



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:

Foxton

FORENAME(S):

Harry

1	Student Number	1702/99
2	Title of Examination Paper	CAE and Stress Analysis
3	Module Code	MSX02064
4	Date and Time of Examination	12:00 9/05/19
5	Examination Venue	310 IQ
6	Seat Number	G025
7	Number of Answer Books handed in	1

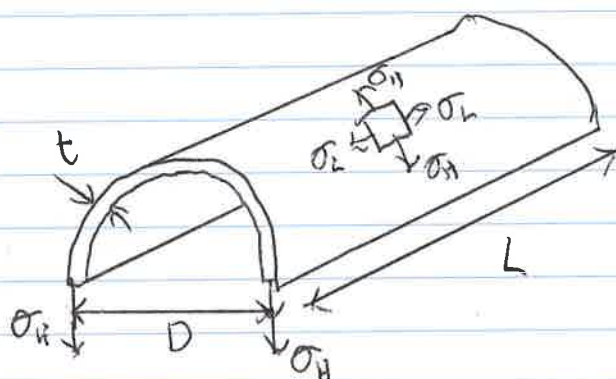
List the numbers of the questions you have attempted	Office Use
1	18
2	19½
3	12
Total	49.5

(Gweler yr ochr arall am y fersiwn Cymraeg)

82.5%



1a)



Force due to hoop stress = Force due to pressure

$$\sigma_H = F/A$$

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

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

$$F = PA \text{ where } A = dL$$

$$P = \sigma_H 2tL$$

$$F = PdL$$

$$\sigma_H 2tL = PdL$$

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

1b) i) $\sigma_H = 200 \text{ MPa}$

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

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

$$P = P_g h$$

$$P = \frac{\sigma_H 2t}{d} = \frac{200 \times 10^6 \times 2 \times 0.5 \times 10^{-3}}{3.5} = 57.142857 \times 10^3 \text{ Pa}$$

$$57.14 \text{ kPa}$$

$$\text{Pressure difference} = 101 - 57.14 = 43.86 \text{ kPa}$$

∴ According to table @ 43.86 kPa $h = 20,000 \text{ ft}$ ✓

ii) Sealed at 75.3 kPa

∴ Pressure difference = $75.3 - 57.14 = 18.16 \text{ kPa}$ ✓

According to table @ 18.16 kPa $h = 40,000 \text{ ft}$ ✓

1c) Hoop stress, which in the case of thin cylinders is the highest stress evolved on the shape is proportional to the pressure difference between the sealed inside and the outside of the cylinder. By sealing at a higher altitude a higher altitude a ~~larger pressure~~ smaller pressure difference is felt which allows the plane to fly higher while feeling the same stress as pressurizing at ground level.
 BUT WHY? ✓

1d) Force due to pressure = Force due to hoop stress

$$F = PA \text{ where } A = \pi r^2 \quad \text{or} \quad \frac{\pi d^2}{4} \quad F = \sigma_H A \text{ where } A = \pi d t$$

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

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

1e) The hoop stress is the highest stress endured by a thin cylinder and due to the nature of the shape of a sphere it is apparent that the hoop stress felt on a sphere is half that felt on a cylinder as shown below.

$$\sigma_H(\text{sphere}) = \frac{Pd}{4t} \quad \sigma_H(\text{cylinder}) = \frac{Pd}{2t}$$

This is beneficial as it means a facility can store certain fuels at higher pressures & this is selected for the specific content.

However it is also beneficial to store fuel in cylinders as they take up less space.

✓ ③

$$1i) AB \tau_{\theta} + (2) = (3)$$

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

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

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

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

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

$$2c) A = 800 \text{ m}^2$$

$$F = 45 \text{ kN} \quad \therefore \sigma_x = F/A = \frac{45 \times 10^3}{800 / (1000^2)} = \frac{45 \times 10^3}{8 \times 10^{-4}}$$

$$= 5.625 \times 10^7 \text{ N m}^{-2} \quad \text{N/m}^2$$

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

$$\sigma_{\theta} = \frac{1}{2}(5.625 \times 10^7) + \frac{1}{2}(5.625 \times 10^7) \cos(40)$$

$$\sigma_{\theta} = \underline{4.967 \times 10^7 \text{ N m}^{-2}}$$

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

$$\tau_{\theta} = \frac{1}{2}(5.625 \times 10^7) \sin(40)$$

$$\tau_{\theta} = \underline{1.808 \times 10^7 \text{ N m}^{-2}}$$

3a) A Design Problem does not have one correct exact solution. It is an iterative process that can take on many forms.

4a)

3a) A design problem does not have 1 exact solution and may have in a variety of shapes as the design adapts to the needs of the customer. It is considered an iterative process. Compared to an Analysis problem which usually only has 1 correct solution to complete the task at hand.

3b) design problems are vitally iterative as there is no exact way to approach a task, and the customer may change certain aspects of the ~~design~~ specification which may heavily alter the design of a product. Analysis problems usually aim at having a very specific problem with a system. Therefore there is usually a final finishing point that a Analysis problem will reach.

3c) The fundamental steps of the design process involve defining the problem and understanding what exactly the customer is looking for and creating a problem statement which outlines the fundamental features the customer looks for in their design.

The next step is to gather the relevant info needed for the project. This includes customer budget, what products already exist to satisfy the requirement of the design, what is good and bad about current designs, the environmental considerations of the product.

The next step is to generate multiple solutions which all fit the criteria but have different approaches. This is the creative process and Brainstorming of the design.

The next step is to analyse the solutions and test each one through a CAE process, to see which ones fit the desired task.

The final step is to Test the product with a prototype model to see how it will act in the real world.

3

- one Theory ~~comes from~~ the (British Standards)
- 2005 has a higher focus on design ergonomics. This is advantageous as it means the end result ~~only~~ is designed with the user in mind creating a product that is both functional and comfortable. A disadvantage of this is that it may sacrifice some function of the design in pursuit of aesthetics or comfort.

1

Question No.

Examiner O

Arholwr yn unig

iff y Cwestiwn

Question No.

Examiner Or

Arholwr yn unig

hff y Cwestiwn

Question No.

Examiner O

Arholwr yn unig

Y Cwestiwn



