



Complete, fold and seal
(see note 2 below)

SURNAME: DI CROSTA

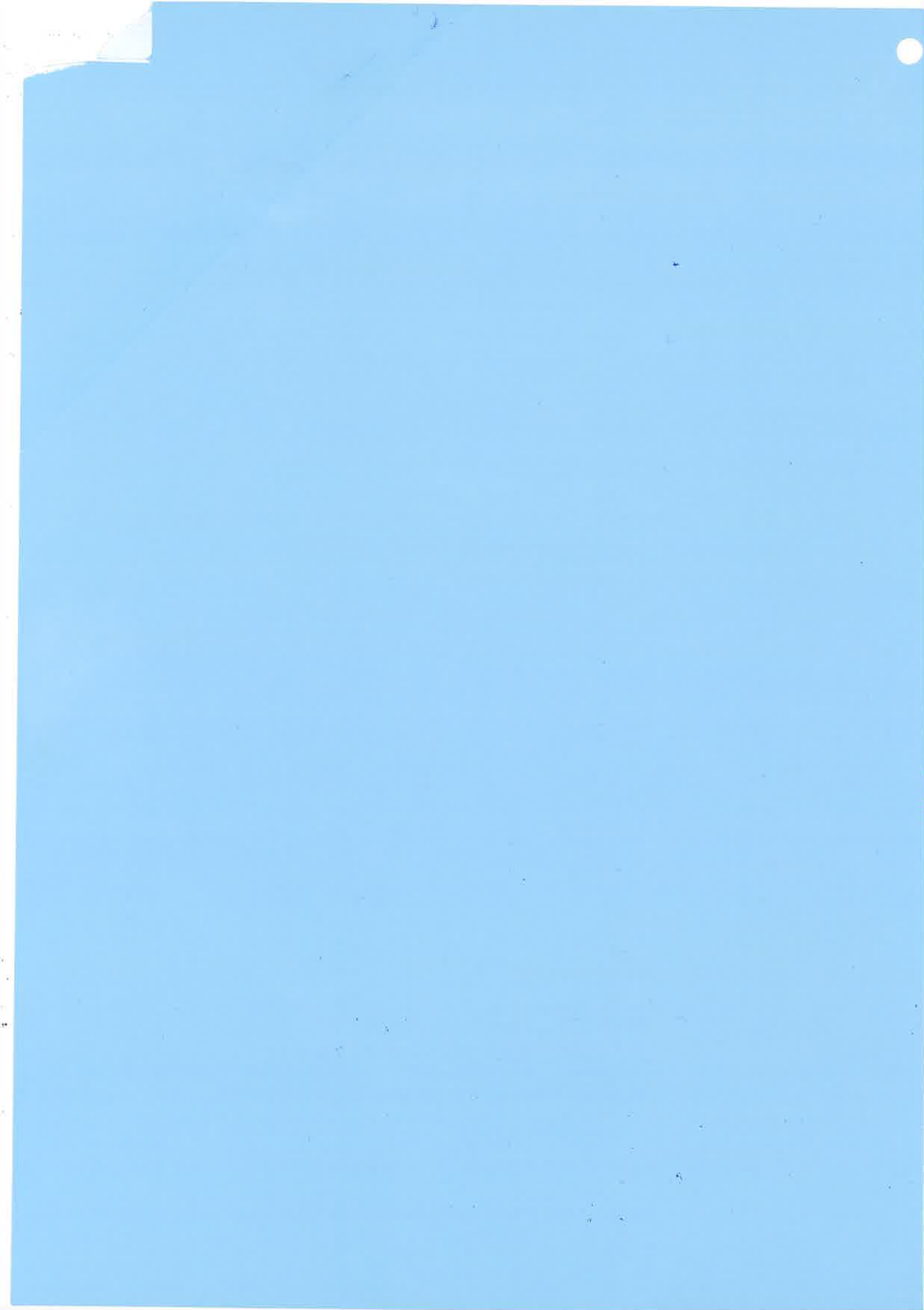
FORENAME(S): EMANUELE

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.**

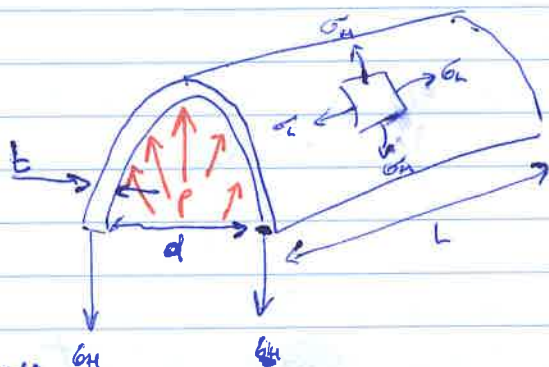
List the numbers of the questions you have attempted	Office Use
1	15
2	18
3	8
Total	41

(Gweler yr ochr arall am y fersiwn Cymraeg)

68.3 ✓



1



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

$$P = \frac{F}{A} \Rightarrow F = P \cdot A \quad P = \sigma$$

$F \uparrow = \downarrow$ in equilibrium

force due pressure = force reaction

$$P \cdot (dL) = \sigma_H (tL) 2$$

rearranging for σ_H

$$\sigma_H = \frac{PdL}{t2L} = \frac{Pd}{2t}$$

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

K	10^3
M	10^6
G	10^9

Alu 7075

$$\sigma_{H, \max} = 200 \text{ MPa}$$

$$\Delta P = \frac{\sigma_{H, \max} \cdot 2 \cdot t}{d} = \text{PRESSURE DIFFERENCE}$$

$$d = 3,5 \text{ m}$$

$$t = 0,5 \text{ mm}$$

$$P = \rho g h$$

$$h_{\max}$$

$$\Delta P = \frac{200 \cdot 10^6 \cdot 2 \cdot 0,5 \cdot 10^{-3}}{3,5} = 57142 \text{ Pa}$$

$$57,14 \text{ KPa}$$

$$P_{\text{atmosphere}} = 101 \text{ KPa}$$

$$P = 101 - 57,14 = 43,86 \text{ KPa}$$

b) i) $h @ P_{\text{atmosphere}} = 20'000 \text{ ft}$ from table
 $\hookrightarrow$ between 20'000 and 25'000 ft

$$P @ 8000 \text{ ft} = 75,3 \text{ KPa}$$

$$P = 75,3 - 57,14 = 18,16 \text{ KPa}$$

b) ii) $h @ P_{\text{atmosphere}} = 40'000 \text{ ft}$ from table
 $\hookrightarrow$ between 40'000 and 45'000

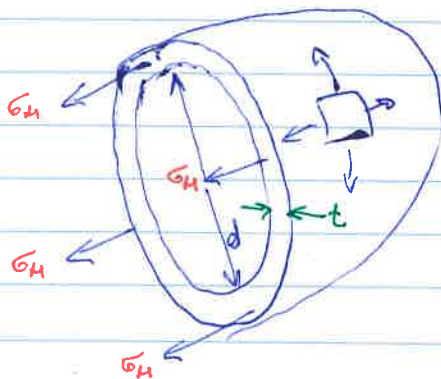
c) ~~Higher internal pressure allows~~

With the features of the airplane given, a fixed pressure difference of 43.86 kPa between the inner and outer of the aircraft can be experienced by the parts without failing -

Lower ~~inner~~ inner pressure therefore allows the aircraft to reach higher ~~altitudes~~ altitudes due to less pressure difference involved -

BUT WHY?

d)



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

$$P = \frac{F}{A} \rightarrow F = P \cdot A \quad P \equiv \sigma$$

For equilibrium
 $F \leftarrow = \rightarrow$

$$P \left(\pi \frac{d^2}{4} \right) = \sigma_H (t \pi d)$$

Rearranging for σ_H : $\sigma_H = \frac{P \cancel{\pi} d^2}{4 t \cancel{\pi} d}$

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

4

e) By analysing the two formulae:

$$\sigma_H = \frac{Pd}{8t} \quad \text{and} \quad \sigma_H = \frac{Pd}{4t}$$

~~it is immediately clear the spherical~~
~~shapes~~ ~~experience~~ half the stress

It is immediately clear that the stress in spherical tanks is half the stress experienced by cylindrical containers -

Therefore, higher pressures can be used for spherical containers -

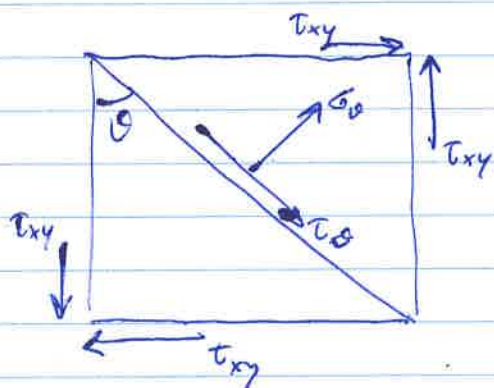
BUT WHY?

0

2

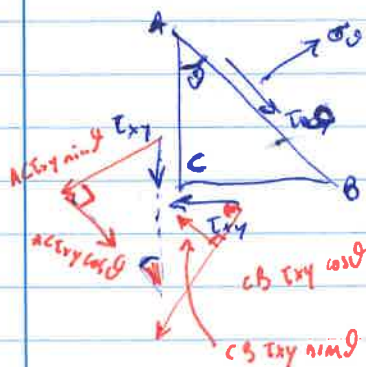
- a) **PRINCIPAL STRESS** is a minimum or a maximum value of stress that an element can experience. It occurs into the **PRINCIPAL PLANE** which is an inclined surface to the perpendicular stress.

b)



given $(\sin 2\theta) = \frac{1}{2} \sin 2\theta$
 $(\sin^2 \theta - \cos^2 \theta = -\cos 2\theta)$

- i) show $\sigma_\theta = T_{xy} \sin 2\theta$:



$F \uparrow = \downarrow$

$AC T_{xy} \sin \theta + CB T_{xy} \cos \theta = \sigma_\theta AB$

$\frac{S}{H}$
 $\frac{C}{A}$
 $\frac{T}{O}$

$\sigma_\theta = \frac{AC}{AB} T_{xy} \sin \theta + \frac{CB}{AB} T_{xy} \cos \theta$

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

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

- ii) show $\tau_\theta = -T_{xy} \cos 2\theta$

$F \leftarrow \rightarrow$

$AB \tau_\theta + AC T_{xy} \cos \theta = CB T_{xy} \sin \theta$

$\tau_\theta \frac{AB}{AB} = \frac{CB}{AB} T_{xy} \sin \theta - \frac{AC}{AB} T_{xy} \cos \theta$

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

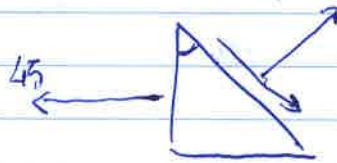
$\tau_\theta = -T_{xy} \cos 2\theta$

c) $A = 800 \text{ mm}^2$
 $\sigma_{\text{TDNS}} = 45 \text{ kN}$

$$\theta = 20^\circ$$

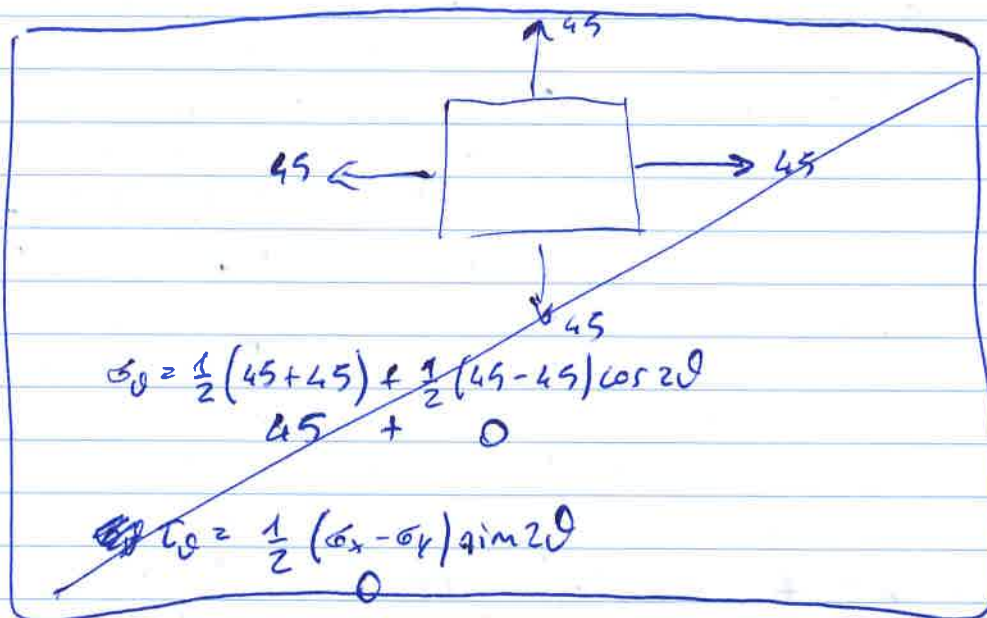
$$\sigma_\theta = ?$$

$$\tau_\theta = ?$$



$$\begin{aligned} \sigma_\theta &= \frac{1}{2} (\sigma_x + \sigma_y) + \frac{1}{2} (\sigma_x - \sigma_y) \cos 2\theta \\ &= 0,5 (45 + 0) + 0,5 (45 - 0) \cos (40) \\ &= 22,5 + 22,5 (\cos(40)) = 17,24 \text{ kN} \end{aligned}$$

$$\begin{aligned} \tau_\theta &= \frac{1}{2} (\sigma_x - \sigma_y) \sin 2\theta \\ &= 0,5 (45 - 0) \sin(40) = 14,46 \text{ kN} \end{aligned}$$



5

3

a) ~~An analysis problem is a problem that tends to have one mathematical solution.~~

A design problem is ^{an} vaguely defined problem which solution is a system with specific properties to meet a need. ~~Therefore, contrary to an analysis problem~~ to an ~~analysis~~ analysis problem which has one solution, a design problem has several ~~solutions~~ due to its "undefined" nature.

REACTIVE
PROCESS

b) An analysis problem, as mentioned, ~~has one solution~~ has one solution due to its analytical and mathematical nature, therefore the solving process can be considered a sequential one, a step by step solving.

On the contrary, a design problem ~~is not~~ has an iterative process because, as the solution ~~is~~ evolves, continuous refinements are required.

For instance, a first solution can ~~lead~~ lead to 'unsafety', it could not work it could be too expensive therefore the analyst has to go back and re-invent it to prevent other issues.

~~This is a cyclic or iterative process.~~

This problem solving approach it is called iterative or cyclic.

Question No.

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Question No.

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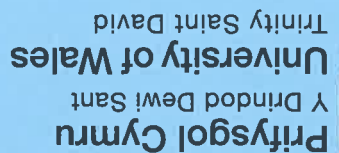
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12 Tüdalen

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF:

1. Rhaid i'r atebion fod mewn llawysgriften ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
2. Ysgriftennwyd eich atebion mewn inc.
3. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
4. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwtr/gwylwyr.
5. 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 Myfyrwr	

Rhestrwch nifau'r gwestiyonau a ymgaiswyd gennyh	Cyfanswm
At Ddbentio y Swyddfa	

(See the other side for English version)