



Complete, fold and seal
(see note 2 below)

Jenkins

FORENAME(S):

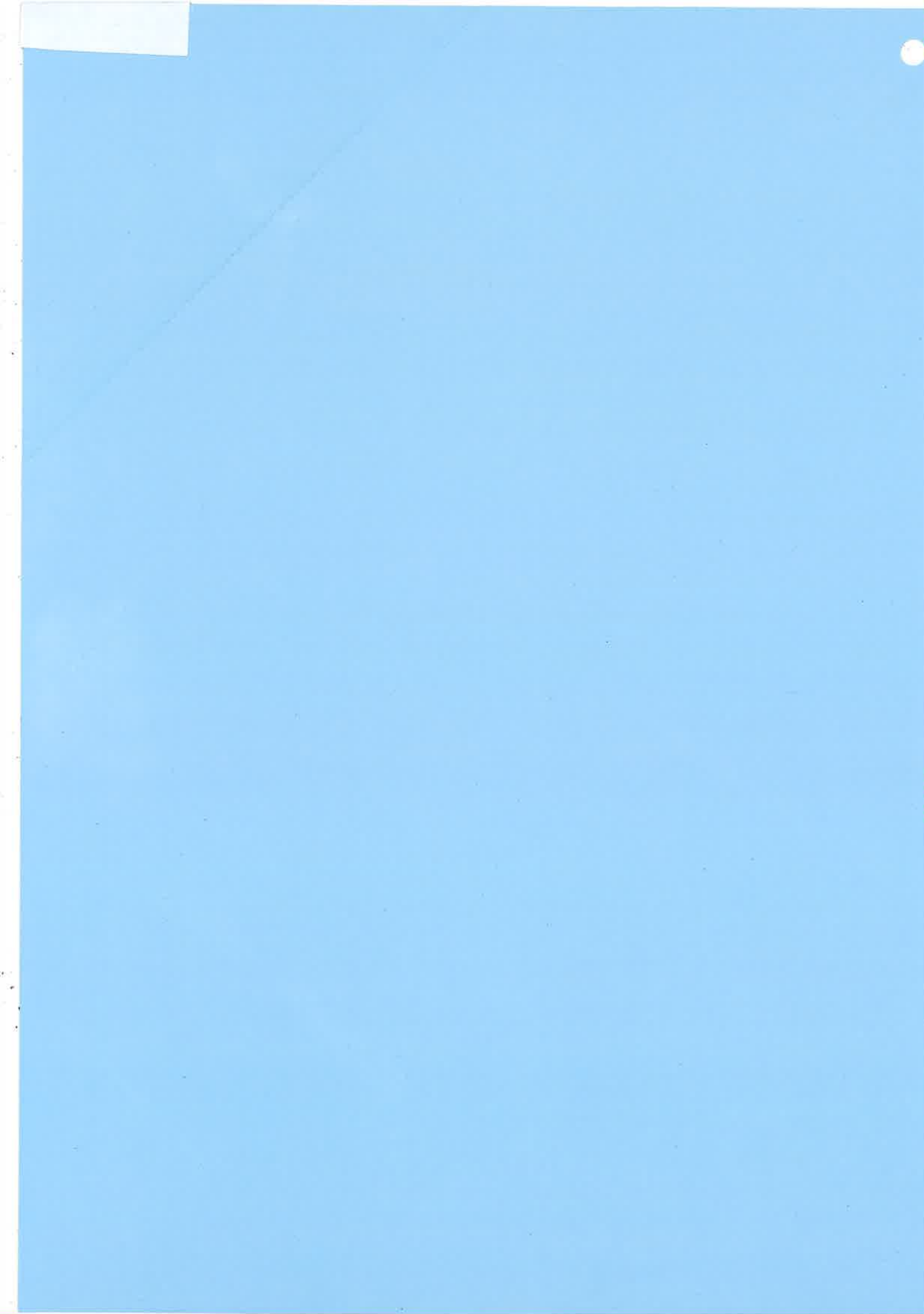
Jordan Ross

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	17
2	11
3	14½
Total	42.5

(Gweler yr ochr arall am y fersiwn Cymraeg)

70.8%



1a $P = \frac{F}{A}$

$F = P \times A$ $A = d \times h$

$F = P d h$

Resistive force = $\sigma = \frac{F}{A}$

$F = \sigma_h A$

$A = d h$

$F = \sigma_h d h$

$F = F$ hence

$P d h = \sigma_h d h$ or take $d h$ under.

$\sigma_h = \frac{P d}{d h}$

6 $d = 3.5 \text{ m}$
 $h = 0.5 \times 10^{-3} \text{ m}$
 $\sigma_h = 200 \times 10^6 \text{ Pa}$

$\sigma_h \times d h / d = P$ $\frac{200 \times 10^6 \times (2 \times 0.5 \times 10^{-3})}{3.5}$
 $= 57.14 \text{ kPa}$

Sea level = 101 kPa

$101 - 57.14 \text{ kPa} = 43.86 \text{ kPa}$

From table altitude at 43.86 = 20,000 ft

$$8000 \text{ ft} = 75.3 \text{ kPa}$$

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

$$18.16 \text{ according to table} = 4000 \text{ ft} \quad (3)$$

c, the benefit to pressurising the plane cabins with altitude is that it allows the plane to fly at higher altitudes without sustaining damage. at higher altitudes air is thinner / less dense so the drag is reduced and fuel efficiency is increased. (2)

d, $\sigma_H = Pd / \text{ft}$

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

$$F = P \times A$$

$$F = \frac{P \times \pi d^2}{4}$$

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

$$F = \sigma_H \times A$$

$$A = \pi r^2$$

$$A = \pi r^2 \quad \sigma_H \times \pi r^2$$

$$\frac{P \pi d^2}{4} = \sigma_H \times \pi r^2$$

$$F = \sigma_H \times A$$

$$A = \pi d t$$

$$F = \sigma_H \pi d t$$

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

$$\sigma_H =$$

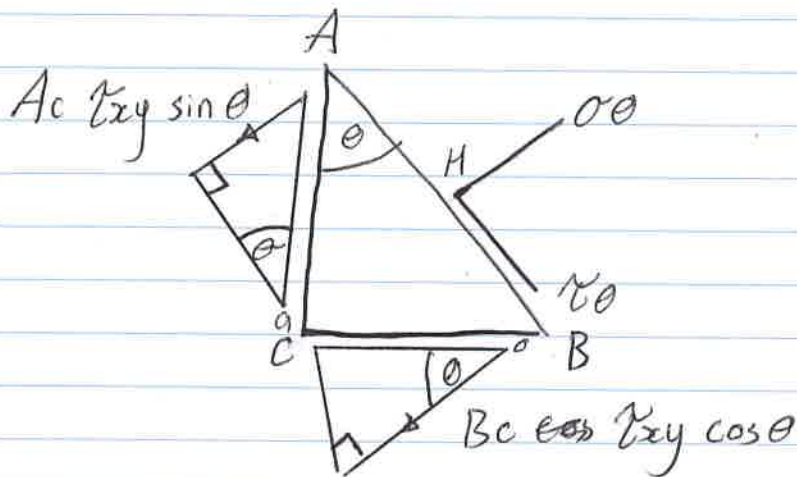
$$\sigma_H \times t = \frac{P \times d}{4t}$$

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

e. The hoop stress in a spherical tank is half that of a cylindrical tank when loaded equally. This is due to the $4t$ in the denominator compared with the $2t$ in the cylindrical σ_H . This means a cylindrical tank would only sustain half roughly half the load a spherical tank could sustain before failing. A spherical tank can store fluids at higher pressure.

FOOTPRINT V. VOLUME?

Q. 1.
b/c



Area = 1/2 * base * height

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

$$\begin{aligned} \sin \theta &= \frac{BC}{AB} = \sin \theta \\ \cos \theta &= \frac{AC}{AB} = \cos \theta \\ \tan \theta &= \frac{BC}{AC} = \tan \theta \end{aligned}$$

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

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

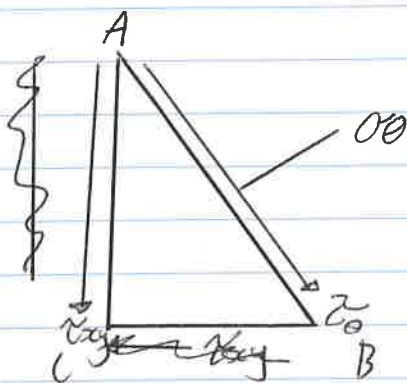
$$\sin \theta \cos \theta = \frac{1}{2} \sin 2\theta$$

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

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

(5)

bii



$$1 = AC \tau_{xy} \cos \theta$$

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

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

From bi, $\frac{AC}{AB} = \cos \theta$

$$\frac{BC}{AB} = \sin \theta$$

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

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

From $\sin^2 \theta - \cos^2 \theta = -\cos 2\theta$

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

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

c $\tau_{\theta} = 45 \times 10^3 \text{ N}$

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

$$\frac{45 \times 10^3}{\cos 40} = 58743.32 \text{ Pa}$$

$$= 58.74 \text{ kPa}$$

X

C Continued.

$$\tau_{xy} = 58.74 \text{ kPa}$$

← actually used non rounded answer.

$$\sigma_{\theta} = 58.74 \times 10^3 \sin(40)$$

$$\sigma_{\theta} = 58.74 \times 10^3 \times \sin 40 = 37.76 \text{ kPa}$$

$$= 37759.48 \text{ Pa}$$

X

(2)

3 a

Fundamentally a ^{problem} analysis ~~problem~~ is numerical and has a definitive correct or incorrect answer. However a "design problem" may not have a "yes or no" answer. A design problem may have multiple valid solutions, however each solution may differ in function, effectiveness or complexity. For example, ~~a scenario where a pipe is leaking~~ imagine a scenario of a hose pipe is leaking, two possible solutions to this problem could be: use of duct tape to seal the hole or fitting a brass connector in place of the hole pipe. Both solutions differ by design but fundamentally achieve the same solution. The effectiveness of both solutions must be studied to ~~then~~ choose which solution to implement.

/ (3)

b.

Traditionally the design process is iterative. Multiple design solutions are created, from which a single solution must be both chosen and implemented. This involves designing a concept, testing it and evaluating the findings. Based on the evaluation of the concept in terms of functionality, economics, manufacturability, changes/improvements may be needed to make the concept fit for purpose. This leads to a further iteration of the design solution.

being created. This process repeats itself until the ~~concept~~ concept is fit for purpose and meets customer needs/requirements.

(2½)

c One such model for how the design process should be carried out is the Pahl & Beitz Methodology of 1996. This methodology has a strong emphasis of involving and considering human ~~and~~ interaction and functionality at the Concept Stage. A limitation to this methodology is that the Evaluation of human interaction and functionality is done after the Conceptual Stage meaning if redesign is required it increases costs & lead times.

(3)

The 2013 British Standards BS1000 Part 2 methodology is based on the Pahl & Beitz method. A benefit to this methodology is that ergonomics are considered throughout the design process. However a limitation is that no guidance on how the ergonomic design should be implemented is given.

(3)

Another design process methodology is the French Method of 1985. A benefit to this method is it offers a procedural/systematic approach that improves efficiency & effectiveness. However a limitation is that functionality and ergonomics aren't considered through out.

(3)

Question No.

Examiner O

Arholwr yn unig

if y Cwestiwn

Question No.

Examiner Only

Arholwr yn yr

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Question No.

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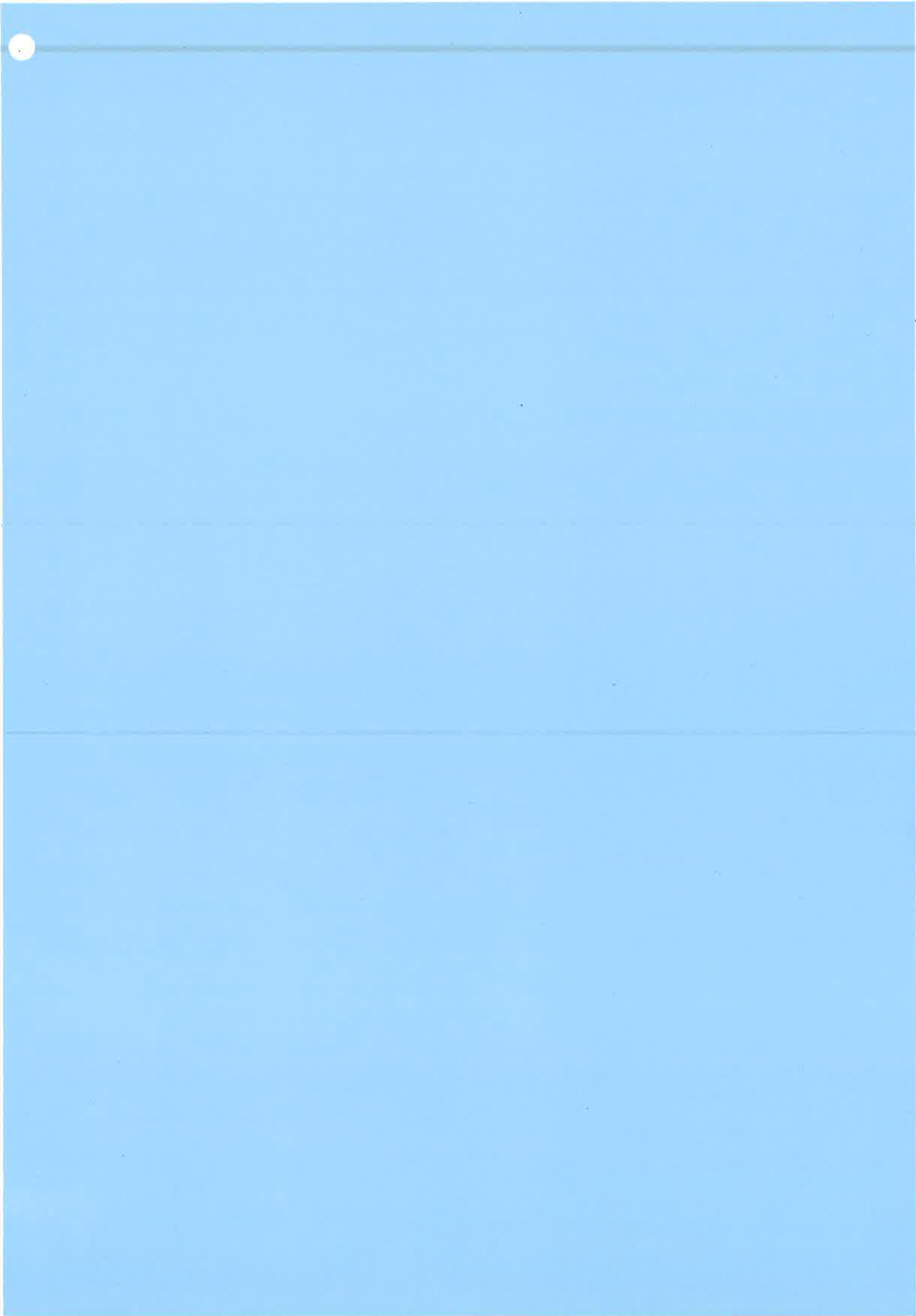
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Question No.

Examiner Or

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f y Cwestiwn



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

- arholi o dan unrhyw amgylchïadau.

[illegible]

(See the other side for English version)

(gweier nodyn 2 isod)

ENW(AU) CYNTAF: