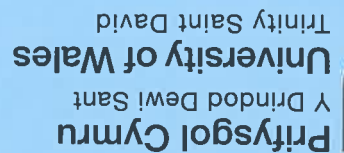
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12 Tudalen

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 et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr nall ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei threipio 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 thynnu llinell drwyddynt.

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

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

8. Rhaid dychwelyd pob llyfr. Ni chaniateir 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)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYN TAF: