Pre-Leaving Certificate Examination, 2017

Construction Studies

Theory - Higher Level

(300 marks)

Time: 3 Hours

(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 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. The pitched roof of a two-storey dwelling house is shown. The house has an internal span of 5.5 m. The external wall is of timber frame construction, with a 100 mm concrete block outer leaf, a 200 mm timber frame inner leaf and a 60 mm insulated service cavity. The roof, which is slated, has prefabricated trussed rafters and is pitched at 30 degrees.

(a) To a scale of 1:10, draw a vertical section through one external wall and one rafter length. Show typical construction details from 400 mm below the ceiling joists, through the external wall and eaves, up to ridge level. Show **three** courses of slate at the eaves. Include **four** typical dimensions of the roof structure.

(b) On your drawing, show clearly the design detailing that ensures sufficient ventilation of the roof structure.

2. **(a)** Discuss in detail, using notes and freehand sketches, **two** functional requirements of a dwelling house designed for lifetime use. Refer in particular to the following areas:

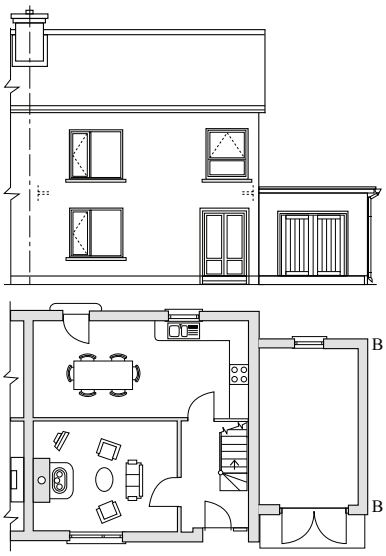
- main entrance
- internal corridor layout.

(b) A new dwelling house will have an open-plan dining and kitchen space, 7 m × 5 m. Using notes and freehand sketches, show a preferred layout for the dining and kitchen space to ensure that it is suitable for a person with reduced mobility. Indicate in your design sketches the location of the following: doors, windows, sink, work surfaces, storage, fridge, electric cooker, dining table. Include **four** typical dimensions.

(c) Discuss in detail the reasons for the proposed location of **three** of the above dining and kitchen items.

3. The drawing shows the elevation and ground floor plan of a two-storey semi-detached house with an adjoining storeroom. The storeroom wall **B-B** is south facing. The external walls are single leaf 215 mm hollow block construction.

Planning permission is being sought to convert the storeroom for use as a playroom. The owners also want to improve the thermal performance of the house.



(a) Show, using notes and freehand sketches, a revised design of the storeroom which will ensure a bright, light-filled interior. In your revised design, you should consider modifying the external envelope to improve the penetration of natural light.

(b) Discuss in detail, using notes and freehand sketches, **two** design considerations for a contemporary window frame and glazing system for the storeroom that will ensure the high thermal performance of both the window frame and the glazing system.

(c) Select either an insulation system for use in this project. Show, using notes and freehand sketches, one method of applying your preferred insulation material.
Include in your sketches **each** of the following:

- method of fixing
- insulating material and its thickness
- surface finish.

4. A two-storey dwelling house in need of significant refurbishment is shown in the sketch.

(a) Discuss **one** advantage to the homeowner and **one** advantage to the local community of refurbishing older buildings.

(b) A survey of the house reveals:

- roof: uninsulated, traditional cut roof with natural slate
- floor: uninsulated suspended timber
- windows: softwood, single-glazed with sliding sash.

Select any **two** of the areas at 4(b) above and, using notes and freehand sketches, describe the steps involved in upgrading each area selected in a manner that respects the appearance and character of the original dwelling.

5. A flat roof of a house has the following specifications:

Specification of flat roof:

Bituminous felt	thickness	9 mm
Marine plywood	thickness	18 mm
Tapered firring piece	thickness	50 mm
Mineral wool insulation between joists	thickness	200 mm
Ceiling joists	thickness	200 mm
Vapour control layer	thickness	0.03 mm
Internal plasterboard	thickness	12 mm

Thermal data of flat roof:

Resistance of external surface	(R)	0.048	m^2	°C/W
Conductivity of bituminous felt	(k)	0.500	W/m	°C
Conductivity of marine plywood	(k)	0.130	W/m	°C
Conductivity of mineral wool insulation	(k)	0.040	W/m	°C
Conductivity of vapour control layer	(k)	0.450	W/m	°C
Conductivity of plasterboard	(k)	0.160	W/m	°C
Resistance of internal surface	(R)	0.104	m^2	°C/W

Note: *The timber joists and the tapered firring piece need not be considered in your calculations.*

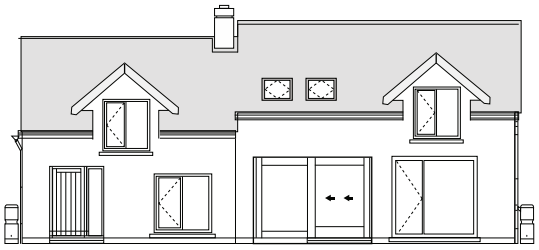
(a) Calculate the U-value of the above flat roof.

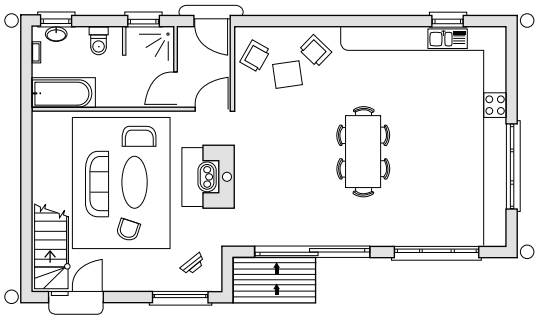
(b) Calculate the cost of heat lost annually through this roof, using the following data:

Area of roof	120 m^2
Average internal temperature	18 ºC
Average external temperature	6 ºC
U-value of roof	as calculated above
Heating period	8 hours per day, every day for 38 weeks per annum
Cost of oil	94 cent per litre
Calorific value of oil	37350 kJ per litre
1000 Watts	1kJ per second

(c) Using notes and freehand sketches, show best practice design detailing to prevent the ingress of water at the junction of the flat roof and the main wall of the house.

6. The elevation and ground floor plan of a house are shown.
The house has three bedrooms and a bathroom upstairs.
The external walls are of timber frame construction with a rendered concrete block outer leaf.
All internal partitions are of timber frame construction.
The house is designed to have low environmental impact.



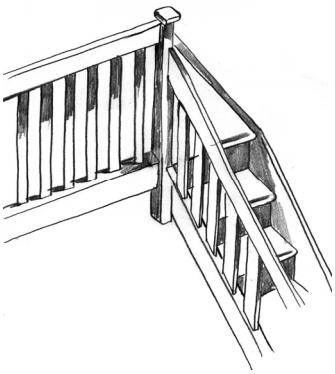


(a) Discuss in detail, using notes and freehand sketches, **three** features of the design that contribute to the house having low environmental impact.

(b) Designing homes to be energy neutral is a key design requirement for all new homes. Describe, using notes and sketches, one means of generating electrical energy on-site.

(c) The introduction of the Nearly Zero Energy Building (NZEB) standard will impact on construction in Ireland. Discuss the importance of designing Nearly Zero Energy Building (NZEB) buildings.

7. The top portion of a closed-string timber stairs is shown in the accompanying sketch. The first floor landing has a hardwood tongue-and-groove floor, on 200 mm × 50 mm timber joists with a plasterboard ceiling beneath. The newel post is 100 mm × 100 mm.

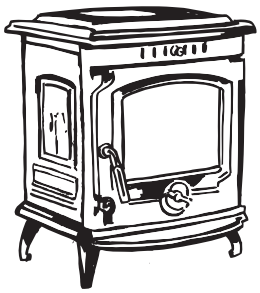


(a) To a scale of 1:5, draw a vertical section through the top three steps of the stairs and landing. Show the newel post, balusters and handrail of the stairs. Indicate on your drawing the:

- handrail height to stairs
- handrail height to landing
- spacing between balusters.

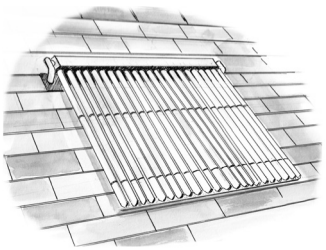
(b) Indicate on your drawing **two** design features that ensure that the landing is safe for all users.

8. A wood burning stove combined with a solar collector is to provide central heating and hot water for a two-storey house.



(a) Using notes and a single-line diagram, show a typical design layout for both the heating system **and** the hot water system. Show **two** independently controlled heating zones, one on each floor, and include **three** radiators on each floor. Indicate the location of the control valves and give typical sizes of the pipework.

(b) Using notes and freehand sketches, discuss **two** considerations that should be taken into account when selecting a location for a solar collector, to ensure its maximum efficiency.



(c) Many homes have retrofitted solar collectors as part of a thermal upgrade. Discuss in detail **two** advantages of installing solar collectors in existing dwellings.

9. **(a)** Sound travels in waves and is classified as either direct or indirect. Using notes and neat freehand sketches, explain and give **one** example of **each** of the following:

- direct transmission
- indirect transmission.

(b) The accompanying sketch shows two semi-detached dwellings with a party wall of concrete block construction. Sound generated in one of the houses is impacting in a negative way on the occupants of the adjoining house. Using notes and freehand sketches, show revised design details to reduce the transmission of sound between the two houses.

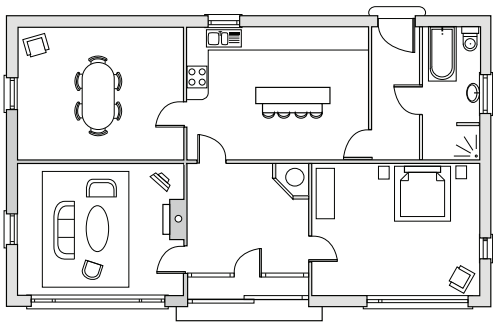
For each of your design choices at (b), explain the sound insulation principles associated with your design choice.

(c) In high density living accommodation, sound transmittance between floors must be considered at design stage. Using notes and freehand sketches, show best practice design detailing to reduce unwanted sound passing between floors.

10. **(a)** Using notes and freehand sketches, discuss in detail the importance of any **two** of the following in the design of a Passive House:

- building orientation
- solar shading
- indoor air quality.

(b) The drawing shows the ground floor plan of a Passive House. It is proposed to install a Mechanical Heat Recovery with Ventilation (MHRV) system in the house. Draw a single-line diagram of the given room layout and indicate a preferred location for the MHRV unit. Show a typical design layout for the ducting to the MHRV unit and indicate clearly on your drawing the direction of airflow in all the ducts.
Describe how a Mechanical Heat Recovery with Ventilation (MHRV) system works.



Note: *Show a plan of the room layout only, it is not necessary to show the furniture.*

(c) Discuss in detail **two** design considerations that should be taken into account when selecting a location for the MHRV unit in a Passive House.

OR

10. It has been said that the greenest building is the one that is already built. It is important to recognise that the reuse or continued use of older buildings is a key component of sustainable development and energy conservation practice.

Energy Efficiency in Traditional Buildings.
Department of Environment, Heritage and Local Government, 2010.

Discuss the above statement in detail and recommend **three** best practice guidelines that would promote the reuse or continued use of existing buildings.

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