



Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2021

Construction Studies

Theory - Higher Level

(240 marks)

Friday, 18 June
Afternoon, 2:00 - 5:00

- (a)*** Answer ***any four*** questions.
- (b)*** All questions carry equal marks.
- (c)*** Answers must be written in ink.
- (d)*** Drawings and sketches are to be made in pencil.
- (e)*** Write the number of the question distinctly before each answer.
- (f)*** Neat freehand sketches to illustrate written descriptions should be made.
- (g)*** The name, sizes, dimensions and other necessary particulars of each material indicated must be noted on the drawings.

The 2021 examination papers were adjusted to compensate for disruptions to learning due to COVID-19. This examination paper does not necessarily reflect the same structure and format as the examination papers of past or subsequent years.

1. The sketch shows an external wooden door which is designed to facilitate ease of access for everyone to the dwelling house. The door is highly insulated with vertical sheeting on both sides. The wall of the house is a 400 mm wall of concrete block construction with a full-fill insulated cavity. The ground floor is a highly insulated solid concrete floor with a 20 mm tongue and groove floating hardwood finish.

- (a) To a scale of 1:5, draw a vertical section through the centre of the door, the external wall and the ground floor. Show the typical construction details from the bottom of the strip foundation to a level 400 mm above finished floor level.

Show a width of 1.0 metre on each side of the door.

- (b) On your drawing, show the typical design detailing that will prevent the formation of a thermal bridge at the threshold.



2. (a) Under **each** of the following, discuss in detail the duty of care that all workers have in maintaining high safety standards on a construction site:

- safety training
- personal protective equipment (PPE)
- vigilance.

- (b) Discuss in detail **one** possible risk associated with each of the following:

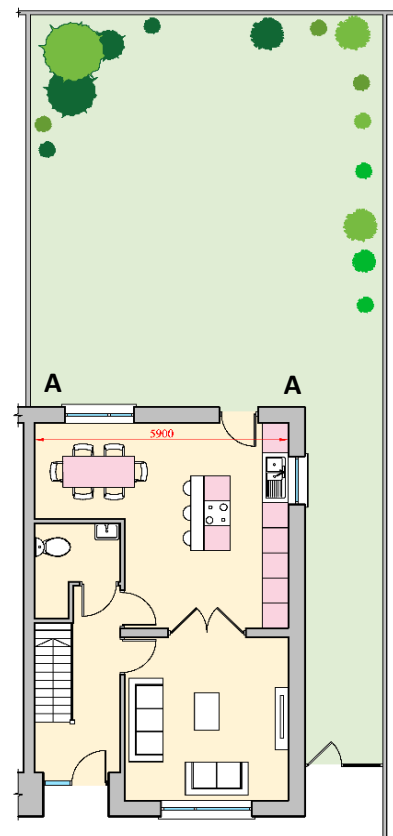
- repairing a chimney stack
- overhead electrical cables
- on-site health & hygiene.



- (c) Using notes and freehand sketches, outline **two** specific safety procedures that should be observed to eliminate each risk identified at **2(b)** above.

3. The drawing shows the ground floor plan of a two-storey semi-detached house and its rear garden. The rear wall **A-A** is south facing. The owners require a home office space, which will enhance health and wellbeing while working from home. It is proposed to build a single-storey office space, not greater than 18.0 m² in area, at the rear of the house.

- (a) Discuss in detail, **three** design considerations that should be taken into account in the design of this home office space to enhance health and wellbeing.
- (b) Using notes and freehand sketches, show a proposed design layout for the office space that incorporates each of the design considerations you outlined at **3(a)** above.
Justify your design choices.
- (c) Discuss **two** advantages and **two** disadvantages of working from a home office.

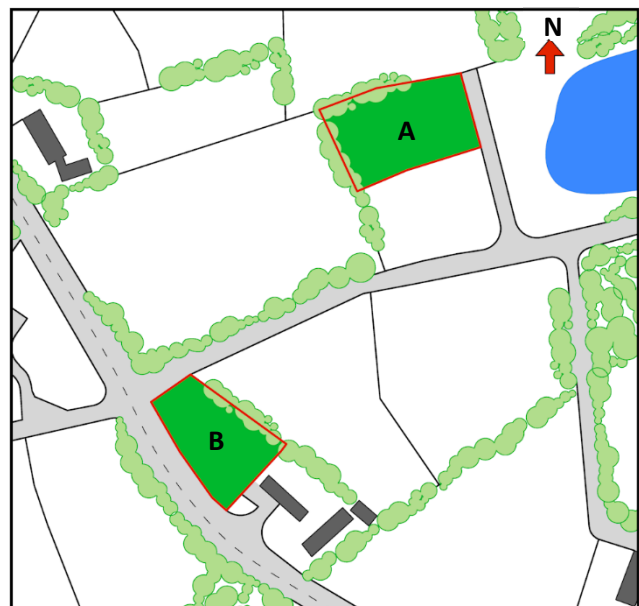


4. (a) Using notes and freehand sketches, discuss in detail **each** of the following factors when selecting a site for a new house in a rural setting:

- availability of services
- existing trees and hedgerows
- site topography.

- (b) Shown is an extract from a site location map. **A** and **B** are possible sites for a new house in a rural setting. Select your preferred site **A** or **B** and discuss **three** considerations you took into account when selecting your site.

- (c) Draw a well-proportioned sketch of your selected site and the immediate boundaries.

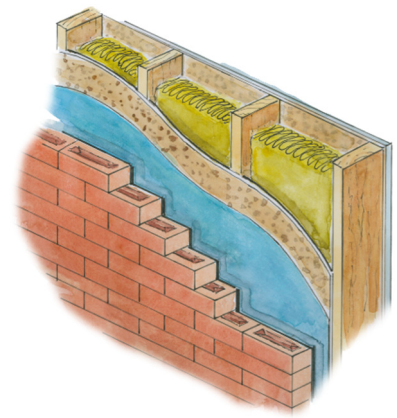


On your sketch, show a preferred:

- location and orientation of a house on the site
- layout of the road entrance and the driveway to the house.

For **each** of the above, justify your design choice.

5. The sketch shows a proposed external wall design detail for a new house of timber frame construction.



- (a) Calculate the U-value of the wall, given the construction has the following sequence and data:

External brick	thickness	100 mm
Clear cavity	width	50 mm
Orientated strand board (OSB)	thickness	9 mm
Timber stud	thickness	175 mm
Cellulose insulation between studs	thickness	175 mm
Orientated strand board (OSB)	thickness	9 mm
Plasterboard	thickness	12.5 mm

Thermal data of the external wall:

Resistance of external surface	(R)	0.048	m ²	°C/W
Resistivity of external brick	(r)	1.300	m	°C/W
Resistance of clear cavity	(R)	0.440	m ²	°C/W
Conductivity of OSB	(k)	0.130	W/m	°C
Conductivity of cellulose insulation	(k)	0.039	W/m	°C
Conductivity of OSB	(k)	0.130	W/m	°C
Conductivity of Plasterboard	(k)	0.250	W/m	°C
Resistance of internal surface	(R)	0.130	m ²	°C/W

Note: The timber studs need not be considered in your calculations.

- (b) It is proposed to redesign the above timber frame wall and upgrade its thermal properties to meet the Passive House standard by adding sheep wool insulation to the design of the internal leaf.

Given the thermal conductivity (k) of sheep wool insulation as 0.034 W/m °C, calculate the thickness of additional insulation required to achieve a U-value of 0.15 W/m² °C.

- (c) Using notes and freehand sketches, discuss why a moisture control layer and a vapour control layer need to be incorporated into timber frame construction.

6. The elevation and ground floor plan of a terraced house constructed in an urban location are shown. The external walls are of timber frame construction with a rendered concrete block and cedar cladding finish. Central heating is provided using a renewable heat source. The house is designed to have low environmental impact.

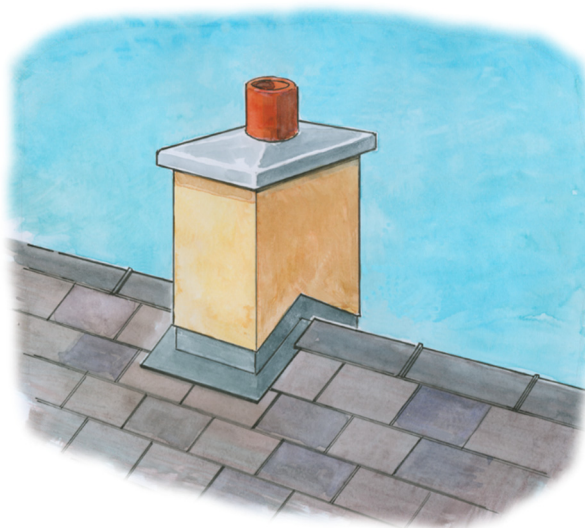
- (a) With reference to the design shown, discuss using notes and freehand sketches, **three** features of the design that contribute to the house having a low environmental impact.
- (b) Operational energy use is an important consideration in designing for low environmental impact. Using notes and freehand sketches, discuss **two** features that could be added to the house that would further reduce its energy use.
- (c) Discuss in detail **two** advantages of designing a house that will have a low operational energy use when the house is built.



7. A chimney stack projects through a pitched roof at ridge level as shown. The chimney is of solid concrete block construction with a sand/cement render finish. The traditional cut roof has a pitch of 45° with a slate finish.

- (a) To a scale of 1:5, draw a vertical section through the centre of the chimney stack and roof structure. The section should show the typical construction details through the chimney stack, flue liner, chimney capping and portion of the roof structure.

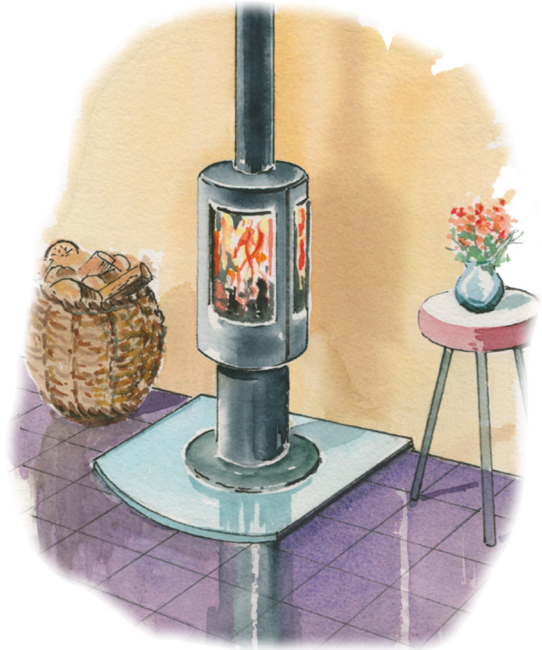
On your drawing include **three** courses of slate at each side of the chimney stack.



- (b) On your drawing, show **two** typical design details to prevent the penetration of moisture at the junction of the roof and chimney stack.

8. The sketch shows a wood-burning stove used to provide hot water and central heating for a two-storey dwelling house.

- (a) Using notes and a single-line diagram, show a typical design layout for both the heating system **and** hot water system. Show **two** independently controlled heating zones, one on each floor. Include **three** radiators on each floor and give the typical sizes of the pipework.
- (b) Using notes and freehand sketches, describe **two** features that increase the efficiency of the heating system. Discuss the importance of **each** feature identified.
- (c) Discuss **two** advantages of installing an Air-to-Water heat pump system in the house as an alternative to the stove.

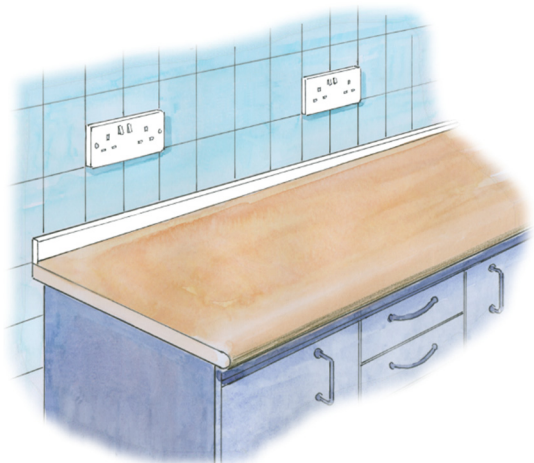


9. (a) Discuss in detail, **three** considerations when designing the layout for sockets in the electrical system of a domestic house.

- (b) Using notes and freehand sketches, show the design of a typical wiring layout for a ring main circuit to include:

- distribution board
- **three** electrical sockets.

Indicate the typical sizes and colour coding of the electrical cables.



- (c) The current Building Regulations require all new houses to have a renewable energy ratio (RER) of 20%. Discuss **two** benefits for the homeowner of generating their own electricity by using micro-generation to help meet this energy requirement.

10. The sketch shows the proposed design for a dwelling house in a rural setting. The design is inspired by vernacular Irish architecture.

- (a) Discuss **two** reasons why solar overheating may occur in the house shown and discuss **two** effects solar overheating may have on occupants.
- (b) Using notes and freehand sketches, suggest **two** ways to reduce the possibility of solar overheating while being sympathetic to the design of this house.



- (c) Using notes and freehand sketches, discuss **two** features of the given house design that contribute to the house responding to its rural setting.

OR

10. “There is considerable potential to convert and reuse former schools, churches, mills and farm buildings in the county which will preserve these historic buildings which presently lie empty. This is an approach which underpins sustainable development in that it retains our built heritage while bringing empty structures into use. The reuse of these buildings can help to reduce the demand for new housing while also preserving the vernacular design of the area.”

Adapted from: **County Roscommon Rural Design Guidelines** by Roscommon County Council
Published by: Roscommon County Council

- (a) Discuss the above statement in detail.
- (b) Propose **three** best practice guidelines that would promote the reuse or repurposing of some existing buildings in Ireland.

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