



**Complete, fold and seal
(see note 2 below)**

SURNAME: Gregory

FORENAME(S): James

12 Pages

Instructions to Candidates

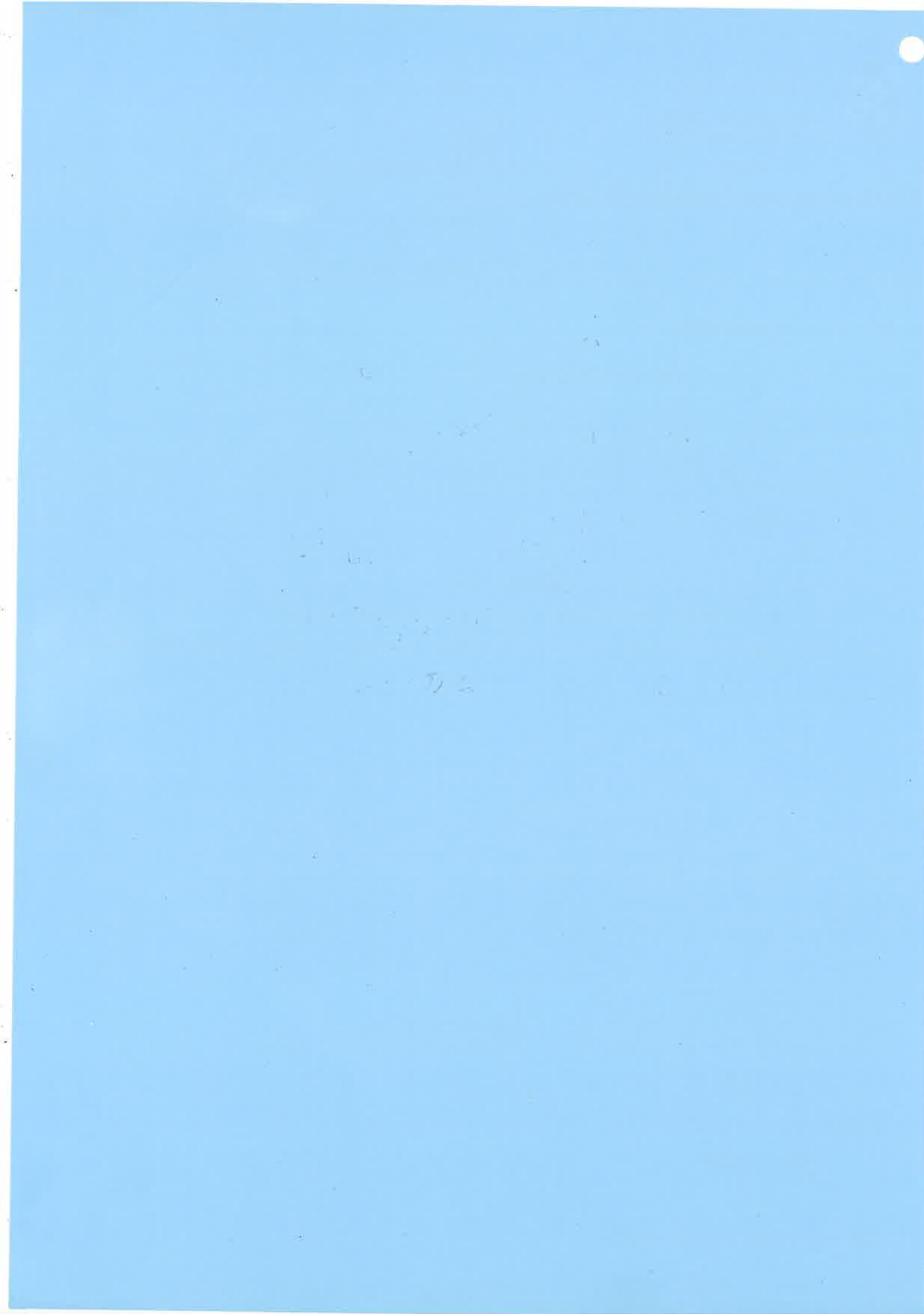
1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible script or have it typed and the expense 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	P148409
2	Title of Examination Paper	CAE and Stress Analysis
3	Module Code	M5X02064
4	Date and Time of Examination	09/05/19 12:00 pm
5	Examination Venue	1Q 302a
6	Seat Number	
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
1	15
2	18 $\frac{1}{2}$
3	15
Total	48.5

(Gweler yr ochr arall am y fersiwn Cymraeg)

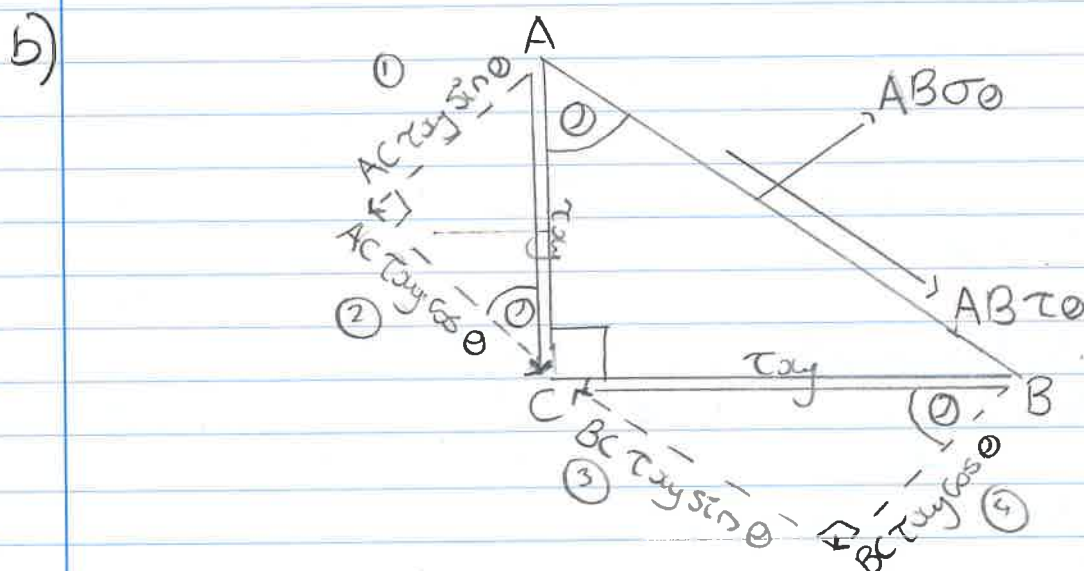
80.8%



Question 2;

- a) Principal stress is the maximum normal stress a body can have at some point. It represents purely normal stress. The plane that contains the principal stress is called the principal plane.

$2\frac{1}{2}$



$$\sin \theta = \frac{BC}{AB} \quad \cos \theta = \frac{AC}{AB}$$

- ① $AC \tau_{xy} \sin \theta$
- ② $AC \tau_{xy} \cos \theta$
- ③ $BC \tau_{xy} \sin \theta$
- ④ $BC \tau_{xy} \cos \theta$

- 7) Resolve perpendicular forces :

$$AB \sigma_0 = AC \tau_{xy} \sin \theta + BC \tau_{xy} \cos \theta$$

$$\sigma_0 = \frac{AC}{AB} \tau_{xy} \sin \theta + \frac{BC}{AB} \tau_{xy} \cos \theta$$

$$\begin{aligned} \sigma_0 &= \cos \theta \tau_{xy} \sin \theta + \sin \theta \tau_{xy} \cos \theta \\ &= \tau_{xy} \frac{1}{2} \sin 2\theta + \tau_{xy} \frac{1}{2} \sin 2\theta \\ &= 2 \tau_{xy} \frac{1}{2} \sin 2\theta \end{aligned}$$

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

i) Resolve parallel forces:

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

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

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

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

$$\tau_{\theta} + \tau_{xy} \frac{1}{2} (1 + \cos 2\theta) = \tau_{xy} \frac{1}{2} (1 - \cos 2\theta)$$

$$\tau_{\theta} + \tau_{xy} \frac{1}{2} + \tau_{xy} \frac{1}{2} \cos 2\theta = \tau_{xy} \frac{1}{2} - \tau_{xy} \frac{1}{2} \cos 2\theta$$

$$\tau_{\theta} = \cancel{\tau_{xy} \frac{1}{2}} - \cancel{\tau_{xy} \frac{1}{2}} - \tau_{xy} \frac{1}{2} \cos 2\theta - \tau_{xy} \frac{1}{2} \cos 2\theta$$

$$\tau_{\theta} = -2 \tau_{xy} \frac{1}{2} \cos 2\theta$$

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

c) $A = 800 \text{ mm}^2 = 8 \times 10^{-4} \text{ m}^2$

$$F = 45 \text{ kN} = 45000 \text{ N}$$

$$\theta = 20^\circ$$

$$\sigma_{\theta} = ?$$

$$\tau_{\theta} = ?$$



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

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

$$\sigma_x = 0$$

$$\sigma = \frac{F}{A} = \frac{45000}{8 \times 10^{-4}} = 56.25 \times 10^6 \text{ N/m}^2 \text{ or Pa}$$

$$= 56.25 \text{ MPa}$$

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

$$\sigma_{\theta} = \frac{1}{2} (0 + 56.25) + \frac{1}{2} (0 - 56.25) \cos 40$$

$$\sigma_{\theta} = 6.58 \text{ MPa}$$

X

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

$$\tau_{\theta} = \frac{1}{2} (0 - 56.25) \sin 40$$

$$\tau_{\theta} = -18.078 \text{ MPa}$$

/

(6)

Question 1:

a) Resolve vertically:

Forces due to pressure = Forces due to hoop stress

$$p = \frac{F}{A} \therefore F = pA$$

$$= pdL$$

$$\sigma_H = \frac{F}{A} \therefore F = \sigma_H A$$

$$= \sigma_H 2Lt$$

$$pdL = \sigma_H 2Lt$$

$$\boxed{\sigma_H = \frac{pd}{2t}}$$

b) $\sigma_H = 200 \text{ MPa} = 200 \times 10^6 \text{ Pa}$
 $d = 3.5 \text{ m}$
 $t = 5 \times 10^{-4} \text{ m}$
 $p = ?$

i) $p = \frac{\sigma_H 2t}{d} = \frac{(200 \times 10^6) \times 2 \times (5 \times 10^{-4})}{3.5} = \frac{57142.86}{1} \text{ Pa}$
 $= 57.14 \text{ kPa}$

~~$p_{\max} = (57.14 \times 10^6) - 101000 = 57.039 \times 10^6 \text{ Pa}$~~

$p_{\max} = 101000 - 57142.86 = 43857.14 \text{ Pa}$
 $= 43.86 \text{ kPa}$

From the table: At 43.86 kPa, it's closer to 46.6 kPa and so the altitude = 20,000 ft

ii) At 8000 ft; $p = 75.3 \text{ kPa}$

$p_{\max} = 75.3 - 57.14 = 18.16 \text{ kPa}$

From the table: At 18.16 kPa, it's closer to 18.7 kPa and so the altitude = 40,000 ft

- c) Pressurizing plane cabins allows the plane to travel at higher altitudes.

Makes it more comfortable and safe for passengers and crew to travel in. X (0)

- d) Resolve horizontally:

Forces due to hoop stress = Forces due to pressure

$$\sigma_H = \frac{F}{A} \therefore F = \sigma_H A = \sigma_H \pi d t$$

$$p = \frac{F}{A} \therefore F = p A = p \frac{\pi d^2}{4}$$

$$\sigma_H \pi d t = p \frac{\pi d^2}{4}$$

$$\sigma_H = \frac{p d}{4 t}$$

- e) Spherical tanks can ^{contain} ~~hold~~ double the amount of stress subjected by the force of the fluid. / (4)

Spherical tanks allow better distribution of fluids to the container walls.

Spherical tanks can be accounted for the change in volume when it is filled with a fluid compared to a cylindrical tank. X (0)

Question 3:

c) British Standard BS7000 part 2 (2015):

Advantage: Procedural approach based on the Pahl and Beitz method (1996).

Disadvantage: No mention of how ergonomics can be integrated in the design process.

French (1985) method:

Advantage: Procedural approach focused on the conceptual design stage.

Disadvantage: No mention of analysing, designing or evaluating ~~results~~ product for human user.

Pahl and Beitz (1996) method:

Advantage: Procedural approach with emphasis on conceptual design phase.

Disadvantage: Costly and time consuming if a re-design was required.

March (1984) method:

a) A design problem analyses the performance of a design which is fundamental to the ~~success~~ Success and Failure of that design.

~~An analysis problem is focused more on the design~~

~~An analysis problem is more focused about the why and how a matter~~

An analysis problem is more focused on the why and how, problems occur in designs. Investigating in depth into each stage of the design process and concluding the evidence gathered.

2

b) The design ^{problem} ~~process~~ is more iterative because it ensures the design meets the Standards of Customers and Criteria to ensure they stay competitive such as; making the design safe, environmentally friendly, disposable, aesthetically pleasing, low cost and simple to use.

An analysis problem is sequential because there are steps to go through ~~to work~~ when trying to work out what the problem is and what ~~a~~ solutions can be put in place to prevent the problem from occurring again. The steps are: ~~define a problem, gener~~

1. Define the problem.

~~2. Generate multiple solutions~~

2. Gather all relevant information.

3. Generate multiple solutions.

4. Analyse and select an appropriate solution.

5. Test and implement the chosen solution.

4

Question No.

Examiner Onl

Question No.

Examiner Only

Question No.

Examiner Onl

Arholwr yn unig

rhif y Cwestiwn

Question No.

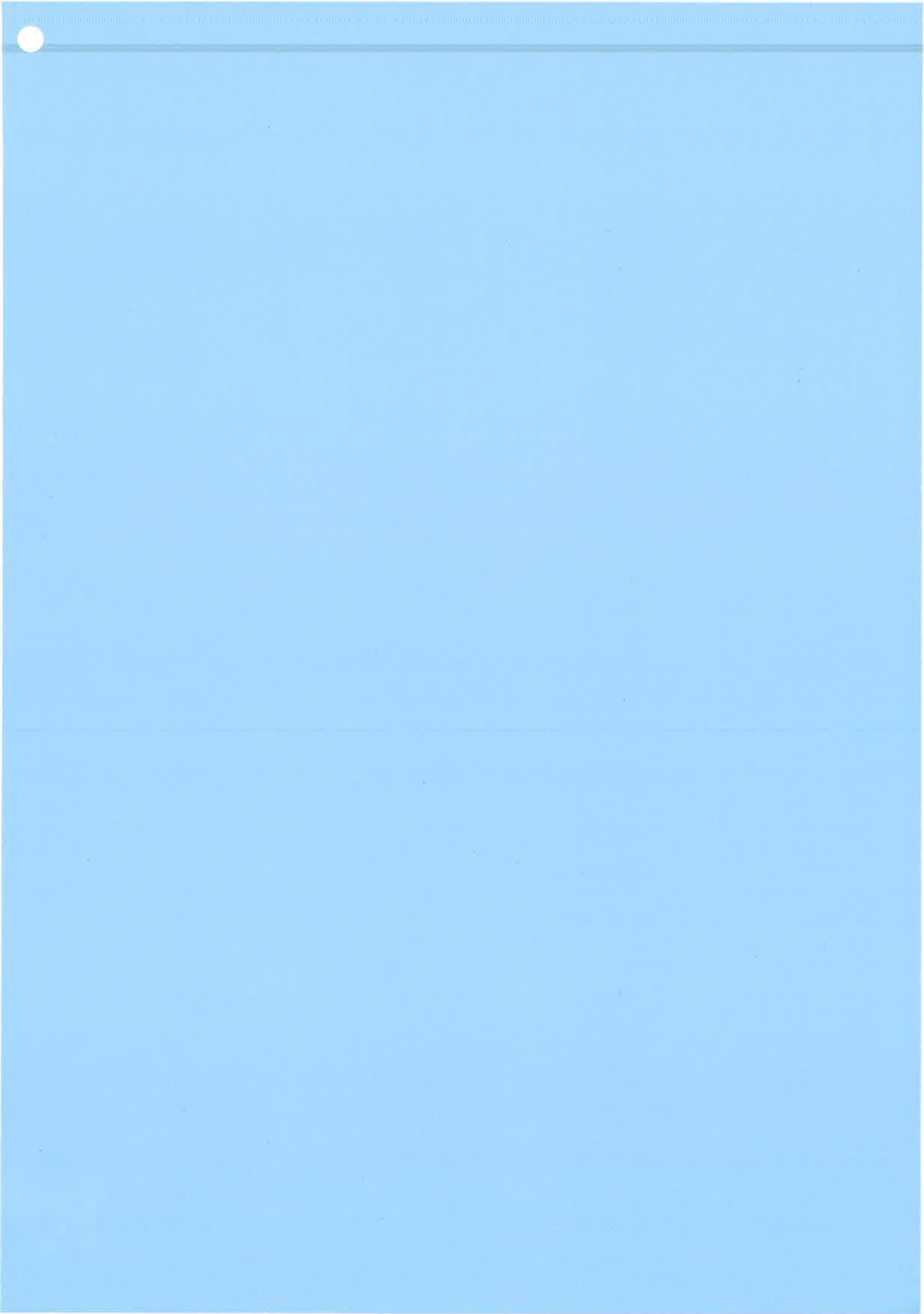
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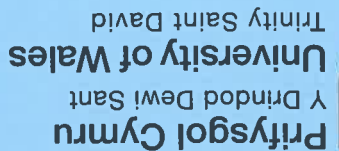
Question No.

Examiner On

Arholwr yn unig

hif y Cwestiwn





12 Tudalen

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn lle a ddarparwyd ar y dde, plygwch ef 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 naill ai anwybyddu sgrifft annarllennadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.

4. Ysgirfennwch eich atebion mewn inc.

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

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 gwylwlr/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.

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

[illegible]

(See the other side for English version)

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

CYFENN:

ENW(AU) CYNTAF:

ENW(AU) CYNTAF: