



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.**

SURNAME: Arthur

FORENAME(S): William

1	Student Number	P149138
2	Title of Examination Paper	CAE + stress analysis
3	Module Code	MSX02064
4	Date and Time of Examination	8.5.19 12:00
5	Examination Venue	310
6	Seat Number	G059
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	12
2	14
3	11
Total	37

(Gweler yr ochr arall am y fersiwn Cymraeg)

61.7%

1.

 σ_H :

Resistive force = force due to hoop stress

a)

$$F = P \times A$$

$$F = \sigma_H \times A$$

$$\text{where } A = \pi dL$$

$$\text{where } A = 2tL$$

$$F = \sigma_H 2tL$$

$$F = PdL$$

$$\therefore PdL = \sigma_H 2tL$$

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

$$b) \quad d = 3.5 \text{ m}$$

$$t = 0.5 \times 10^{-3} \text{ m}$$

$$i) \quad P = 101 \text{ kPa}$$

$$\sigma = 101 \text{ kPa} \times 3.5$$

$$\frac{2 \times 0.5 \times 10^{-3}}$$

$$= \cancel{3535} \text{ Pa} \quad 3535$$

$$= 35.3 \text{ kPa}$$

$$\therefore 25,000 \text{ feet}$$

$$ii) \text{ at } 8,000 \text{ feet } \therefore 75.3 \text{ kPa}$$

$$= \frac{75.3 \times 10^2 \times 3.5}{2 \times 0.5 \times 10^{-3}}$$

$$= 2635.5 \text{ Pa}$$

$$= 26.35 \text{ kPa}$$

$$\therefore 35,000 \text{ feet}$$

- c. When the plane is pressurised at an equivalent pressure of 8000 ft it undertakes a hoop stress of 26.35 kPa which the plane is capable of flying at 35000 feet without losing structural strength.

this means the plane can fly higher and therefore faster due to thinner air whilst not losing strength. / (2)

- d. σ_H for a sphere.

$$F = P \times A \quad \text{Resistive force} = \text{forces} \quad \sigma_H = \frac{F}{A} \quad \therefore F = \sigma \times A$$

$$A = \frac{\pi d^2}{4}$$

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

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

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

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

- e. Sphere containers can't be as strong and so can be used but for smaller quantities of fluids. / (4)

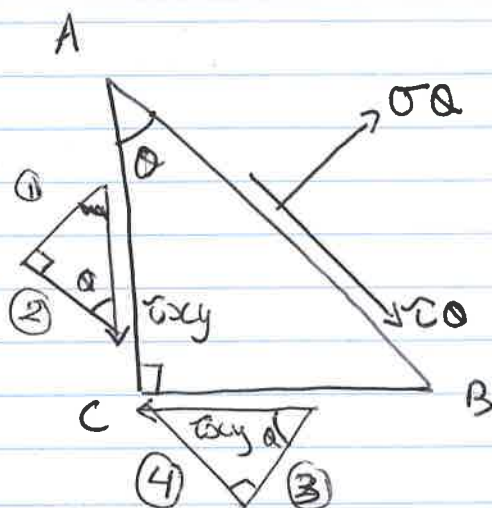
Cylindrical containers can undertake more hoop stress and so are used where this extra strength is needed, for denser fluids. (0)

2. a) Principle stress is the stress acting on a part / element in the directions σ_x and σ_y .

Principle plane is the plane / ~~direct~~ angle at which the principle stress is acting

①

b) i)



$$\textcircled{1} AC \sin \theta \tau_{xy}$$

$$\textcircled{3} \textcircled{2} BC \cos \theta \tau_{xy}$$

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

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

$$AB \sigma_{\theta} = \textcircled{1} + \textcircled{2} \textcircled{3}$$

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

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

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

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

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

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

⑤

ii) ~~AB~~ (2) $AC \cos \theta \tau_{xy}$

(4) $BC \sin \theta \tau_{xy}$

$$\cancel{AB \tau_{\theta}} + (4) = (2)$$

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

$\div AB$

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

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

$\Rightarrow$

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

$\Rightarrow$

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

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

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

(5)

$$\sigma = \frac{F}{A}$$

c) $A = 800 \text{ mm}^2 \times 10^{-3} \text{ for m}$

~~$$\tau_{\theta} = \frac{\sigma_p + \sigma_x}{A}$$~~

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

$$\sigma_{\max} = \frac{1}{2}(45 + 45) + \frac{1}{2}(45 - 45) \cos 2 \times 20$$

$$\sigma_F = 45 \text{ kN}$$

Normal stress

$$\sigma = \frac{F}{A} = \frac{45 \times 10^3}{800 \times 10^{-3}} = 56.25 \text{ kN/m}^2$$

UNITS

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

$$= \frac{1}{2}(45 - 45) \sin 2 \times 20$$

$$= 0 \text{ kN}$$

(3)

3. a) A design problem is an issue in the design of a product which can be altered before the product is made,

An analysis problem is an issue in a product, when it has been prototyped and analysed. This can have values attached to it, for example it can undergo a test to see how much stress will break the product and this value can be used to select a new, stronger material or to then change the design. Or young's modulus can be tested and the product results will show a value of elasticity, which

b) A design problem is an iterative process as when a ~~bad~~ problem is seen in the design stage, the next step is to go back and ~~start the design again~~ or modify the design and see if the problem still occurs. you don't have to ~~complet~~ start again.

An analysis problem will be detected later on in a prototype and the design will then have to be changed and a new prototype will be made to see if the problem is solved. This may be because the problem cannot be seen in the design until it is made, and can cost ~~much~~ a lot of money. This sequence can continue until the problem is solved rather than iteratively, as you go in the design process.

c). ~~B. defining the problem~~

1. Gathering information about the problem

advantage: information can be gathered ~~from prototypes~~ and the problem might be fixable without any prototypes which would save money.

disadv: some problems cannot be seen until the prototype is actually made, could cost more.

2. finding multiple solutions

multiple solutions means that there are several options ~~which~~ in case one does not work.

time may be wasted thinking of more solutions when the best one has already been thought of.

3. Analyse solutions and pick one to implement.

~~this~~ means an advantage of this is that once the solutions have been analysed the best possible ~~choice~~ one will be chosen.

a disadvantage is that this can be a long process and waste time if the best option was unknowingly chosen first.

4. Test and implement the solution

An advantage of testing the solution is that even though it was thought to be the best option, it may still not work and another solution can still be used.

a disadvantage is that running multiple tests can raise costs dramatically.

3

Question No.

Examiner Only

Rhif y Cwestiwn

Arholwr yn un

Question No.

Examiner O

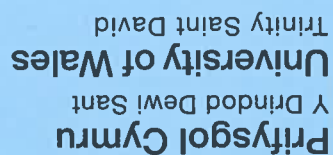
Arholwr yn unig

if y Cwestiwn

Question No.

Examiner O





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

1. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
2. Ysgrifennwch eich atebion mewn inc.
3. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
4. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
5. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwr/gwylywr.
6. 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 Arholiad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

Cyfanswm	
Phrestrwch nffau'r cwestiynau a ymgeiswyd gennyh	At Dibenion y Swyddfa

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: