



Complete, fold and seal
(see note 2 below)

SURNAME: MIGLIORATI N'DOUA

FORENAME(S): DAVID

Instructions to Candidates

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.**

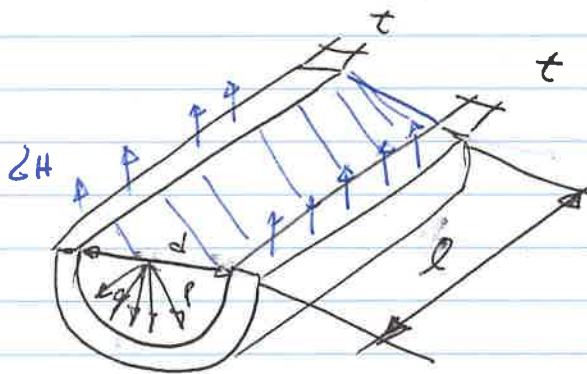
1	Student Number	P150320
2	Title of Examination Paper	CAE - stress ANALYSIS
3	Module Code	MSX02064
4	Date and Time of Examination	9/05/10
5	Examination Venue	IQ 310
6	Seat Number	G038
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	13
2	18
3	3 $\frac{1}{2}$
Total	34 $\frac{1}{2}$

(Gweler yr ochr arall am y fersiwn Cymraeg)

57.5%



Q₁₁
a)

$$\sum F = 0$$

$$\uparrow \vec{F} = \downarrow \vec{F}$$

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

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

$$\sigma_H \cdot (2t \cdot l) = P \cdot (d \cdot l)$$

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

(4)

$$\sigma_{H \max} = 200 \cdot 10^6 \text{ Pa}$$

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

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

$$P = \rho \cdot g \cdot h$$

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

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

$$P_{\text{pressure max}} = \frac{\sigma_H \cdot 2t}{d} = \frac{200 \cdot 10^6 \cdot 2 \cdot (0,5 \cdot 10^{-3})}{3,5} = 57,14 \cdot 10^3 \text{ Pa}$$

$$h_{\text{max}} = \frac{57,14 \cdot 10^3}{\rho \cdot g}$$

$$\text{at } 500 \text{ Ft} = 152 \text{ m } P =$$

The nearest end pressure above $57,14 \cdot 10^3$ is 46,6 kPa at 20'000 Ft = 6096 m

If cabin is at SEA level. $m = 0$
 $P = 101 \text{ kPa}$

(4)

if pressurized At 8000 Ft $P = 75,3 \text{ kPa}$, ~~if not~~.

$$\delta H = \frac{75,3 \cdot 3,5 \cdot 10^{-3}}{2 \cdot (0,5 \cdot 10^{-3})} = 263,55 \cdot 10^6 \text{ Too High}$$

as must not exceed 200 nPa

$$\text{Max } P_{\text{outside}} = 46,6$$

$$\Delta P = 75,3 - 46,6 = 28,7 \text{ kPa}$$

$$\delta H = \frac{28,7 \cdot 3,5}{2 \cdot (0,5 \cdot 10^{-3})} = 100,45 \cdot 10^3$$

(hoop stress is reduced)

c) The Advantage of pressurizing plain cabins is that ~~we~~ reduce the pressure difference, which reduces the hoop stress ⁱⁿ the plane.

~~if not~~

$$d) \delta H = \frac{P d}{4 t}$$

forces

$\nwarrow = \nearrow$

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

$$\delta H = \frac{P \cdot \frac{\pi d^2}{4}}{\pi d t} = \frac{P \cdot d}{4 t}$$

oil storage in spherical tanks as the

hoop stress is given by $\sigma_H = \frac{P \cdot d}{4t}$ while in cylinder

is given by $\sigma_H = \frac{P \cdot d}{2t}$

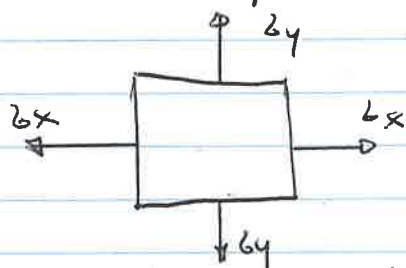
That means that a sphere can resist

contain the double of the double of the stress.

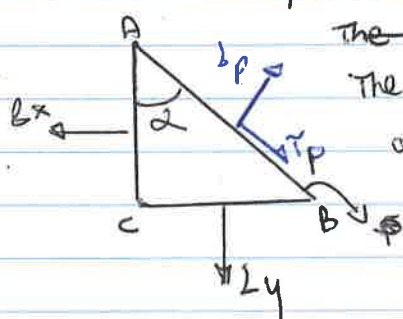
Oils which as to stay at high pressure will be probably stored in sphere while oil which can stay at low pressure in cylinders. BUT WHY? 0

(Q₂) When we deal with complex stress we are dealing with a component which has

stress in different directions (x; y; z) if we represent our component as follows. σ_x represents the stress



in the x direction and σ_y in the y direction. If hypothetically we cut our component in the middle as follows.



~~The stresses represented before will be~~

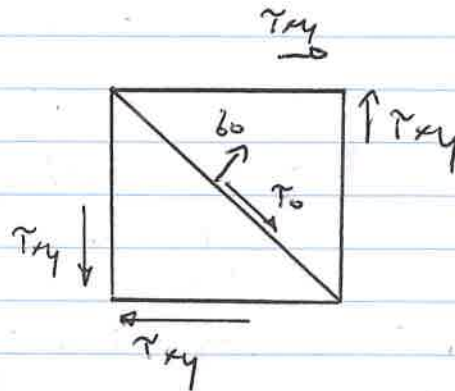
The component will have σ_y and σ_x but now are "inside" stresses σ_p and τ_p

σ_p and τ_p are the stress principal stresses acting on the plane AB. The principle plane is AB.

CONTINUES

WATER AT THE END

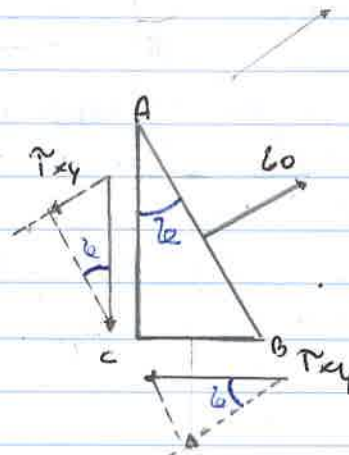
see



show that

$$\phi_0 = \tau_{xy} \cdot \sin(2\theta)$$

A



$$\sum \text{Forces} = 0$$

$$\uparrow = \downarrow$$

$$\phi_0 \cdot AB = \tau_{xy} \cdot AC \cdot \sin(2\theta) + \tau_{xy} \cdot CB \cdot \cos(2\theta)$$

$$\phi_0 \cdot AB = \tau_{xy} \cdot AC \cdot \sin(2\theta) + \tau_{xy} \cdot CB \cdot \cos(2\theta)$$

$$\phi_0 = \tau_{xy} \cdot \frac{AC}{AB} \cdot \sin(2\theta) + \tau_{xy} \cdot \frac{CB}{AB} \cdot \cos(2\theta)$$

$$\frac{AC}{AB} = \cos(\theta)$$

$$\frac{CB}{AB} = \sin(\theta)$$

$$\phi_0 = \tau_{xy} \cdot \cos(\theta) \cdot \sin(2\theta) + \tau_{xy} \cdot \sin(\theta) \cdot \cos(2\theta)$$

$$\phi_0 = 2\tau_{xy} \cdot \cos(\theta) \cdot \sin(\theta)$$

know that

$$\sin(\theta) \cdot \cos(\theta) = \frac{1}{2} \sin(2\theta)$$

$$\phi_0 = 2 \cdot \tau_{xy} \cdot \frac{1}{2} \sin(2\theta)$$

$$= \tau_{xy} \cdot \sin(2\theta)$$

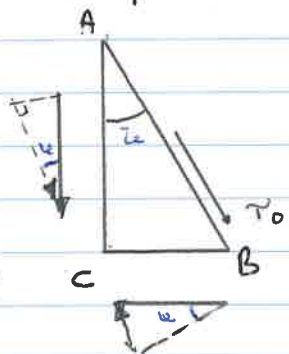
(5)

19

$$T_0 = -T_{xy} \cdot \cos 2\theta$$

$$\frac{AC}{AB} = \cos \theta$$

$$\frac{CB}{AB} = \sin(\theta)$$



$$\sum F = 0$$



$$T_0 \cdot AB + T_{xy} \cdot AC \cdot \cos \theta = T_{xy} \cdot CB \cdot \sin(\theta)$$

$$T_0 \cdot AB = T_{xy} \cdot CB \cdot \sin(\theta) - T_{xy} \cdot AC \cdot \cos(\theta)$$

$$T_0 = T_{xy} \frac{CB}{AB} \cdot \sin(\theta) - T_{xy} \cdot \frac{AC}{AB} \cdot \cos(\theta)$$

$$= T_{xy} \sin(\theta) \cdot \sin(\theta) - T_{xy} \cdot \frac{AC}{AB} \cos(\theta) \cdot \cos(\theta)$$

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

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

$$= -T_{xy} \cdot \cos(2\theta)$$

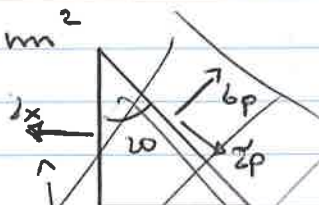
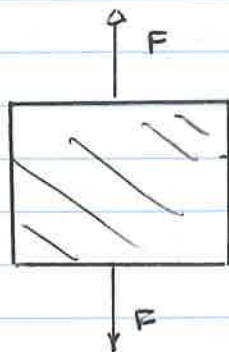
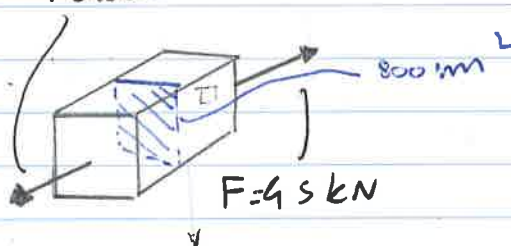
(5)

C)

$$A = 800 \text{ mm}^2$$

$$F = 45 \text{ kN}$$

$$F = 45 \text{ kN}$$



$$b_x = F \cdot (A) = 45 \cdot 10^3 \cdot (800 \cdot 10^{-6}) = 36 \frac{\text{N}}{\text{m}^2}$$

$$b_0 = \frac{1}{2} (b_x + b_y) + \frac{1}{2} (b_x - b_y) \cdot \cos(2\theta)$$

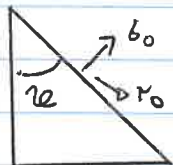
$$= \frac{1}{2} (36) + \frac{1}{2} (36) \cdot \cos(40) =$$

$$= 18 + 13.788 = 31.788 \frac{\text{N}}{\text{m}^2} = \sigma_a \text{ TENSILE}$$

27, 57

$$\begin{aligned}
 \tau_o &= \frac{1}{2} (6x - 6y) \cdot \sin(2\theta) \\
 &= \frac{1}{2} \cdot (36) \cdot \sin(40) = 11,57 \frac{\text{N}}{\text{m}^2} = \text{Pa}
 \end{aligned}$$

TENSILE



direction of the loading

$$\begin{aligned}
 \sigma_o &= \frac{1}{2} (\sigma_x + \sigma_y) + \frac{1}{2} (\sigma_x - \sigma_y) \cdot \cos(2\theta) \\
 &= \frac{1}{2} (1 + 36) + \frac{1}{2} (1 - 36) \cdot \cos(40)
 \end{aligned}$$

$$= 18 - 13,78 = 4,22 \frac{\text{N}}{\text{m}^2} \text{ TENSILE}$$

$$\tau_o = \frac{1}{2} (1 - 36) \cdot \sin(2\theta) = \frac{1}{2} \cdot (-36) \cdot \sin 40 = -11,57 \frac{\text{N}}{\text{m}^2} = \text{Compressive}$$

Part 2)



When it comes to complex stress is possible to determine only the maximum and the minimum stresses acting on a plane θ inclined 'theta' from the direction of loading. They are usually called σ_1 and σ_2 respectively, MAX and MINIMUM.

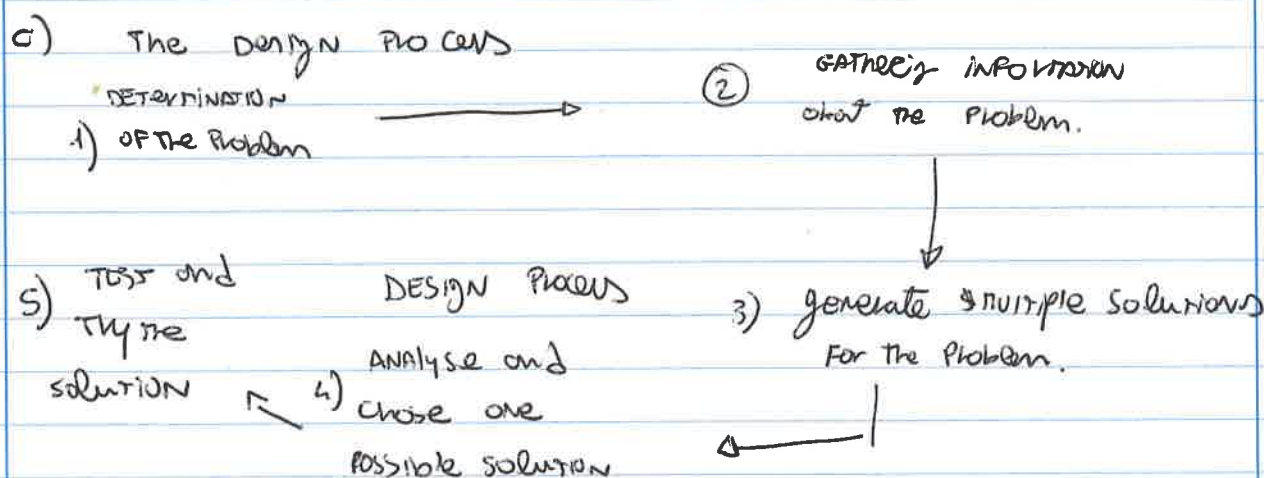
- The Design Problem: Design means "create"/produce so when it comes to
- Q₃) design a new tool we basically start from scratch. This means that various investigation and idea collection have to be done.
- 2) While ~~not~~ when it comes to "Solve / Analysis" a problem, in a product ~~is~~ already working a series of sequential analysis have to be done to try to solve properly.

1 1/2

the

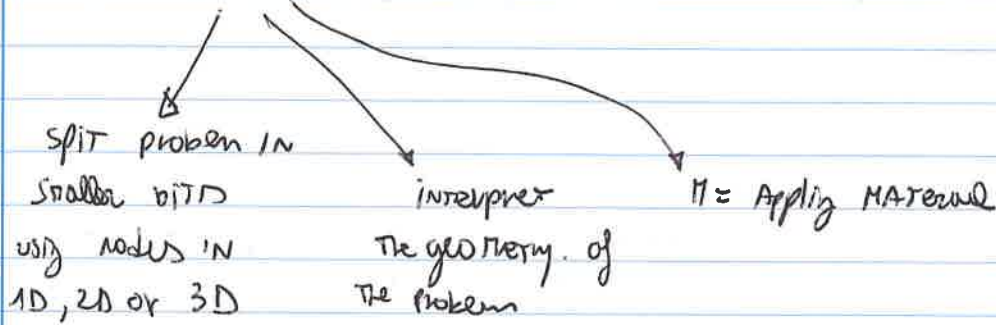
- b) Design Problem is an iterative problem as we need a specific plan to solve any problem in engineering; using an iterative process we can "break in bits" the problem and solve it easily.

The Analysis problem is primarily sequential as the problem will be discovered solving sequential questions; ~~step by~~



2

An FEA Problem is usually solved using the
ACRONYM SIMPLE, which means:



P → INPUT PHYSICAL PROPERTIES ("I" = material of interest)

L → Loading the structure, (Apply correct forces in the correct direction.)

E → Evaluate the results (As the FEA process is a simplistic model of the real structure (ASSUMPTIONS) it'll be necessary to evaluate the results in the right way)

X

Question No.

Examiner Only

Question No.

Examiner On

Arholwr yn unig

ff y Cwestiwn

Question No.

Examiner Only

Arholwr yn yr

Rhif y Cwestiwn

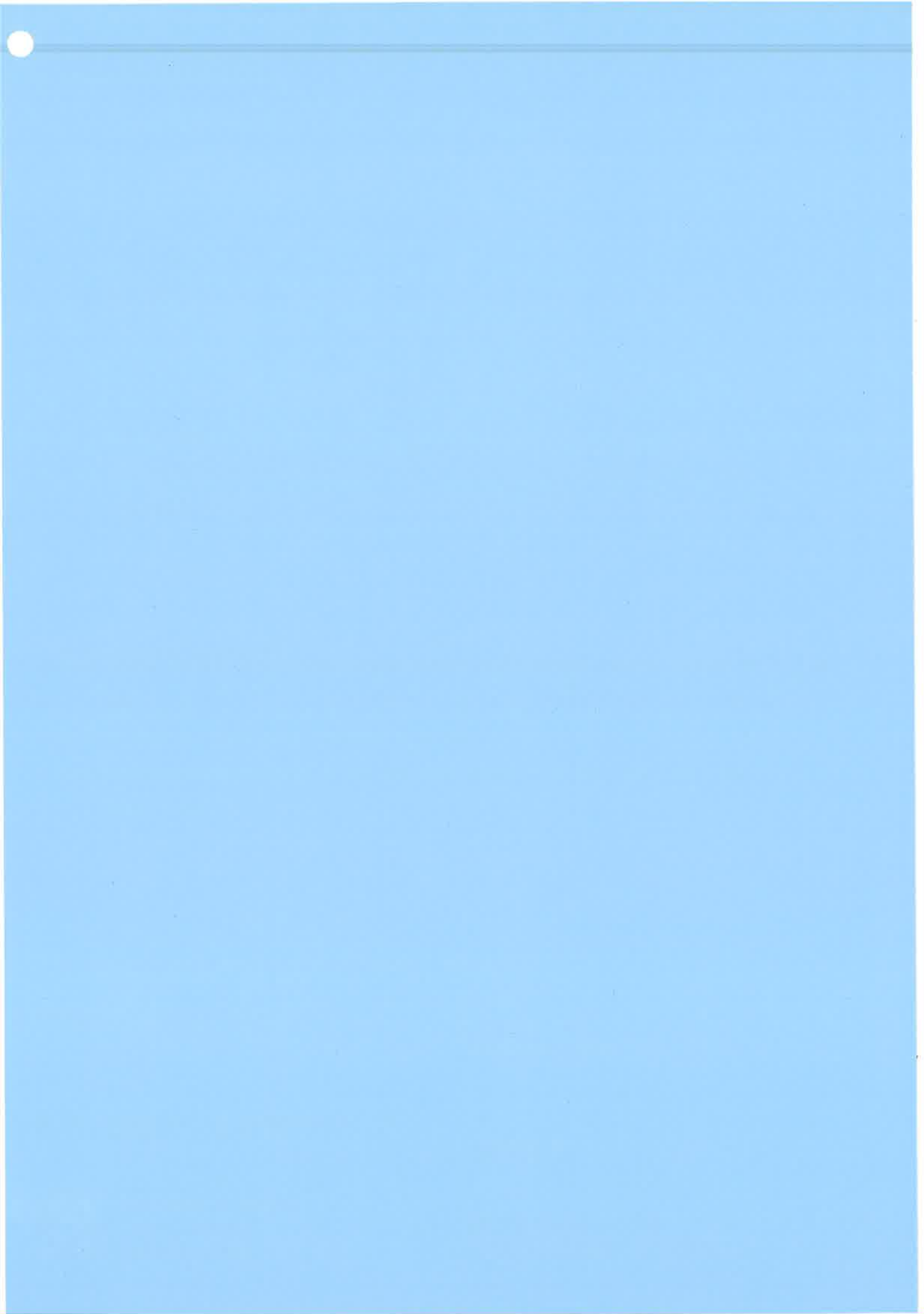


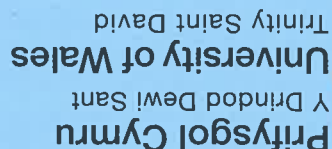
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Arholwr yn unig

y Cwestiwn





12 Tudalen

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 et a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgrifen ddarlennadwy. Gall yr Arholwyr naili at anwybyddu sgript annarllennadwy, neu drehnu 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 defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllyllwyr/gwylwyr.
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.

7	Rhif Sedd	Nifer y Llyfrau Atebion a gyflwynwyd
6		
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Arholiad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

[illegible]

(See the other side for English version)

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: