



Complete, fold and seal
(see note 2 below)

FORENAME(S): Joshua

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.**

1	Student Number	P149438
2	Title of Examination Paper	CAE and Stress
3	Module Code	MSX02064
4	Date and Time of Examination	12:00
5	Examination Venue	
6	Seat Number	G020
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	9
2	17
3	10
Total	36

(Gweler yr ochr arall am y fersiwn Cymraeg)

60%



2.)

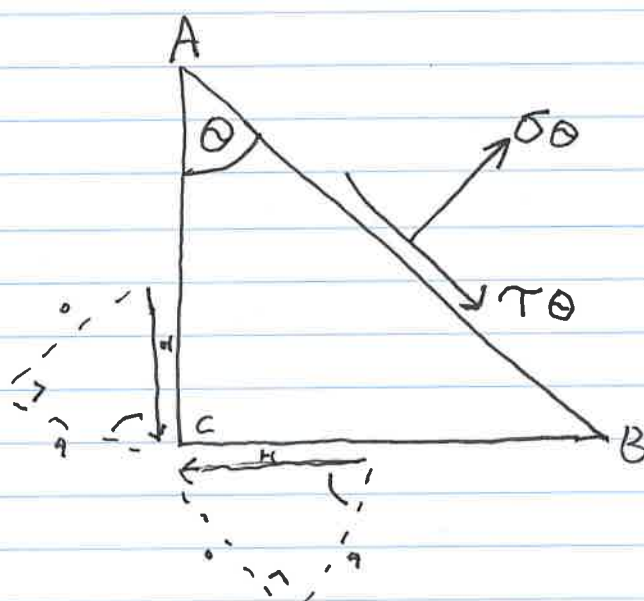
a.)

Principle Stress - The Normal and Shearing Stress acting on a Plane

principle plane - The plane the principle stresses stress acts on

2

b.)



$$S_{\theta}^A \quad C_{\theta}^A \quad T_{\theta}^A$$

$$i.) \quad AB \sigma_{\theta} = AC \tau_{xy} \sin \theta + BC \tau_{xy} \cos \theta$$

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

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

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

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

$$ii) AB \tau_{\theta} = BC \tau_{xy} \sin \theta - AC \tau_{xy} \cos \theta$$

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

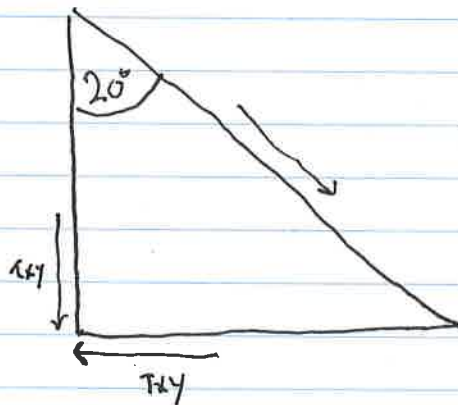
$$\tau_{\theta} = \tau_{xy} \sin \theta \sin \theta - \tau_{xy} \cos \theta \cos \theta$$

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

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

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

c.)



Shear Stress

$$\sigma_{\theta} = 45 \sin 2(20)$$

$$= 28.93$$

Also

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

$$\sigma_{\theta} = \frac{1}{2}(45 + \overset{28.93}{45}) + \frac{1}{2}(45 - \overset{28.93}{45}) \cos 2(20)$$

$$\sigma_{\theta} = 43.12$$

$$\tau_{\theta} = -45 \cos 2(30)$$

$$\tau_{\theta} = -34.47$$

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

$$\tau_{\theta} = \frac{1}{2}(45 - 34.47) \sin 2(20)$$

$$\tau = 3.38$$

X (5)

(3)

~~The Design Problem is an Iterative process as it means Multiple Designs or Solutions need to be made~~

The Design Problem indicated that Multiple designs could be made however they would have to be tested to see if they work by either creating prototypes or in a ~~complex~~ CAE/CAD Software Package and this could create errors in the final product and is time consuming. However the analysis problem shows that a certain design has to be picked which best solves the problem and therefore advantages of other designs could be left behind or missed in the final product.

(2)

- 6) The Design Problem is a iterative problem because Multiple designs have to be made called initial designs and then put into CAD for a final design. This process could be reset or carried on until the solution is found. Whereas the analysis problem ~~gives~~ gives a set criteria on the problem and is sequential to see if the design meets the solution to the

Problem.

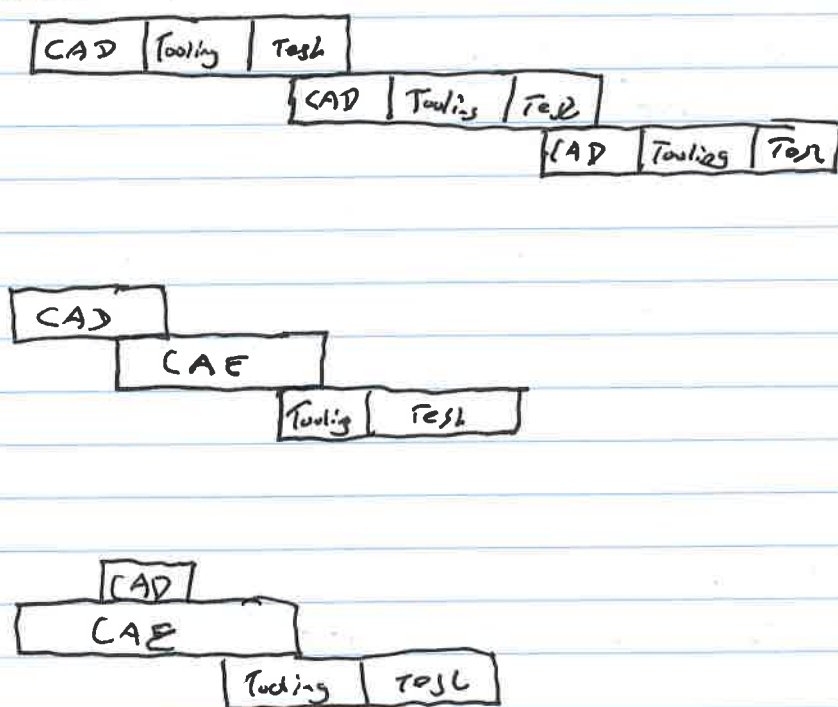
C.)

The design process can be carried out in a number of ways. Normally the process starts off with the identifying the problem first. This involves looking for the problem or analysing the situation to find the problem. The advantage of this is to make sure you know what the problem is before you start solving it which will help solve the problem better. The next step is to research the ~~problem~~ problem. This ~~is~~ is an advantage as it allows you to understand the area of the problem better to allow you to come up with a better design to solve the problem. However you could come across incorrect research which ~~you~~ would affect the design. Next is coming up with multiple designs which would allow you to brainstorm ideas and come up with different solutions to solve the initial problem. An advantage to this is that it allows you to think about different designs and ~~satisfying~~ solutions even if they are expensive or not feasible as this will help solve the problem. The disadvantage of this is that you may or ~~not~~ solve the problem across different designs ~~or~~ and not on one design.

The next step would be ~~Analysing~~ Analysing and Implementing the Solutions. This would mean a design would be picked out of the multiple solutions. The advantage of this would

be ~~for~~ that factors like how expensive would it be to make it and if it's possible etc. would be taken into account meaning the design would then be feasible. However the ~~disadvantage~~ disadvantage of this would be that some features of the other designs would have to be left behind. Finally the solution would then be tested and implemented meaning it ~~will~~ ^{can} be used to see if the solution is fit for purpose. The advantage of this is that the solution can be tested before it goes to market or in industry to see if it's fit for purpose. However the disadvantage would be that a ~~problem~~ could another problem could occur from the solution and could mean the process to start again or that it didn't meet the criteria set by ~~identifying~~ identifying the problem.

Figure 1



From Figure 1 it shows that a model used for the design process and shows that if CAE is used it can help save time and money as it will be able to test the design before production. In the last step it also shows that it can be partly solved by CAE which again saves time however the disadvantage to this is that the problem could not completely be solved or the criteria not achieved properly.

(4)

1.)

$$\text{Resistor force} = P d L$$

$$2 \sigma_H K t = P d L$$

$$2 \sigma_H t = P d$$

$$\sigma_H = \frac{P d}{2 t}$$

P = Pressure

d = diameter

L = length

t = thickness

(4)

6.)

$$P = \rho g h$$

i.)

$$h = \frac{P}{\rho g}$$

$$\text{Sea level} = 0 \text{ feet}$$

$$P =$$

$$\sigma_H = \frac{P d}{2 t}$$

$$0.5 \text{ mm} \rightarrow 0.0005 \text{ m}$$

$$\sigma_{H1} = \frac{P(3.5)}{2(0.0005)}$$

④ $\sigma_{H1} =$

$$P = \frac{200 \times 10^6 \times 9.81 \times 0}{1962000000}$$

R

$$\sigma_{H1} = \frac{P d}{2t}$$

$k_2 =$

$\frac{2t}{d}$

$$\sigma_{H1} 2t \approx P d$$

~~work~~ $\frac{P}{k_2}$

$$\frac{57142.86}{(0.0005)(9.81)}$$

$$\frac{\sigma_{H1} 2t}{d} = P$$

$$\frac{200 \times 10^6 \times d(0.0005)}{3.5} = 57142.86$$

①

k_2

$$\rightarrow \approx 15000 \text{ FT} \rightarrow$$

ii)

$$\frac{200 \times 10^6 \times d(0.0005)}{3.5}$$

$$P = \rho g h$$

ad

$$\frac{57142.86}{(8000)(9.81)}$$

$$\frac{P}{\rho g} = \frac{57142.86}{(8000)(9.81)}$$

ca

$$h \approx \frac{57.14}{(0.854)(9.81)} \times 1000 = 10.32 \rightarrow 50,000 \text{ feet}$$

$$= \frac{57.14}{(8000)(9.81)} = 448521653$$

$$= 4484347.2$$

②
X

2.)

Resistible forces $\propto P \pi r^2$

$$4 \sigma_{H1} \pi t = P \pi r^2$$

$$4 \sigma_{H1} t = P d$$

$$\sigma_{H1} = \frac{P d}{4t}$$

④

c.) The pressurized cabin at 8000ft shows it can reach a higher altitude ^{rather} than if pressurized at sea level as shown by results

BUT WHY?
②

- e.) The equations show that for cylindrical containers there ^{are} less resistive forces. Which means that there is less strain exerted on the material just by the shape of the storage where as the spherical tanks have more resistive forces.

FOOTPRINT $\checkmark$ VOLUME?

Ⓢ
x

Question No.

Examiner Or

Arholwr yn unig

liff y Cwestiwn

1.)

Identify the Problem

2.)

Research the Problem

3.)

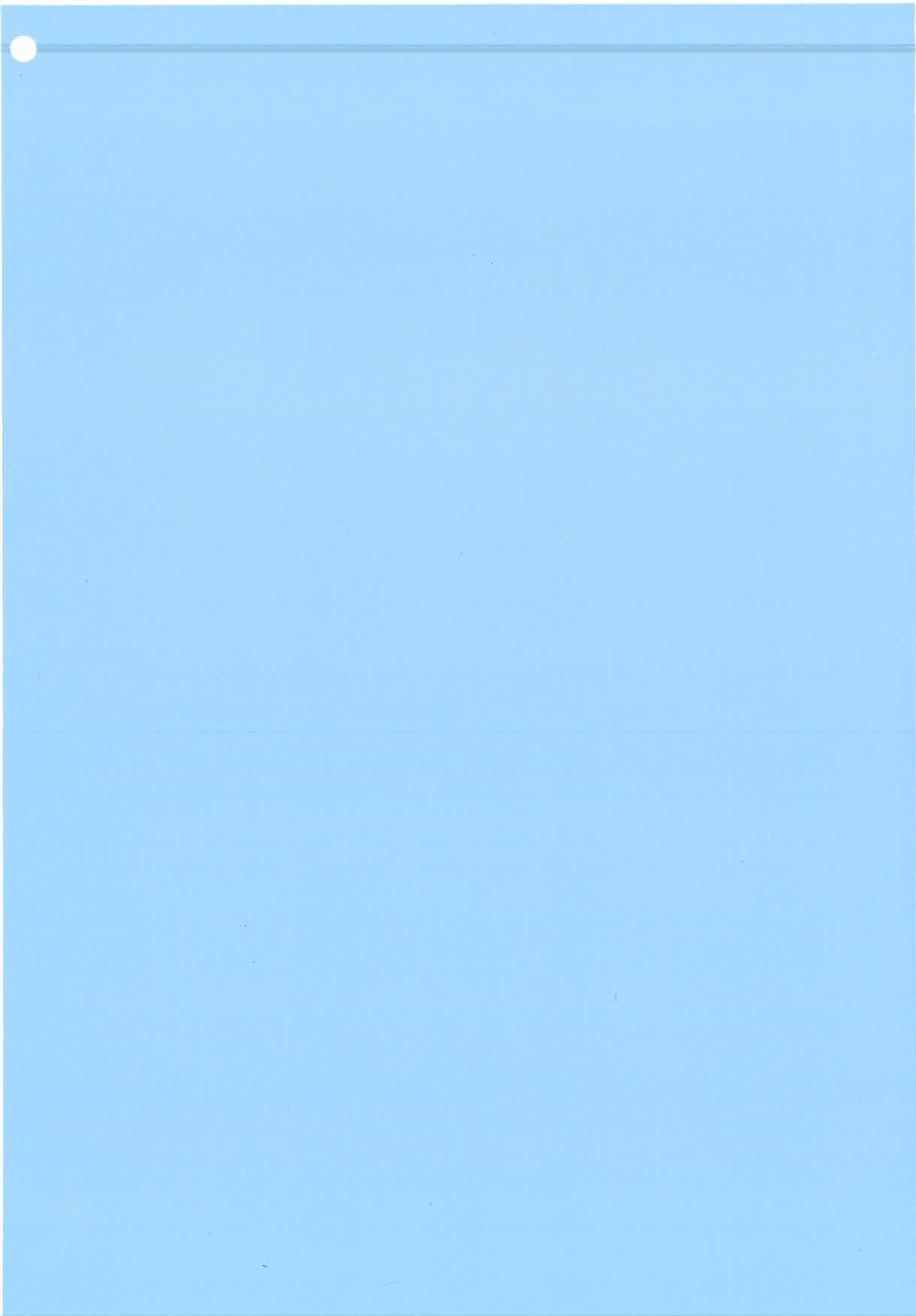
Come up with Multiple Solutions

4.)

Analyse and Implement a Solution

5.)

Test and Implement the Solution



1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plynwch ef a'i seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarllenadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgriennwch eich atebion mewn inc.

5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.

6. Ni ddylid rhwgo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.

7. Os ddefnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllywr/gwylwyr.

8. Rhaid dychwelyd pob llyfr. Ni chanafeir mynd â llyfrau afebion, 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	

[illegible]

(See the other side for English version)

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: