



12 Pages

1. Please give the information requested in the boxes below.
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1	Student Number	P149642
2	Title of Examination Paper	CAE + Shem Analysis
3	Module Code	MSX02064 .
4	Date and Time of Examination	12:00pm 9-5-19 .
5	Examination Venue	1Q310
6	Seat Number	4056 .
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
Q.1	10
Q.3.	3
Q.2	14
Total	27

(Gweler yr ochr arall am y fersiwn Cymraeg)

452



Q.1.

$$a) \quad \sigma_H = \frac{Pd}{2t}$$

Pressure Vertically

$$\begin{aligned} \text{Forces } \uparrow &= \text{Pressure} \times \text{Projected Area} \\ &= P \times A \\ &= P \times dL = PdL \end{aligned}$$

$$\begin{aligned} \text{Forces } \downarrow &= 2 \times \text{Hoop Stress} \times \text{Thickness} \times \text{Length} \\ &= 2\sigma_H \times t \times L \\ &= 2\sigma_H tL \end{aligned}$$

∴

$$Pd = 2\sigma_H t$$

1m

$$\therefore Pd = 2\sigma_H t$$

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

/4

b)

i) Cabin Sealed at Sea level.

$$P_{\max} = 200 \times 10^4 \text{ Pa} \quad d = 3.5 \quad t = 0.005$$

$$P_{\text{at Sea level}} = 101 \times 10^3 \text{ Pa} \quad \sigma_H = \frac{Pd}{2t}$$

$$200 \times 10^4 = \frac{101 \times 10^3 \times 3.5}{2 \times 0.005} = 88.375 \text{ kPa}$$

from table 88.375 kPa Plane must fly below
3500 ft.

x 0

ii) Pressurised to equivalent of 8000 ft.

$$\frac{P_d}{2b} = \frac{75.3 \times 3.5}{2 \times 0.0005} = 65.89 \text{ kPa}.$$

from table 65.89 kPa $\Rightarrow$ Plane can fly up to 10,000 ft. X (0)

C. By Pressurising the Plane Cabin, the aircraft can fly at higher altitude, thus allowing it to fly in less dense air and thus increase fuel efficiency. / (2)

D. $\sigma_H \text{ Sphere} = \frac{P_d}{4t}.$

Forces acting on ~~ball~~ outwards

$$= \text{Pressure} \times \text{Area of circle}.$$

$$= P \times \pi r^2 = \frac{P \pi d^2}{4}.$$

$$\text{resulting force} = \sigma_H \times \text{Circumference}$$

$$= \sigma_H \times 2\pi r \times \text{thickness}$$

$$= \sigma_H \times \pi d \cdot t.$$

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

$$\therefore \sigma_H = \frac{P_d}{4t}.$$
/ (4)

- e. Due to the spherical containers having half the hoop stress of cylindrical containers there are more suitable for containing fluids at higher pressures.

FOOTPRINT?

②

Q.3

- a) Design Problems usually have multiple Solutions, there could be various ways to solve the problem. The design process is also normally iterative i.e. can ~~take~~ take many re-designs to get to production, Whereas Analytical Problems usually have only one solution and can generally be solved without the need for 3d CAD modelling of parts then redesign.
- b) The design process is usually iterative as it depends on the knowledge and skill of the CAD engineer on initial design, if the initial design is not correct, another iteration of the design may be necessary and so on. Analytical problems are usually sequential as the part is generally modelled based on boundary conditions and load paths that are programmed into the design process before any modelling in CAD takes place. This allows the designer to produce a pre-optimised part that generally won't require another iteration before production.
- c) Define the problem. first the need for the product must be defined, what is the product for and who will use it for example.
- i) Gather Relevant Information. Information relevant to the product can now be gathered. Has a product been designed previously to solve the particular problem, who has made the product, how much does it cost. Does it comply to Regulations, is it environmentally

friendly. The advantage of this process is that it finds the need for the product within the marketplace and predicts whether or not it will be profitable.

Disadvantages would include the time and cost factors involved.

- ② Generation of multiple solutions - After information is gathered, design teams begin initial designs, at this stage they are encouraged to take risks, various ideas are tendered to the design process.

The advantage of this is that multiple ideas may fit the design criteria and it is made easier to choose a design.

The disadvantage is again the time spent and costs incurred.

- ③ Early design process - Many CAD designs + iterations - Costly and time consuming. Achieved reliable products due to constant iterations.

- ④ CAD with CAE. - Feedback based design loop between CAD + CAE. Allowed for early optimisation of product and lower prototype costs. Initially very expensive and required immense computing power.

- ⑤ CAE Based design process - Allowed for minimal CAD input. Very rapid from concept to product. Could be problematic with incorrect information entered to CAE Software (garbage in, garbage out).

⑥

⑦

Q.2.9) Principal Stress with regard to ~~Complex~~ stress refers to the maximum or minimum stress applied to the principal plane of an element.

The principal plane is the axis upon which the stress is applied, usually on angle to the vertical plane of the element.

b)

3

X

$$c) \sigma_{\theta} = \sigma_{\theta} = 45 \times 10^3 \sin 2(20) \cdot \frac{28925.44 \text{ N}}{0.008 \text{ m}^2} \cdot 800 \text{ mm}^2 \cdot 10^{-6}$$

$$28925.44 \times 0.008 = \sigma_{\theta} \cdot 231.40 \text{ MPa}$$

$$ii) \tau_{\theta} = -45 \times 10^3 \cos 2(20) = -34472 \text{ N}$$

$$\tau_{\theta} = -275.78 \text{ MPa}$$

X

Question No.

Examiner Only

Arholwr yn unig

Thif y Cwestiwn

Question No.

Examiner Only

Arholwr yn unig

Phif y Cwestiwn

Question No.

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