Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2019

Construction Studies

Theory - Higher Level

(300 marks)

Friday, 14 June
Afternoon, 2:00 - 5:00

(a) *Answer **Question 1** and **four** other 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.*

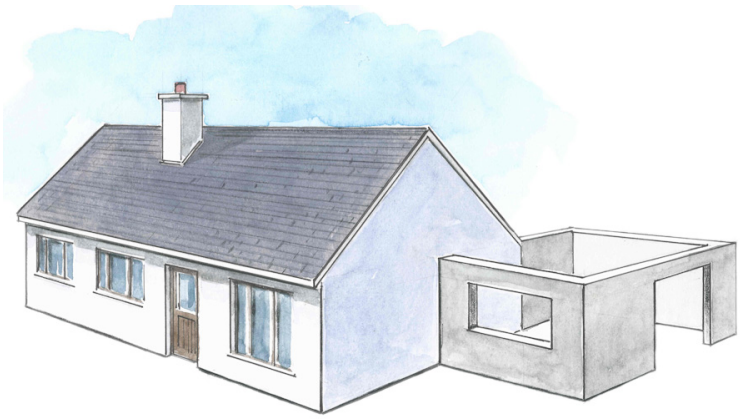
1. A triple glazed window with a wooden frame is fitted in the external wall of a dwelling house as shown. The fixed frame of the window is 100 mm × 80 mm. The wall is of timber frame construction with an external concrete block leaf. The internal timber frame is 250 mm × 50 mm and the outer leaf is of 100 mm concrete block construction with an external render finish. A 50 mm service cavity is also provided at the internal surface. Above the window head, an inset wooden panel is sheeted with vertical larch cladding of 130 mm × 20 mm to form an external rainscreen, as shown.
The window is 600 mm in height and has a thermally broken insulated frame.

(a) To a scale of 1:5, draw a vertical section through the fixed frame of the window and the external wall of the house. Show the typical construction detail from a level 400 mm below the window cill, through the window frame, up to a level 500 mm above the window head.

(b) On your drawing, show the typical design detailing to prevent the ingress of rainwater at the window cill.

2. **(a)** Discuss in detail, using notes and freehand sketches, **three** functional requirements of a roof suitable for a domestic dwelling house.

(b) The owners of a house located in a rural setting wish to build an extension to create an additional living space. The sketch shows the existing house and the proposed outline of the new extension at design stage.



Using notes and freehand sketches, show the design for **three** different, distinct roof profiles suitable for the proposed extension.

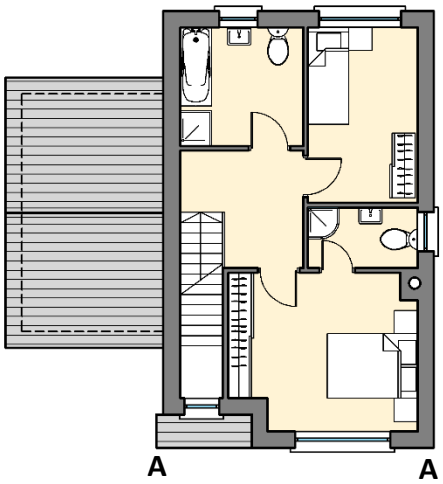
Recommend a preferred roof profile for the proposed extension **and** justify your recommendation.

(c) Select a different roofing material for **each** of the three roof types you have shown at **2(b)**. Give **one** advantage and **one** disadvantage for **each** material selected.

3. The drawing shows the elevation of a detached house and the plan of its first floor.
The front wall **A-A** is south facing.
The owners intend to apply for planning permission to build an additional bedroom and *en suite* bathroom. It is proposed to remove the roof of the single storey extension on the left and build the bedroom and bathroom over it.

(a) Discuss in detail, **three** design considerations for the proposed bedroom and *en suite* bathroom.

(b) Using notes and freehand sketches, show a proposed internal layout for the bedroom and *en suite* bathroom that incorporates each of the design considerations you outlined at **3(a)** above.
Justify your choices.



(c) Using notes and freehand sketches, show an external design for **your extension** that will enhance the overall visual appearance of the house.

4. The sketch shows a row of terraced townhouses built over 100 years ago. A young couple have purchased one of the houses and have decided to refurbish it as their family home.

(a) Discuss **three** benefits to the local community of refurbishing one of the townhouses as a family home.

(b) The owners commissioned a survey of the house which revealed the following:

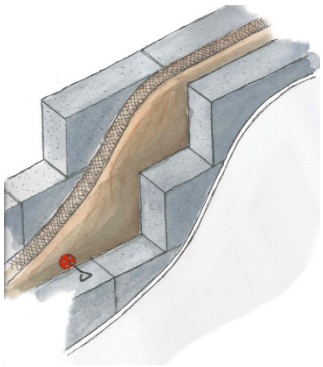
- traditional cut roof with natural slates
- softwood sliding sash windows with single-glazing
- solid external walls of brick construction, uninsulated and with internal lime render.

Select any **two** of the above areas and, using notes and freehand sketches, describe in detail the steps involved in upgrading each area selected in a manner that respects the appearance and character of the original townhouses.

5. The external wall of a house built in the 1990s is of 100 mm concrete block construction with a 100 mm partially filled cavity, as shown.

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

External render	thickness	16 mm
Concrete block outer leaf	thickness	100 mm
Clear cavity	width	50 mm
Polystyrene insulation	thickness	50 mm
Concrete block inner leaf	thickness	100 mm
Internal plaster	thickness	12 mm



Thermal data of the external wall:

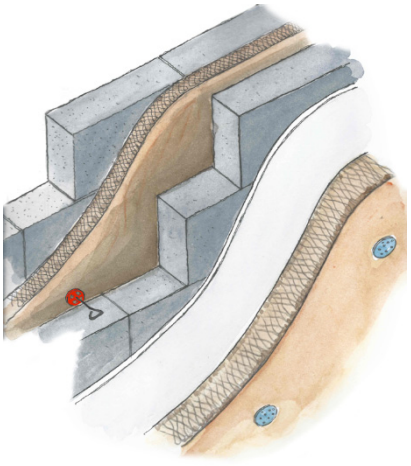
Resistance of external surface	(R)	0.048	m^2	°C/W
Resistivity of external render	(r)	2.170	m	°C/W
Conductivity of concrete external blockwork	(k)	1.440	W/m	°C
Resistance of clear cavity	(R)	0.170	m^2	°C/W
Conductivity of insulation	(k)	0.037	W/m	°C
Conductivity of concrete internal blockwork	(k)	1.440	W/m	°C
Resistivity of internal plaster	(r)	6.250	m	°C/W
Resistance of internal surface	(R)	0.122	m^2	°C/W

(b) Using the U-value of the wall obtained at **5(a)** above and the following data, calculate the cost of heat lost annually through this wall:

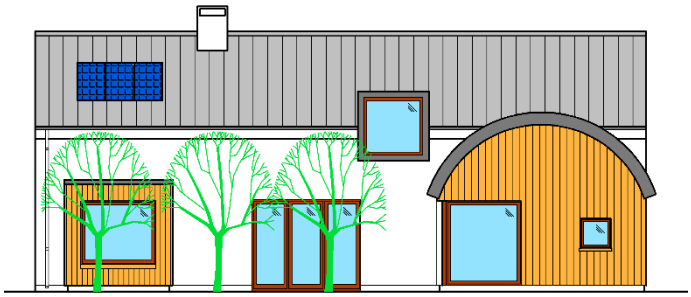
- area of external wall — 135 m^2
- average internal temperature — 19 °C
- average external temperature — 5 °C
- heating period — 9 hours daily for 36 weeks per annum
- cost of oil — 94 cent per litre
- calorific value of oil — 37350 kJ per litre
- 1000 Watts — 1 kJ per second.

(c) It is proposed to upgrade the thermal properties of the above wall, to meet the Passive House standard, by fixing expanded polystyrene to the external surface, as shown.

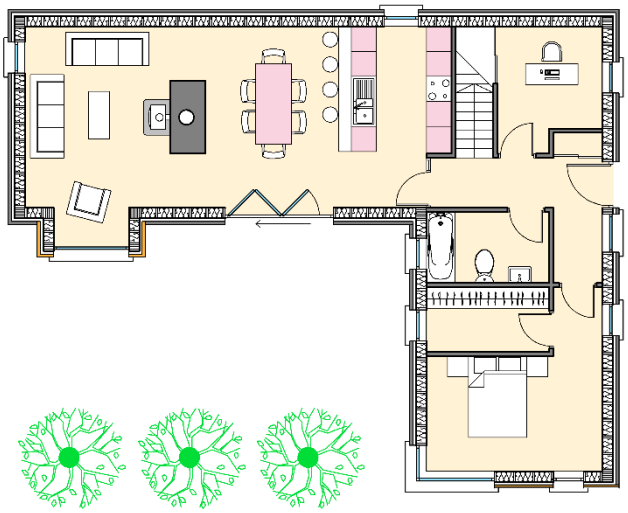
Given the thermal conductivity (k) of expanded polystyrene as 0.031 W/m°C, calculate the thickness of expanded polystyrene required to achieve a U-value of 0.15 W/m^2 °C.



6. The elevation and ground floor plan of a house are shown. The house has two bedrooms and a bathroom upstairs. The external walls are of timber frame construction with a rendered concrete block and timber cladding finish. 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) Using notes and freehand sketches, discuss in detail **each** of the following renewable energy technologies and identify how each contributes to making a home more eco-friendly:

- evacuated tubes
- wind turbines
- photovoltaic panels.

(c) Discuss in detail **two** advantages of using local craft skills when building the house shown.

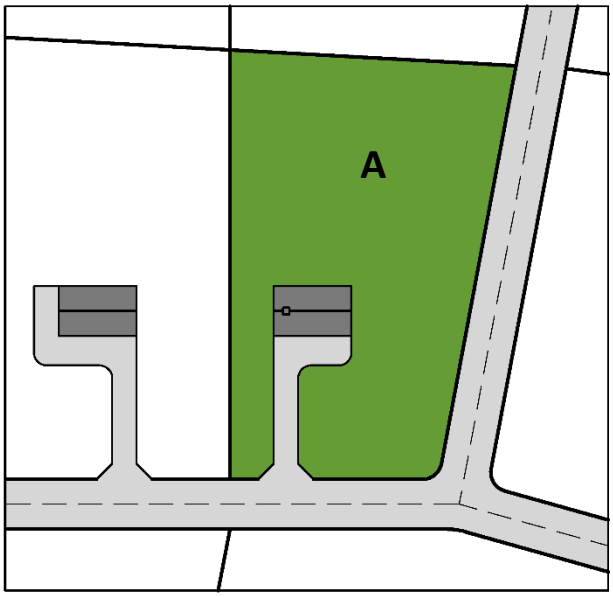
7. The main hall of a two-storey dwelling has a closed riser wooden stairs. The bottom of the stairs has a bullnose step as shown. The newel post is 120 mm × 120 mm and the rise of a step should not exceed 175 mm.

(a) To a scale of 1:5, draw a vertical section through the centre of the stairs. The section should show the typical construction detail through the bottom **three** steps of the stairs, showing the newel post, string, balusters and handrail.

Include the typical dimensions of **three** structural members of the stairs.

(b) Indicate on your drawing **three** design features that ensure the stairs is safe for users.

8. **(a)** Discuss **three** considerations to ensure the proper treatment and disposal of sewage when selecting a site for a house in a rural location.



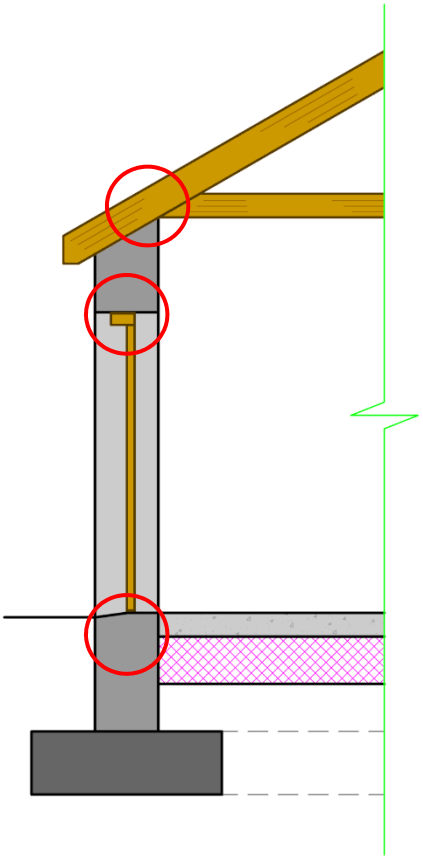
(b) The drawing shows a site layout map. The outline of a new house and driveway is shown on site **A**. Using notes and freehand sketches, show the design layout necessary for a typical wastewater treatment system and percolation area on this site.

Include typical dimensions for the system.

(c) Using notes and freehand sketches, discuss an alternative method, other than a typical percolation area to ensure the safe treatment of wastewater from a dwelling house.

9. Thermal envelope continuity is essential to ensure a dwelling house is thermal bridge free. The drawing shows an outline section through the external door of a single-storey house having a 450 mm external concrete block wall with a 250 mm full-fill insulated cavity.

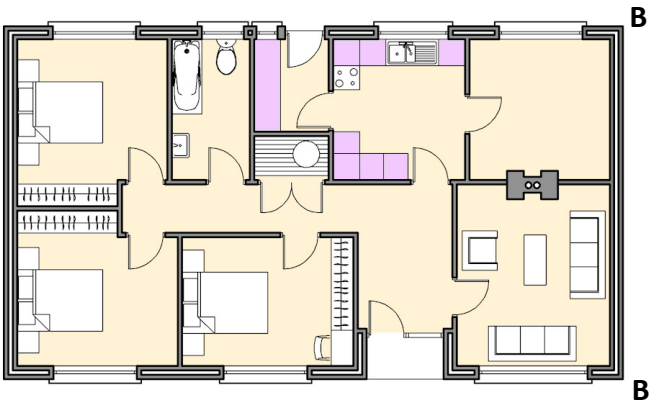
The house has a traditional cut roof with an insulated solid concrete ground floor. The external door and frame are thermally broken.



(a) Using notes and freehand sketches, show best practice design detailing that will prevent the formation of a thermal bridge at **each** location circled on the drawing.

(b) Discuss **two** negative impacts of thermal bridging as a result of poor design detailing.

10. The plan and elevation of a bungalow built in the 1970s are shown.
The wall **B-B** is south facing. The owners intend to carry out a deep retrofit upgrade of their house to meet the ***EnerPHit*** Passive House standard.



(a) Using notes and freehand sketches, outline **three** design considerations necessary to achieve the ***EnerPHit*** Passive House design standard.

(b) Discuss in detail, using notes and freehand sketches, how you would retrofit the given house to include each consideration you specified at **10(a)** above.

(c) Discuss **two** advantages of retrofitting an existing house to meet the ***EnerPHit*** standard.

OR

10. "Global warming is now a generally recognised phenomenon and sustainability is recognised as being a necessity, not an option. One of the main culprits blamed for global warming is carbon dioxide (CO_2), so it is worth taking a look at what can be done about it.
CO_2 is produced by each of us every day, and our personal carbon footprint is a measure of how many tonnes of CO_2 are emitted directly or indirectly, as a result of the consumption of goods and services. When building your own home you should take every opportunity to build in the most sustainable way so as to minimise your own carbon footprint."

Adapted from: **Building Your Own Sustainable and Energy Efficient House.**
by Henry Skates
Published by: The Crowood Press Ltd. ISBN: 978-1-84797-258-3

Discuss the above statement in detail and propose **three** best practice guidelines that would ensure that buildings are built in the most sustainable way possible and thus minimise their carbon footprint.

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