



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: Hopkins

FORENAME(S): Christopher

List the numbers of the questions you have attempted	Office Use
1	20
2	17
3	15
Total	52

(Gweler yr ochr arall am y fersiwn Cymraeg)

86.77

1

a

$$F \uparrow = PdL$$

$$F \downarrow = 2\sigma_H Lt$$

$$2\sigma_H Lt = PdL$$

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

(4)

b

$$200 = \frac{P(3.5)}{2(0.0005)}$$

$$\frac{200(2)(0.0005)}{3.5} = P = 0.057 \text{ MPa}$$

$$0 \text{ ft} \rightarrow \text{Pressure} = 101 \text{ kPa}$$

$$101 \text{ kPa} - 0.057 \text{ MPa} = 44$$

$$101 - 57 = 20000 \text{ ft}$$

(4)

$$\textcircled{a} \quad 8000 \text{ ft} \quad \text{Pressure} = 75.3 \text{ kPa}$$

$$75.3 - 57 = 18.3 \text{ kPa}$$

$$40000 \text{ ft}$$

(3)

c By pressurizing passenger cabins it allows the plane to travel at higher altitudes where the air is thin allowing for a more economically efficient flight.

(2)

d

$$F \uparrow \pi P d^2$$

$$F \downarrow 4 \pi d t \sigma_H$$

$$\pi P d^2 = 4 \pi d t \sigma_H$$

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

e

Hoop Stress in a Spherical ~~cyl~~ tank is half the value in cylindrical containers. Allowing for higher pressures. However cylindrical containers are a more efficient use of space to store.

1b asks for 500ft not 5000ft so increase this was intentional looking for 1b below if answers were supposed to be nearest 5000 ignore

① 0ft Min Pressure ~~44~~ $46.6 - 37.6 = 9 \text{ kPa}$
 44 kPa

between 20000ft = 46.6 kPa $1.8 \times 10^{-3} \text{ kPa ft}$
 25000ft = 37.6 kPa Per ft 5000

$$46.6 - 44 = 2.6 \text{ kPa}$$

$$\frac{2.6}{1.8 \times 10^{-3}} = 1444.4$$

$$44 \text{ kPa} = 21444 \text{ ft}$$

Closest 500ft below
 $= 21000 \text{ ft} \text{ @ } 0$

② 8000ft Min Pressure
 18.3 kPa

$$40000 = 18.7 \text{ kPa}$$

$$45000 = 14.5 \text{ kPa}$$

$$18.7 - 18.3 = 0.4$$

$$\frac{0.4}{8.4 \times 10^{-4}} = 476.19 \text{ ft}$$

$$18.7 - 14.5 = 4.2 \text{ kPa}$$

$$\frac{4.2}{5000} = 8.4 \times 10^{-4} \text{ kPa Per ft}$$

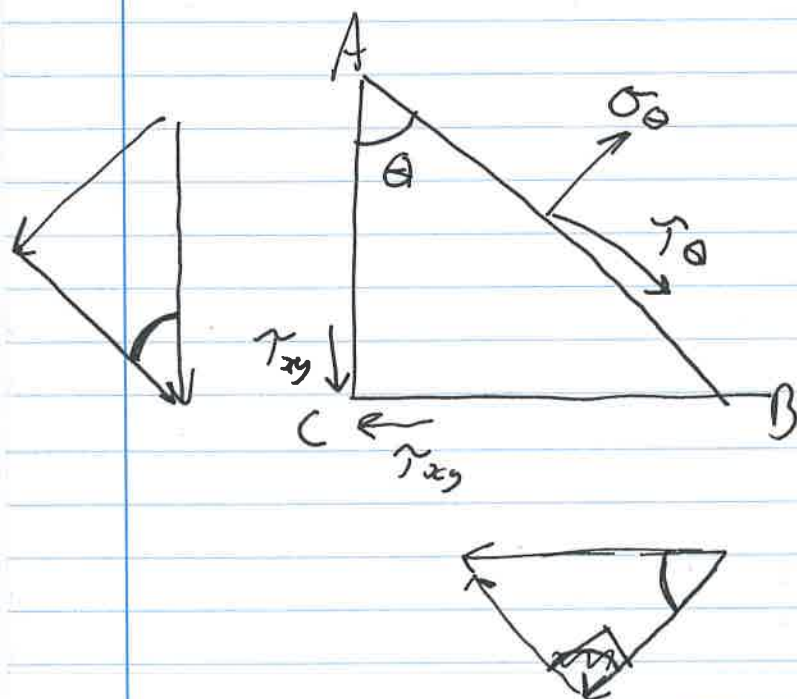
$$18.3 \text{ kPa} = 40000$$

Closest 500ft below
 $= 40000 \text{ ft}$

2)

a Principal Stress - the $\sigma_{\max}$ and $\sigma_{\min}$ stress that can be applied to the element

Principal Plane - the plane on which principal stress acts on.



i

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

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

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

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

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

$$ii) \quad AB \tau_{\theta} = BC \sin \theta \quad \text{or} \quad AC \tau_{xy} \cos \theta$$

$$\tau_{\theta} = \frac{BC}{AB} \quad \frac{AC}{AB}$$

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

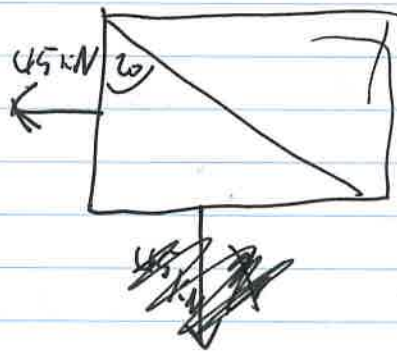
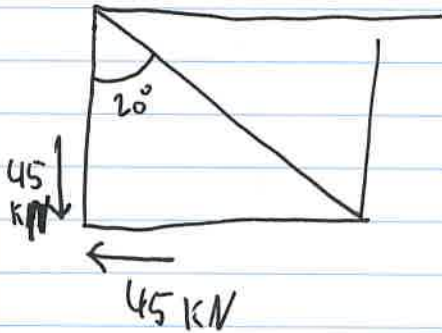
$$\sin^2 \theta$$

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

$$\sin^2 \theta - \cos^2 \theta = -\cos 2\theta$$

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

C



$$\tau_{\theta} = -45 \cos 2\theta = -34.47 \text{ kN}$$

X

$$\sigma_{\theta} = 45 \sin 40 = 28.93 \text{ kN}$$

$$\sigma_{\theta} = \frac{1}{2} (45 + 45) + \frac{1}{2} (45 - 45) \cos 2\theta = 45 \text{ kN}$$

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



$$O_x = \frac{1}{2}(45) + \frac{1}{2}(45) \cos 40^\circ = 39.74 \text{ kN}$$

$$T_y = \frac{1}{2}(45) \sin 40^\circ = 14.46 \text{ kN}$$

4

Q3

a Design Problem is ~~not~~ an iterative process that can have many solutions from different devices. Analysis Problems have only one solution ~~and~~ and are therefore very step based.

b A design problem is iterative because once developed a newer iteration that is cheaper, weighs less, performs better, looks better etc. could be produced. Additionally products could fail and have to be redesigned due to any of the above mentioned attributes

~~The~~ analysis problems are sequential because to find the one solution steps need to be followed. ~~There~~ there is no redesigning the solution.

c

CAE in the design process Feedback Loop

No CAE

cad → tooling → test

early CAE

cad → tooling → test
 | CAE | feedback
 cad → tooling → test₁

Current

cad | CAE | feedback
 cad → tooling → test

time

complete

This model states that using CAE as a design tool instead of an analytical tool or not at all severely reduces time spent on designing as well as money spent on creating prototypes. The downside is the cost of software and people qualified

to use the Software + bad information in CAE
Will turn out bad results.

3

iterative Process

using an iterative process designs can consequently be measured on factors such as cost. if the product will cost too much the design can be redesigned for cost (not limited to cost)

Advantage

+ Allows for the final product to be the best iteration as every iteration should be better than the last

Negative

- Constant redevelopment is costly even without production (nothing to sell)

1

Design Process Model

The design process stages are A problem is thought of → research into the problem → develop some solutions → pick the best solution → evaluate the solution and test it

Advantage / Dis

+ Allows for constant redevelopment once product is produced creating better designs for next model.

- Creating a product then evaluating it could lead to a faulty product (wasted money)

3

Question No.

Examiner Only

Arholwr yn unig

Yn unig y Cwestiwn

Question No.

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Question No.

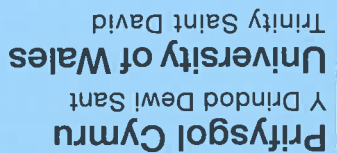
Examiner Only

Question No.

Examiner Only

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Arholwr yn unig



12 Tudalen

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.

[illegible]