

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: Golt

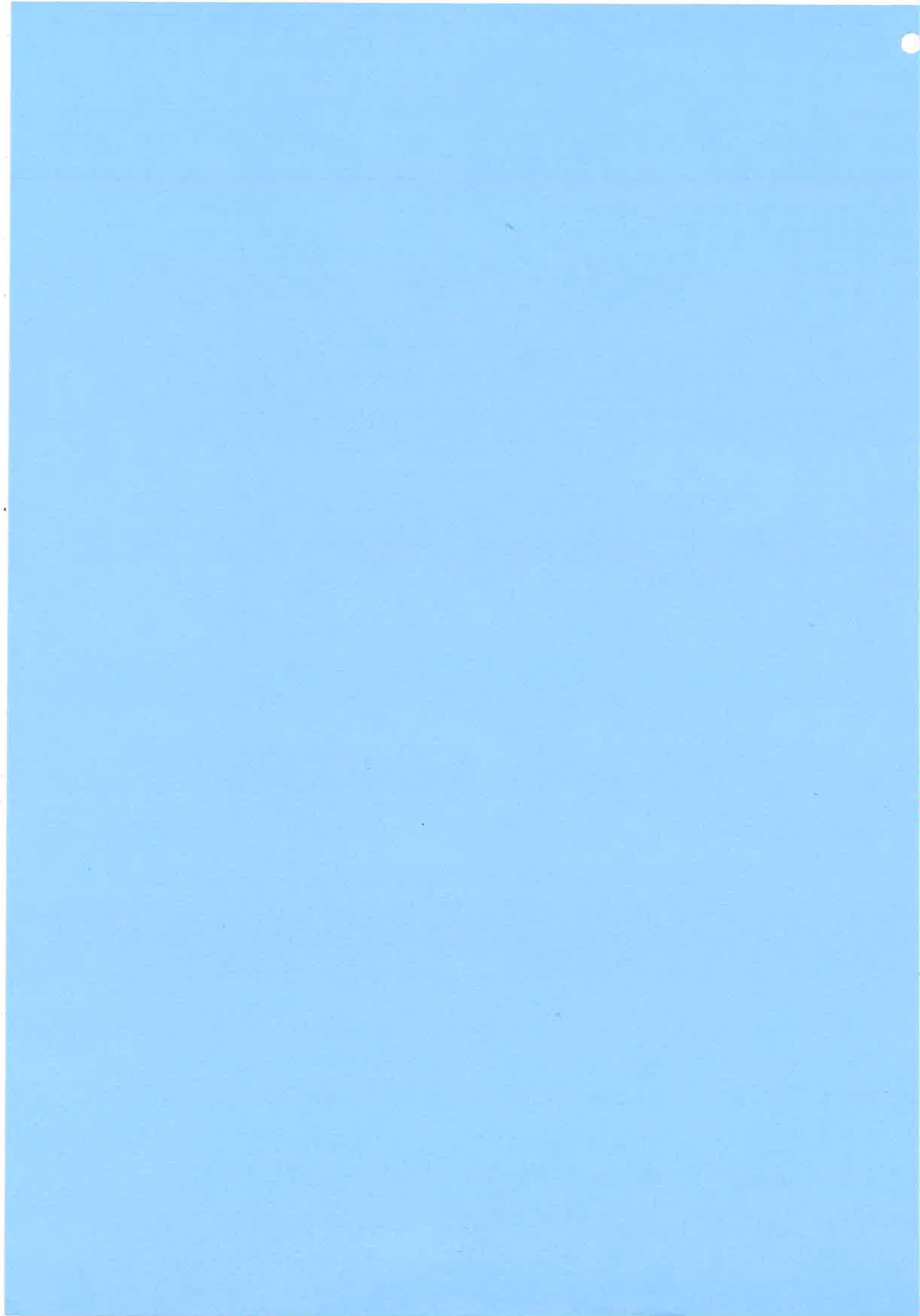
FORENAME(S): A. MEE

1	Student Number	1302416
2	Title of Examination Paper	Advanced Stress & FEa.
3	Module Code	M6X00420
4	Date and Time of Examination	31/1/2020 1.30pm
5	Examination Venue	1Q002
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
2	9
3	9
4	14
Total	32

(Gweler yr ochr arall am y fersiwn Cymraeg)

53.3%

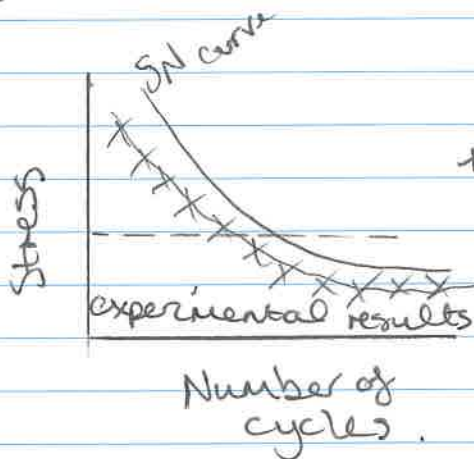


2

- a) - Cracks can appear on materials due to thermal changes. The heating and cooling can cause expansion & compression on a weakness $\therefore$ causing a crack.
- Cyclic stresses can cause a fatigue crack as this will ~~add~~ cause the weakness to be exposed and eventually fail.
 - Chemical exposure can cause fatigue cracks as ~~the~~ depending on the material type & chemical it can cause pitting or abrasion which can expose weaknesses in the material.
 - ~~to~~ Incorrect or unstable loading of a part can cause fatigue cracks as the part will not be as secure or stable as the loading increases or changes.

- b). 1) Point of initiation.
 2) Arrest lines as failure propagates
 3) Crystalline form as part fails.

c).



Under Onmean stress condition the Wohler machine can simulate the potential stresses that can occur in a test lab $\therefore$ enabling the material stress to be known and material failure point, yield stress of a part.

$$d) \sigma_r^a N_f = k$$

σ_a - Stress Amplitude
 N_f - No. of cycles
 a - constant
 k - constant

$$N_f = 10^9$$

$$\sigma_r = 100 \text{ MPa} \times 10^6$$

$$N_f = 10^6$$

$$\sigma_r = 200 \text{ MPa} \times 10^6$$

$$\sigma_r = 150 \text{ MPa} \times 10^6$$

$$N_f = ?$$

$$k = 1$$

$$a = 0$$

$$\sigma_r^a N_f = k \quad \sigma_r = 100$$

- or
1. 100×10^6
 2. 150×10^6
 3. 200×10^6

$$N_f$$

$$10^9$$

$$?$$

$$10^6$$

$$\sigma_a N_f = k \quad = 0$$

$$\sigma_r N_f = k \quad = 95.42 \times 10^6$$

$$= 155.63 \times 10^6$$

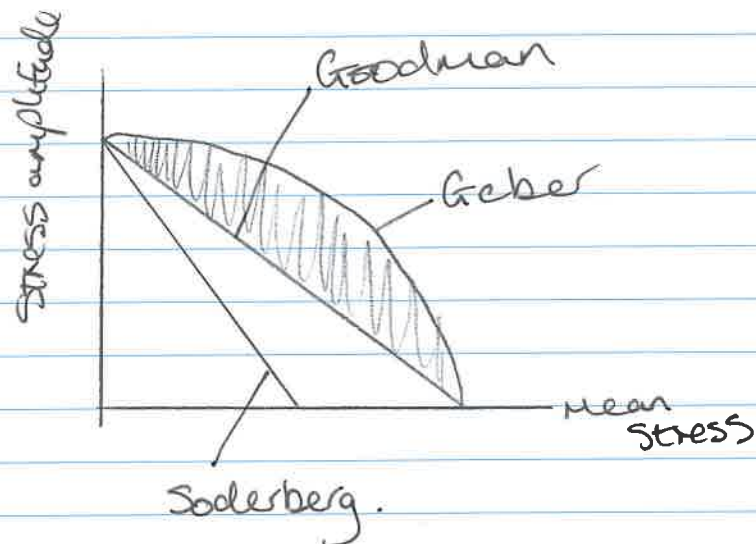
$$125.525 \times 10^6$$

$$\frac{150 \times 10^6 \times ?}{k} = \frac{k}{150 \times 10^6}$$

$$= 0.83683$$

X

e.



Soderberg is the most widely used theory as it ~~feature has a large~~ considers a large safety factor. As mean stress increases the stress amplitude decreases in cases where mean stress is non zero. Most examples will fall in the area between Goodman and Geber.

4

3a.

Size
Overlapping
Geometry

Quality - Part II.

It is critical to get the pre-processing part of FEA as accurate as possible as ~~this~~ any mistakes or errors will affect the end result and the resultant design. One part of pre-processing is ensuring the ~~the~~ chosen mesh is as accurate and efficient as possible.

Considerations need to be made to the chosen mesh size. This ultimately needs to be a consideration between the run time of the analysis and accuracy as the smaller the mesh the longer the run time will be. The next consideration to be made is the layout of the mesh. Any free edges or ~~addit~~ nodes ~~count~~ counted twice need to be eliminated if they are not necessary. This can all affect the effectiveness of the end model.

The geometry of the mesh needs to be the most efficient for the shape, size and required loading of the part. Often around features on a part the mesh can be obscured or irregular causing errors in the analysis. These should be eliminated if possible or changed.

Finally, the last consideration should be towards mesh quality. It is important for the designer to choose the most appropriate mesh quality for the part and analysis needed. All these considerations need to be thought through when looking to conduct accurate & efficient FEA analysis.

static loadings.
dynamic forces
optimisation studies.

Question No.

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- b. Tools that can be used to help correlate FEA models to physical tests include static and dynamic studies available on FEA model packages. These studies can help outline various parameters including loadings, forces and cyclical stresses. The designer can input a set of parameters that the part will experience or possibly to test what extremes will be experienced by the part, to enable the designer and to witness ~~the experienced~~ how the model will perform. The outcome of these studies can then help improve the part or show how suitable the part is for use.

XO

Split
Interpret
Material
Physical properties
Loading

Evaluate

4 a). Pre-processing

This is an important stage in FEA and should include considerations towards the part geometry and whether the design can be simplified for analysis purposes, mesh design, Material properties and how this will affect the FEA, the nodal properties and element sizes and shapes. Any loadings or forces that the part will experience.

Processing.

This is the actual analysis being performed on the part and will be as efficient as the pre-processing part has been.

Post-processing.

This is the evaluation part of the FEA. The designer needs to interpret the results to decide whether they are ~~efficient~~ useful or whether further analysis should be carried out.

6

- b). larger models - easier for analysis purposes
however automatic mesher can cause issues
from before - more accurate more elements
still time consuming -

By using a larger model it would enable analysis to be carried out a lot quicker as the detail that might be included on the model or part will not be as intricate as if the model was smaller. However by suggesting an automatic mesher could create potential issues. The designer will have to ensure that the mesh used is the most efficient. This would have to include the size, shape and geometry of the automatic mesh. The designer will have to ensure that all potential errors have been corrected. This is to include any free edges or overlapping meshes or elements. This could end up taking the designer longer than if they had created the required mesh.

Although computer capacity has increased it will only generate analysis on what it has been told to do. If the input to the FEA of model has been rubbish the results will be rubbish. and this with It is still important for the designer to ensure that the analysis techniques employed are the most suitable for the analysis. Although the statement can be true it is making assumptions which can about the input of the model which if not considered can have negative effects on the resultant analysis.

Question No.

Examiner On

Arholwr yn unig

ntif y Cwestiwn

Question No.

Examiner Only

Question No.

Examiner Onl

Arholwr yn unig

nyff y Cwestiwn

Question No.

Examiner Only

Arholwr yn unig

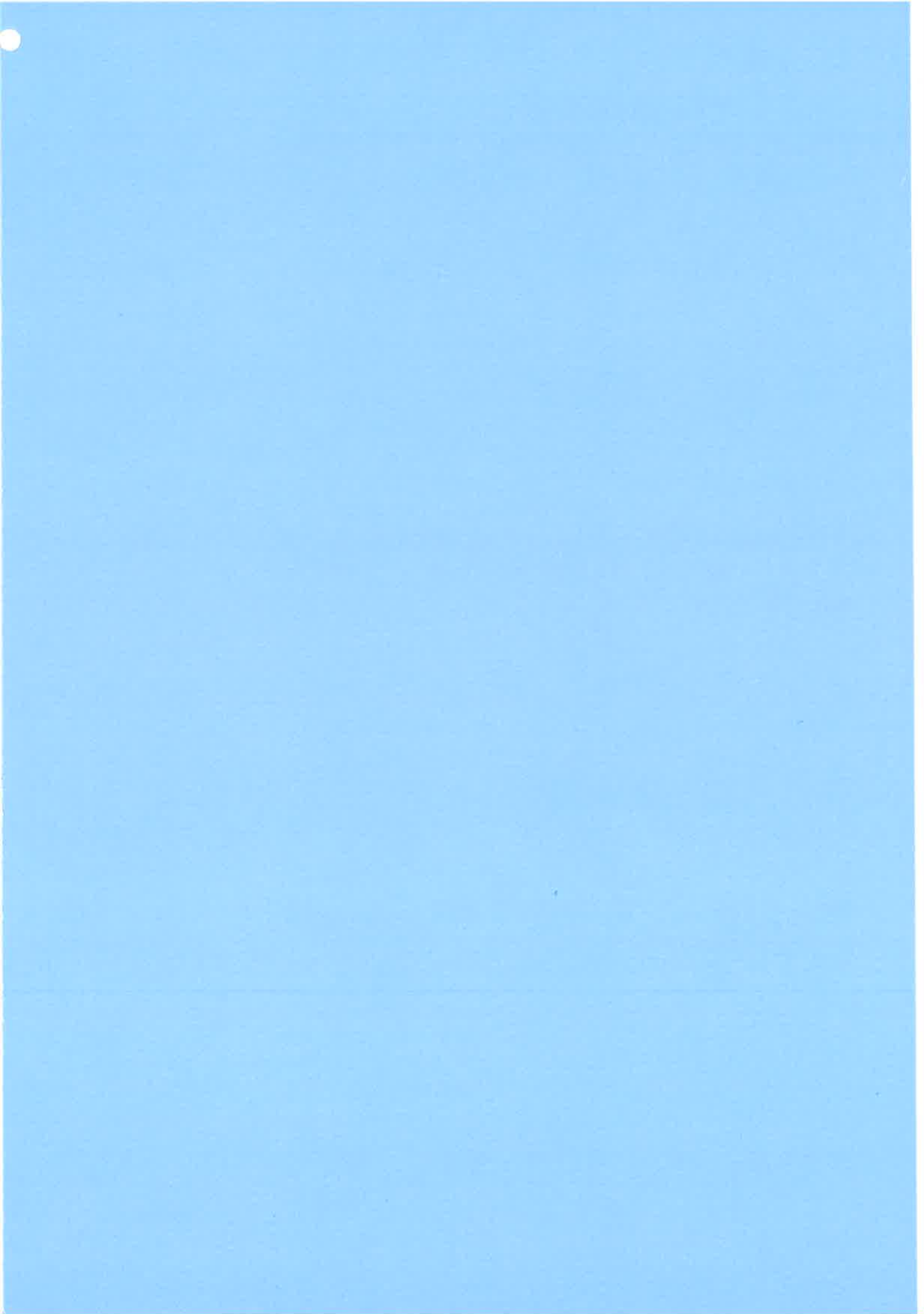
Rhify Cwestiwn

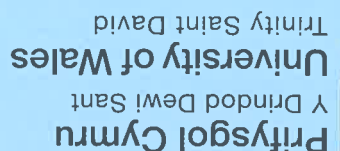
Question No.

Examiner Only

Arholwr yn unig

Unig y Cwestiwn





12 Juden

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

CYFENW:

Llenwch, plynwch a seliwch
(gweler nodyn 2 isod)

ENW(AU) CYNTAF:

3. Rhaid i'r atebion fod mewn llawysgrifen ddarlunadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
4. Ysgrifennwch 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 gwyllwr/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 amgylchadau.

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 Myfyriwr	

Rhestrwch nifrau cwestiynau a ymgelisiwyd gennych	
At Ddiibenion y Swyddfa	

(See the other side for English version)