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**Pre-Leaving Certificate Examination, 2018**

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# **Construction Studies**

## **Marking Scheme**

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**Ordinary** Pg. 4

**Higher** Pg. 27

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Pre-Leaving Certificate Examination, 2018

## Construction Studies

Ordinary & Higher Level

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**Pre-Leaving Certificate Examination, 2018**

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**Construction Studies**

**Ordinary & Higher Level**

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**Explanation**

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**Conventions Used**

1. A **dash** – before an answer indicates that the answer is a separate answer, which may be considered as independent of any other suggested answers to the question.
2. A **single forward slash** / before an answer indicates that the answer is synonymous with that which preceded it. Answers separated by a forward slash cannot therefore be taken as different answers.
3. A **double forward slash** // is used to indicate where multiple answers are given but not all are required.
4. **Round brackets** ( ) indicate material which is not considered to be essential in order to gain full marks.
5. Answers which are given in this marking scheme should not be considered as the only possible answers that may be accepted. Answers which are synonymous with or equivalent to those in this marking scheme are also acceptable.
6. ‘*etc.*’ is used in this marking scheme to indicate that other answers may be acceptable. In all other cases, only the answer given or ‘words to that effect’ may be awarded marks.

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**Current Marking Scheme**

Assumptions about these marking schemes on the basis of past SEC marking schemes should be avoided. While the underlying assessment principles remain the same, the exact details of the marking of a particular type of question may vary from a similar question asked by the SEC in previous years in accordance with the contribution of that question to the overall examination in the current year. In setting these marking schemes, we have strived to determine how best to ensure the fair and accurate assessment of students’ work and to ensure consistency in the standard of assessment from year to year. Therefore, aspects of the structure, detail and application of the marking schemes for these examinations are subject to change from past SEC marking schemes and from one year to the next without notice.

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Pre-Leaving Certificate Examination, 2018

Construction Studies

Ordinary Level  
Marking Scheme (200 marks)

Answer Question 1 and **three** other questions.

All Questions carry 50 marks.

Question 1

(50)

1. A dwelling house has a tiled roof, which has been constructed on a 350 mm external concrete block wall with a full-fill insulated cavity. The roof is a traditional cut roof and has a pitch of 45°.

- (a) To a scale of 1:5 draw a vertical section through the eaves of the tiled roof and the external wall. Show the typical construction details from a level 400 mm below the wallplate, through the eaves, and show **three** courses of tiles at the eaves. Include the roof insulation and **four** typical dimensions on your drawing.



(40)

Nine details: (9 × 4m)

Four typical dimensions: (4 × 1m)

Specifications

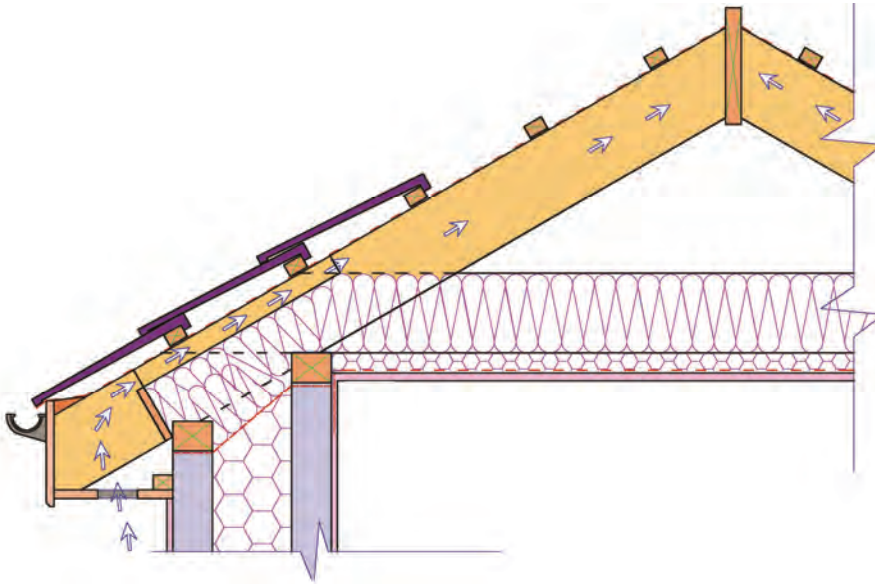
- concrete tiles //
- softwood battens - 44 mm × 35 mm //
- vapour diffuser / breather membrane overlapped and taped //
- rafters - 200 mm × 40 mm @ 450 mm centres //
- roof insulation to comply with current building regulations - min. 200 mm //
- ceiling joists - 200 mm × 40 mm @ 450 mm centres //
- airtightness seal to internal wall //
- insulated plasterboard with skim coat //
- 100 mm × 75 mm double wallplate fixed to blockwork //
- 15 mm internal plaster with hardwall finish //
- concrete block inner leaf - 100 mm //
- full-fill insulated cavity - 200 mm //
- concrete block outer leaf - 100 mm //
- 19 mm external render //
- soffit - 12 mm //
- fascia - 25 mm //
- eaves gutter - 100 mm // etc.

\*\* Accept any alternative detailing which complies with current building regulations.

\*\* Accept any other appropriate answer(s).

## Question 1 (cont'd.)

(a) (cont'd.)



(b) Show clearly on your drawing how the roof is ventilated at the eaves.

(10)

Ventilation detail: (2m)

Sketch(es): (8m)

- \*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.
- \*\* Detail must be shown clearly on the drawing.
- \*\* Expect students to show arrows showing path of air.

Possible answers

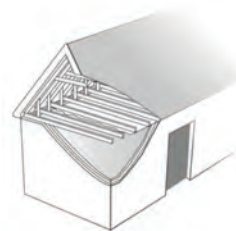
- provide vents in the soffit //
- use proprietary tile ventilators where soffit ventilation is not possible //
- fix proprietary eaves ventilators between the rafters // *etc.*
- \*\* Accept any other appropriate answer(s).

## Question 2

(50)

2. The owners of a house have decided to improve the insulation properties of both the roof and the external walls. The external wall is a single leaf, 215 mm solid concrete block wall. It is proposed to insulate the external wall and the attic space.

- (a) Using notes and freehand sketches, show **one** method of improving the insulation properties of the wall by fixing an external insulation system to the external wall. Specify the insulation material used.



(20)

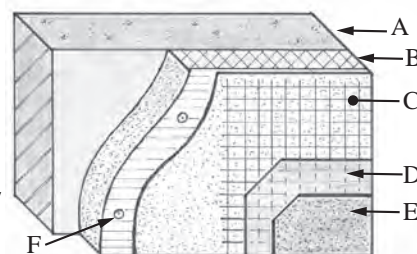
Method: **(8m)**Insulation materials: **(4m)**Sketch(es): **(8m)**

\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

① Method

Possible answers

- a base stainless steel track to carry the slabs is fixed to the wall A at DPC level //
- first row of insulation boards B is fixed in place resting on the track //
- boards are fixed in position using a special adhesive C //
- the next rows of insulation (D and E) are fixed in staggered pattern //
- all rows are fixed in place and the adhesive allowed set //
- mechanical fixings F are used to fix each board in place //
- number of fixings is typically seven per square metre //
- special longer fixings are available for thicker insulation boards //
- fixings are installed by drilling through the insulation and into the wall //
- fixings are then hammered into place // etc.



\*\* Accept any other appropriate answer(s).

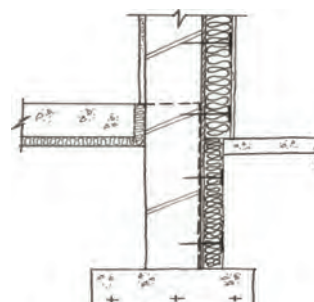
② Materials

Insulation materials

- polystyrene, mineral fibre board and phenolic foam

Insulation thickness

- 80 mm - 300 mm depending on eaves overhang



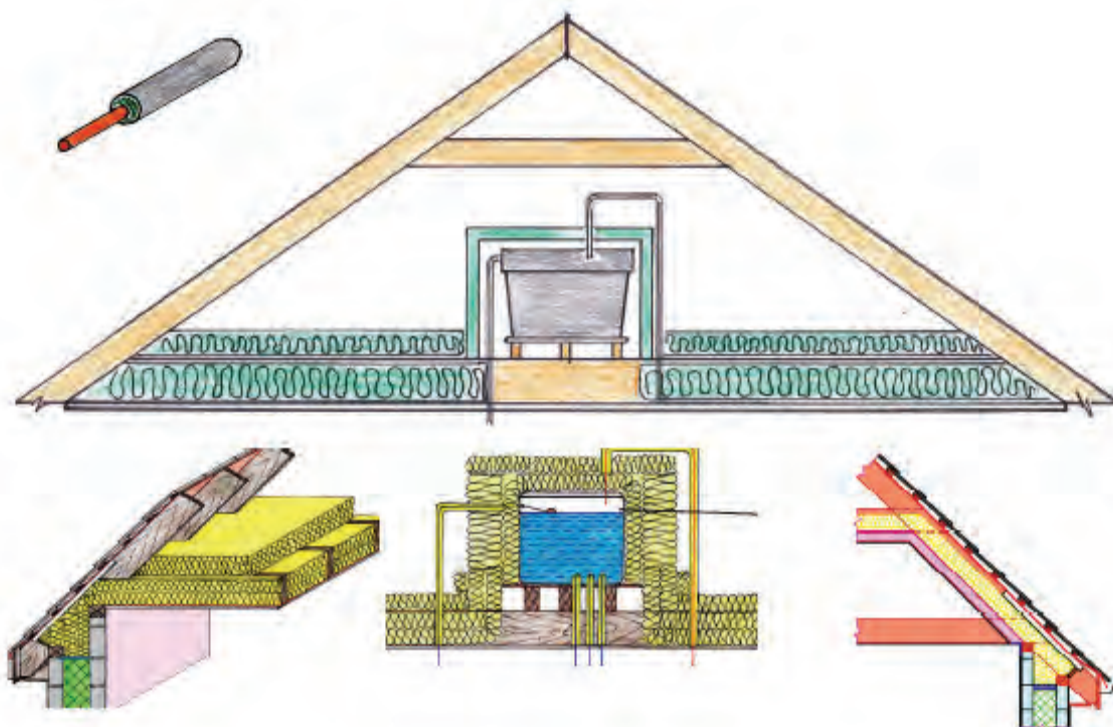
## Question 2 (cont'd.)

- (b) Using notes and freehand sketches, show the typical design detailing necessary to insulate the attic space. Specify the type and thickness of insulation. (20)

Method: (12m)

Sketch(es): (8m)

\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.



Possible answers

- fibreglass to depth of 300 mm min. //
- insulation positioned between joists //
- ventilation path to be maintained at eaves by use of eaves ventilator //
- trap door to attic should be sealed and insulated //
- rigid urethane insulation may be positioned between rafters //
- 50 mm ventilation maintained under rafter to avoid condensation build-up //
- it is relatively easy to insulate the attic and this can be carried out by the home owner provided the necessary precautions are taken //
- water tank fully insulated //
- pipes fully insulated //
- if attic space converted for use, insulation above ceiling // etc.

\*\* Accept any other appropriate answer(s).

## Question 2 (cont'd.)

- (c) List **two** advantages of improving the insulation properties of the dwelling. (10)

Two advantages: (2 × 5m)

Possible Answers

- the greatest heat loss is through the roof; up to 30% of heat is lost //
- insulation reduces heat loss //
- improves the thermal comfort of occupants //
- it is the most effective way to save energy inside the home / energy bills are reduced //
- it improves the U-value rating //
- lower CO<sub>2</sub> emissions, therefore better for the environment, as less fossil fuels are used to heat the house //
- improves the Building Energy Rating (BER) //
- the house will be warmer //
- reduces condensation and mould due to dampness //
- no loss of internal floor area //
- better indoor environment - no extremes of heat or cold //
- retains the heat in the external wall and the wall becomes a heat store / sink // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 3

(50)

3. (a) Using a single-line labelled diagram, show the pipework necessary to supply **hot** and **cold water** to the wash hand basin and the bath, as shown in the sketch.

Include the following in your diagram:

- water storage tank and overflow
- rising main
- hot water cylinder and pipework
- insulation to the water storage tank and to all pipework
- all necessary valves.



(43)

Seven details: (7 × 5m)

Sketch: (8m)

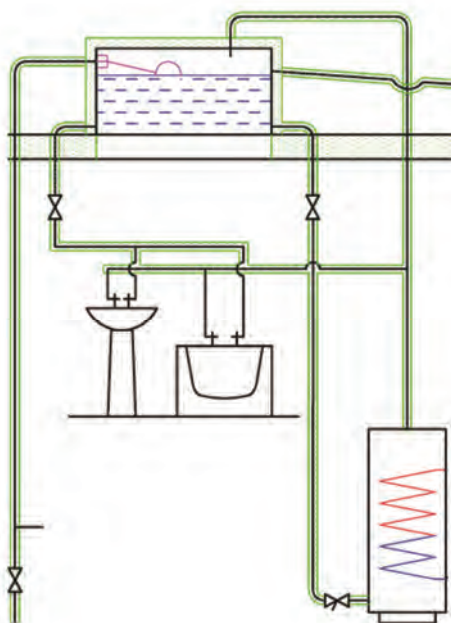
\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

### Specifications

- rising main //
- ball valve //
- cold water storage tank //
- overflow //
- cold feed from storage tank to indirect hot water cylinder //
- indirect hot water cylinder //
- expansion pipe from indirect hot water cylinder //
- hot water supply to appliances //
- cold water supply from storage tank to appliances //
- valves //
- insulation to storage tank, cylinder and pipework //
- labelling // etc.

\*\* Accept any alternative detailing which complies with current building regulations.

\*\* Accept any other appropriate answer(s).



**Question 3 (cont'd.)**

- (b) Show **one** design detail that prevents odours entering the bathroom from the waste discharge system of the wash hand basin and the bath. (7)

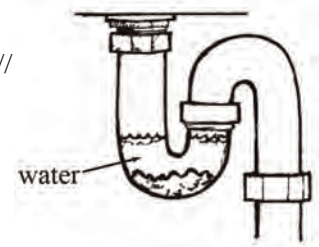
Design detail: **(3m)**

Sketch: **(4m)**

Possible Answers

- S-bend / P-trap positioned under the wash hand basin and bath //
- water seal ensures foul air does not travel back up into the room //
- depth of the seal depends on the appliance and distance from stack (if used) // *etc.*

\*\* Accept any other appropriate answer(s).



## Question 4

(50)

4. A non load-bearing timber stud partition with a plasterboard finish separates a bedroom and living room on the ground floor of a house, as shown in the sketch.



- (a) Using notes and freehand sketches, show the typical construction details of the stud partition. Name the components and give their typical dimensions.

(20)

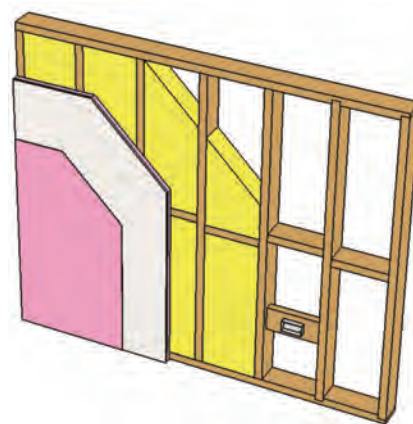
Four details: (4 × 3m)

Sketch(es): (8m)

\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

Details required

- sole piece or base plate - 75 mm × 50 mm or 100 mm × 50 mm //
- studs - 75 mm × 50 mm or 100 mm × 50 mm @ 400 mm centres //
- nogging or bridging for stability - 75 mm × 50 mm or 100 mm × 50 mm //
- head plate - 75 mm × 50 mm or 100 mm × 50 mm //
- fixing piece for electrical services - 100 mm × 50 mm //
- insulation fitted between joists //
- plasterboard - 2400 mm × 1200 mm × 12.5 mm - fixed to studs with zinc-coated nails or screws //
- plaster skim // etc.



\*\* Accept any alternative detailing which complies with current building regulations.

- (b) On a **separate sketch**, show **one** method of fixing a double electrical socket in the stud partition.

(16)

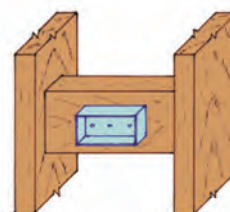
Note: (8m)

Sketch: (8m)

Possible answers

● Metal socket box

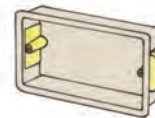
- locate the position of the socket on the timber studs //
- fit fixing batten between the studs //
- set the fixing batten back from the edge of the studs //
- the front of the gang box should be flush with the front edge of the studs //
- fix the socket box to the fixing batten //
- mark the position of the socket on the plasterboard //
- cut out with a pad or plasterboard saw // etc.



## Question 4 (cont'd.)

(b) (cont'd.)

- Dry lining back box
- mark the position of dry lining back box on the plasterboard //
- cut around the rectangle using a pad or plasterboard saw //
- fit the box into the opening //
- ensure that the side clips grip the plasterboard //
- when the fixing screws of the socket are tightened, the side clips will grip the plasterboard // *etc.*



\*\* Accept any other appropriate answer(s).

(c) Using notes and freehand sketches, show **one** method of providing a surface finish to the plasterboard prior to painting.

(14)

Note: (7m)

Sketch(es): (7m)

Possible answers

- spread sheeting over the floor //
- tape over all the joints and seal the partition to the existing walls and ceiling //
- always add plaster to the water and use a clean mixing bucket //
- use a power or hand mixer to mix the plaster //
- mix the powder and water thoroughly until the mixture is free from lumps //
- pour the plaster onto a mortar board //
- cut away a section of the plaster with the plastering trowel and put on a plastering hawk //
- using smooth strokes spread the plaster over the wall to a thickness of 1 to 2 mm, moving from left to right / right to left //
- work quickly to cover the whole area //
- level and smooth the surface when the plaster is still soft //
- apply a second coat similar to the first coat //
- when the surface is covered, even out the surface //
- leave the plaster to dry until the surface is firm to touch //
- the plaster can now be polished //
- wet the trowel and flick water over the surface with a large paintbrush //
- float the trowel over the surface working in sweeping strokes to get a fine finish //
- wash the bucket and all the tools immediately // *etc.*

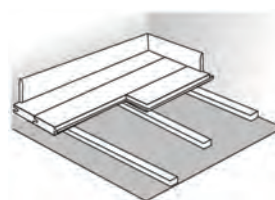


\*\* Accept any other appropriate answer(s).

## Question 5

(50)

5. A tongue-and-groove hardwood floor is fixed, on battens, to a concrete ground floor slab, as shown in the sketch. The external wall of the house is a 400 mm concrete block wall with an insulated cavity and the wall is plastered on both sides.



- (a) To a scale of 1:5, draw a vertical section through the ground floor and the external wall. Show the typical construction details from the bottom of the foundation to 400 mm above the hardwood floor. Include **four** typical dimensions on your drawing.

(40)

Nine details: (9 × 4m)

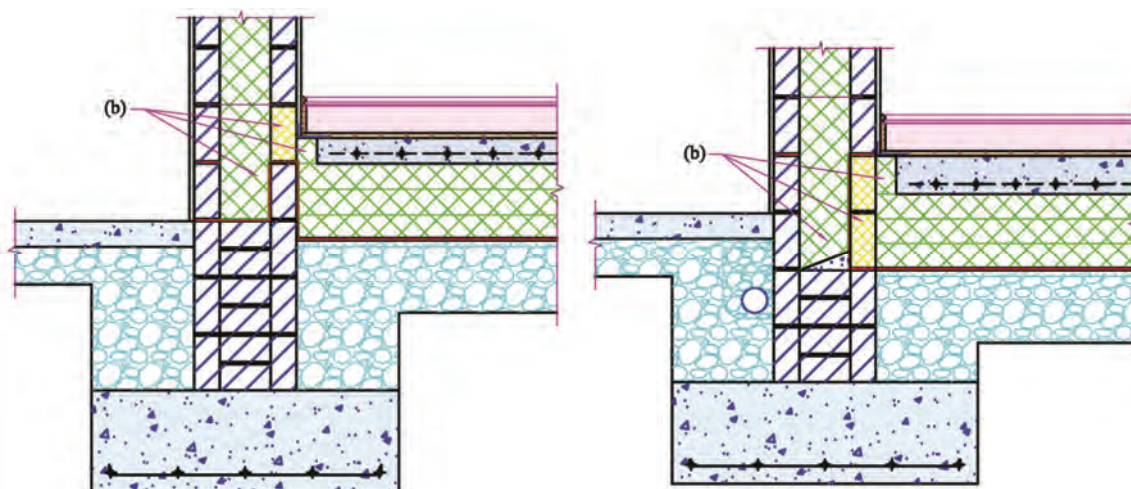
Four typical dimensions: (4 × 1m)

Specifications

- 100 mm concrete footpath / ground level //
- D.P.C //
- 19 mm external render //
- 100 mm concrete block outer leaf //
- 200 mm full-fill cavity //
- wall tie //
- 100 mm concrete block inner leaf //
- 15 mm internal plaster taped and sealed to floor //
- skim coat //
- skirting board - 120 mm × 20 mm //
- 50 mm × 25 mm battens and a 20 mm hardwood floor //
- reinforced concrete slab with perimeter insulation taped and sealed to internal plaster //
- 200 mm - 300 mm rigid insulation //
- inside leaf - 100 mm thermal blocks / aerated concrete insulation blocks //
- radon barrier or damp-proof membrane //
- 50 mm sand blinding //
- 300 mm hardcore //
- concrete fill / footings //
- reinforced concrete foundation // etc.

\*\* Accept any alternative detailing which complies with current building regulations.

\*\* Accept any other appropriate answer(s).



**Question 5 (cont'd.)**

---

- (b) Show on your drawing the typical design detailing to prevent the formation of a thermal bridge at the junction of the external wall and the floor. (10)

Design detail: **(2m)**

Sketch(es): **(8m)**

- \*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.  
\*\* Detail must be shown clearly on the drawing.

Possible answers

- thermal blocks along inner leaf //
  - 80 mm upstand insulation at floor and wall junction //
  - ensure no structural connection between inside and outside leaf // *etc.*
- \*\* Accept any other appropriate answer(s).

## Question 6

(50)

6. (a) Draw the particular safety signs to show the personal protective equipment (PPE) for **each** of the following:

- eye protection
- safety helmet
- safety gloves.

Three signs: (3 × 8m)

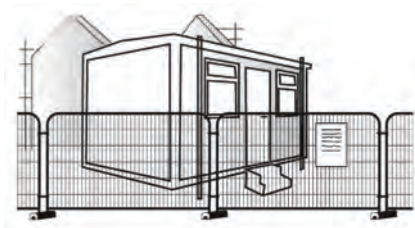
- ① eye protection



- ② safety helmet



- ③ safety gloves



(24)

## Question 6 (cont'd.)

- (b) Describe **three** specific activities that require personal protective equipment (PPE) to be worn by workers on a construction site. For **each** activity, give **one specific** reason why the item of personal protective equipment must be worn. (12)

Three activities named: (3 × 1m)

Reasons for PPE: (3 × 3m)

\*\* Students must provide one reason why each activity requires PPE.

Possible answers

Any 3:

<u>Activity</u>	<u>Reason</u>
– laying of blocks or bricks //	– requires safety gloves to protect workers' hands from injury and skin irritation //
– moving roof tiles or slates //	– requires safety gloves to protect workers' hands from cuts and abrasions //
– handling sharp materials //	– require safety gloves to protect workers hands from cuts and punctures //
– building or working with stone //	– requires safety gloves to protect workers' hands from injury and skin irritation //
– fixing or removing scaffolding //	– requires safety gloves to protect workers' hands from injury and irritation //
– working with corrosive or toxic substances //	– requires safety gloves to protect workers' hands from chemical burns //
– mechanically cutting concrete or steel //	– requires eye protection to protect workers eyes from flying chips or particles //
– drilling concrete or steel //	– requires eye protection to protect workers' eyes from flying chips or particles //
– using hammer, angle grinder or nail gun //	– requires eye protection to protect workers' eyes from flying chips or particles //
– using a jackhammer //	– requires ear protection ( earmuffs or earplugs) to protect workers' hearing in high-noise work areas //
– welding steel //	– requires eye protection to protect workers' eyes from flying steel chips or particles //
– painting ceilings / chipping loose paint // etc.	– requires eye protection to protect workers' eyes from drops of paint / flying paint chips or particles // etc.

\*\* Accept any other appropriate answer(s).

**Question 6 (cont'd.)**

---

- (c) Using notes and freehand sketches, describe **two** specific safety precautions that should be observed when using a jigsaw in the Construction Studies room. Give **one** reason for **each** safety precaution described. (14)

Two safety precautions: (2 × 3m)

Two reasons: (2 × 4m)

Possible answers

- wear appropriate personal protective equipment (PPE) //
- ensure work is well secured and supported //
- ensure hands are away from moving blade //
- keep the workplace clear from obstructions or other students //
- keep leads tidy to avoid trip hazards // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 7

(50)

7. The sketch shows a new dwelling designed to be eco-friendly. A water butt will be used to collect rainwater from the pitched roof.

- (a) Using notes and freehand sketches, show the pipework necessary to collect the rainwater from the roof and to store it in the water butt.

Two details: (2 × 6m)

Sketch(es): (8m)

- \*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

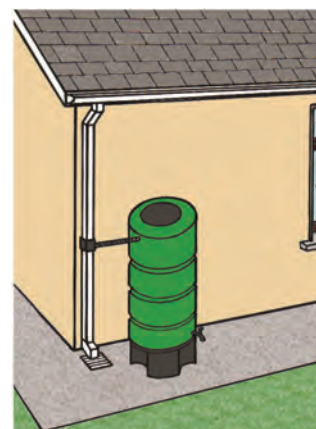
Possible Answers

- rainwater is collected from sloping roof and flows into the eaves gutter //
- rainwater flows from the eaves gutter into the downpipe //
- a diverter is connected to the downpipe and diverts the rainwater into a connecting hose //
- the hose connects the diverter to the water butt //
- the rainwater flows through the hose into the water butt //
- when the water butt is full the diverter directs the rainwater into the downpipe and down into the gully //
- the water butt usually sits on a stand //
- a tap is fitted close to the bottom of the water butt // etc.

- \*\* Accept any other appropriate answer(s).



(20)



- (b) Discuss **two** disadvantages of using a water butt to store rainwater.

(10)

Two disadvantages: (2 × 5m)

Possible Answers

- the amount of stored rainwater is limited to the size of the butt //
- rainwater usage is limited to the amount of water in the butt //
- the water in the butt is not pressurised //
- the rainwater may be contaminated by dirt or other contaminants from roofs // etc.

- \*\* Accept any other appropriate answer(s).

## Question 7 (cont'd.)

- (c) Discuss **two** advantages of harvesting rainwater and suggest **two** suitable uses for harvested rainwater. (20)

Two advantages: (2 × 5m)

① Advantages

Possible Answers

- rainwater harvesting encourages users to conserve water //
- water harvesting supplements main water supply //
- most sloped roofs act as collectors for harvesting water //
- rainwater storage capacity can be sized to suit the demand for water //
- water butts are environmentally friendly and inexpensive while easy to fit and can be linked for greater capacity //
- harvested rainwater provides water when there is drought //
- rainwater is often free from many chemicals found in the ground water //
- rainwater harvesting can provide an independent water supply //
- harvested rainwater reduces demand on wells, which can help to maintain ground water levels //
- large storage units can reduce flooding in low-lying areas // *etc.*

\*\* Accept any other appropriate answer(s).

② Two uses: (2 × 5m)

Uses

Possible Answers

- rainwater can be used for tasks that do not require potable water //
- rainwater can be used for flushing toilets, washing clothes and washing cars //
- rainwater is ideal for garden purposes, agriculture and livestock, dust control and construction activity //
- it can be used for irrigation, landscaping, public parks and artificial lakes and any use where non-drinking water is suitable // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 8

(50)

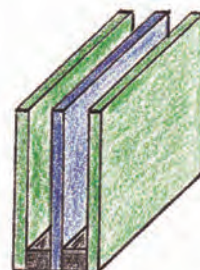
8. Explain, with the aid of notes and freehand sketches, any **five** of the following: (50)

Any 5: (5 × 10m)

\*\* Primary information: (6m), Secondary information: (4m).

• Triple glazing

- three layers of glass are used with cavity between the glass panels //
- by using three layers of glass the panel is a better insulator //
- the panel also has a better acoustic performance //
- low-e coating on the panes reflects heat back into house //
- cavities filled with argon or krypton gas to reduce heat loss //
- triple glazing improves the U-value of the window //
- triple-glazed panels provide a comfortable indoor temperature //
- triple glazing reduces condensation // *etc.*



\*\* Accept any other appropriate answer(s).

• Cordless drill

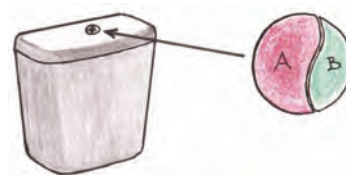
- this is a battery-operated drill and is not directly connected to AC power when in use //
- it uses rechargeable batteries for its power //
- the drill is available with similar features to an AC mains-powered drill //
- the drill is available with hammer action //
- cordless drills are used for driving screws //
- a clutch is fitted to prevent damage to screw heads //
- they are also available as a right-angle option for work in tight spaces //
- cordless drills are very useful for all types of construction work //
- they come with several power and speed settings //
- light low-voltage drills are useful for DIY work //
- higher-voltage drills are heavier and are more suitable for robust work // *etc.*



\*\* Accept any other appropriate answer(s).

• Dual flush toilet

- this is a special fitting within some modern toilet cisterns //
- it has two buttons, allowing the user to choose between two water flush settings //
- a larger flush A, of 6-9 litres, is designed for solid waste //
- the smaller flush B, of 3-4 litres, is designed for liquid waste //
- this type of cistern reduces the amount of water used //
- it also reduces the amount of water entering waste treatment and sewerage systems // *etc.*



\*\* Accept any other appropriate answer(s).

• Wall tie

- this is a special fitting used in the construction of a cavity wall //
- it holds the internal and external leaves of a cavity wall together //
- this ensures that both leaves act as single unit //
- this produces a stronger structure //
- the modern wall tie is designed to hold the insulation in place //
- wall ties are made of stainless steel //
- the ties are placed at 900 mm apart horizontally and 450 mm vertically // *etc.*

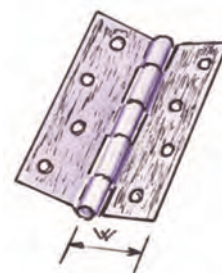


\*\* Accept any other appropriate answer(s).

## Question 8 (cont'd.)

- Butt hinge

- a widely used hinge //
- it varies in length from 12 mm to 150 mm //
- it is made of brass or mild steel //
- used for doors, windows, boxes, *etc.* //
- consists of two leaves and a central pin //
- the leaves are fitted into two shallow trenches //
- hinge is secured using countersunk screws // *etc.*



\*\* Accept any other appropriate answer(s).

- Site notice

- this is a clear notice placed at the proposed entrance to the site as shown in the site plan //
- the notice should be A4 in size, positioned 1.5 m above ground level and clearly visible //
- the notice must be erected on site during a two-week period before application is made and must remain in place for five weeks after the planning authority receives the application //
- it should be stated what date the site notice was erected //
- the notice should state the name of the planning authority //
- the notice must contain the name of the townland and the postal address //
- it should state the type of permission being applied for //
- the notice must contain a brief description of the proposed development //
- the notice should give the details of where the application can be inspected //
- the applicant or agent must sign the notice //
- the sign must be replaced if it is damaged or becomes illegible //
- copies of site notice must be included with planning application // *etc.*



\*\* Accept any other appropriate answer(s).

- Newel post

- this can be made of hardwood or softwood //
- it stands vertically at the top or bottom of the staircase string //
- it can also be used on intermediate landings //
- it acts as a support for the handrail //
- the newel post is generally 75 mm × 75 mm or 100 mm × 100 mm //
- it may be square or round in section with shaping at the top //
- further decoration may include carving // *etc.*

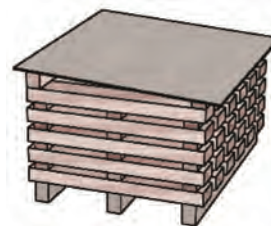


\*\* Accept any other appropriate answer(s).

## Question 8 (cont'd.)

- Natural seasoning

- this is a traditional method used to reduce the moisture content of wood //
- the planks of wood are laid parallel to each other with a space between them //
- the planks are separated by sticker pieces usually 25 mm × 15 mm in section //
- the planks are stacked in an open shed and dried by the prevailing weather conditions //
- the stack of wood should rest on a clean, dry and level base //
- the ends of the planks are painted to prevent splitting //
- the stack may rest on brick piers or on a concrete base //
- wood of the same species should be seasoned in the same stack //
- this method will reduce moisture content to 18% – 22%, reaching equilibrium with the surrounding air //
- it is a relatively cheap method of seasoning timber as no electrical energy is used //
- it is a slow method of drying wood and the rate of seasoning cannot be controlled // *etc.*



\*\* Accept any other appropriate answer(s).

- Wind turbine

- a device that converts the energy of the wind into mechanical energy //
- the mechanical energy is then used to generate electricity //
- wind turbines may be used for small-scale applications or for large-scale production of commercial electricity //
- small wind turbines are used as auxiliary power on boats / in caravans and for charging batteries //
- wind turbines are situated to exploit the wind energy at a location //
- wind is a clean and renewable source of energy //
- wind turbines are made up of three main parts: blades, generator and structural support tower // *etc.*



\*\* Accept any other appropriate answer(s).

## Question 9

(50)

9. The sketch shows a wooden garden seat suitable for use in a family garden.



(16)

- (a) Show, using notes and freehand sketches, a suitable joint for attaching the arm rest to the back leg of the garden seat.

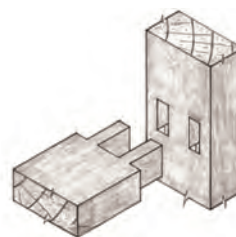
Notes: (8m)

Sketch(es): (8m)

\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

Possible answers

- the mortise and tenon joint is most suitable //
- a double tenon would strengthen the joint //
- there is a large glue contact area //
- the joint is suitable for outside use //
- joint can be wedged for further strength //
- waterproof glue is to be used, giving good adhesion // etc.



\*\* Accept any other suitable joint.

- (b) Specify a suitable wood for the seat and give **two** reasons for your choice of wood.

(14)

Wood: (4m)

Possible Answers

- oak //
- ash //
- teak // etc.

Two reasons: (2 × 5m)

Possible Answers

- solid and durable, suggesting strength and security //
- naturally hard-wearing //
- natural, sustainable material //
- attractive appearance //
- resistant to decay //
- takes applied finish well // etc.

## Question 9 (cont'd.)

- (c) Recommend a suitable applied finish for the garden seat and give **one** reason for your answer. Using notes and freehand sketches, describe the steps involved in preparing the wood and in applying the recommended applied finish. (20)

Suitable Finish: (2m)

Possible answers

- paint //
- varnish //
- stain //
- Danish oil // etc.

\*\* Accept any other suitable waterproof finish.



Reason: (2m)

Possible answers

- prolongs the life of the timber / protects the wood //
- improves the appearance of the wood //
- water-based finishes are more environmentally friendly //
- finishes are available in a range of colours //
- ease of application // etc.

\*\* Accept any other appropriate reasons.

Notes: (8m)

Sketch(es): (8m)

\*\* Award 8 marks for excellent sketch, 6 marks for good sketch, 4 marks for fair sketch.

① Preparing the wood

Possible answers

- the surface is cleaned thoroughly //
- the surface is sanded using medium to fine glasspaper //
- the surface is then cleaned using white spirits //
- a further light sanding is carried out before applying the chosen finish //
- a brush is used to apply most finishes //
- Danish oil may be applied using a clean cloth // etc.



\*\* Accept any other appropriate answer(s).

② Applying a finish

● Applying a paint finish

- the surface is prepared as described //
- a primer coat is applied //
- the surface is sanded //
- the undercoat is applied //
- the surface is sanded and two coats of gloss paint are applied //
- the paint is applied using a good-quality brush // etc.

● Applying a varnish finish

- the surface is prepared as described //
- the first coat of varnish is applied //
- the surface is lightly sanded to provide a key //
- a second coat of varnish is then applied //
- the varnish is applied using a good-quality brush // etc.

**Question 9 (cont'd.)**

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(c) (cont'd.)

- Applying a stain finish
  - the surface is prepared as described //
  - the surface is cleaned / sanded //
  - a thin even coat of wood stain is applied with a cloth or medium-sized paint brush //
  - allow the stain to penetrate the wood //
  - apply additional coats to create a darker colour //
  - lightly sand between coats with fine sand-paper //
  - wipe off excess stain with a clean cloth // *etc.*
  
- Applying a Danish oil finish
  - the surface is prepared as described //
  - the surface is cleaned / sanded //
  - the first coat of Danish oil is applied //
  - once absorbed, wipe any excess oil away with a cloth //
  - a second coat of Danish oil is applied and further coats as required until the finish is rich and hard //
  - after the coats have dried, any raised grains can be removed with a fine grade sandpaper //
  - the Danish oil is best applied using a lint-free cloth // *etc.*
  
- \*\* Accept any other appropriate answer(s).

**Notes:**

## Construction Studies

### Higher Level Marking Scheme (300 marks)

Answer Question 1 and **four** other questions.  
All Questions carry equal marks.

#### Question 1

(60)

1. The main entrance to a dwelling is designed to allow access for everyone. The door shown is a high performance insulated wooden door with vertical sheeting on both sides. The door frame is 150 mm × 70 mm in cross-section and is fixed in the external wall. The external wall consists of a 100 mm concrete block outer leaf, a 200 mm timber frame inner leaf and a 60 mm insulated service cavity. The ground floor is an insulated solid concrete floor with a 20 mm quarry tile finish.



- (a) To a scale of 1:10, draw a vertical section through the centre of the door. Show the typical construction details from 500 mm below the finished floor, through the floor, the threshold, the external wall, the door and door frame to a level 300 mm above the concrete lintels over the door frame. Include **four** typical dimensions.
- (b) On your drawing show clearly the design detailing that ensures ease of access for all persons.

(60)

Features: (11 × 4m)

\*\* Expect 8 features from the external wall (8 × 4m).

\*\* Expect 3 features from the door, door frame and threshold (3 × 4m).

Typical dimensions: (4 × 1m)

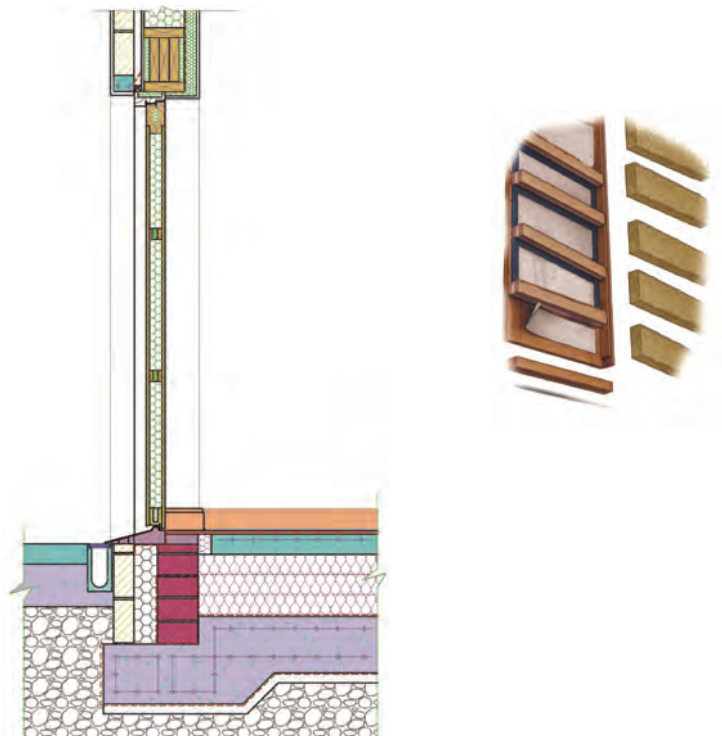
Scale: (4m)

Draughtsmanship: (4m)

Design detailing for ease of access: (4m)

## Question 1 (cont'd.)

- (a) (cont'd.)  
 (b) (cont'd.)

Possible AnswersWall

- head plate and top rail - 200 mm × 50 mm //
- vertical stud framework - 200 mm × 50 mm @ 400 mm centres //
- horizontal bridging - 200 mm × 50 mm //
- insulated service cavity - 60 mm //
- vapour barrier to ceiling and wall - joints sealed and taped //
- vapour barriers at junction of wall and ceiling taped for airtightness //
- 12.5 mm plasterboard - best practice - 2 × 12.5 mm gypsum plasterboard //
- skim finish to ceilings and walls //
- scrim / tape at wall and ceiling junction to ensure airtightness //
- insulation to timber frame - 200 mm //
- racking board - 12 – 20 mm OSB or plywood with taped joints //
- breather membrane with taped joints //
- vapour diffusion clear cavity - 50 – 75 mm //
- stainless steel wall ties //
- fireproof cavity closer //
- 100 mm concrete block outer leaf //
- 15 mm render - 2 coats // etc.

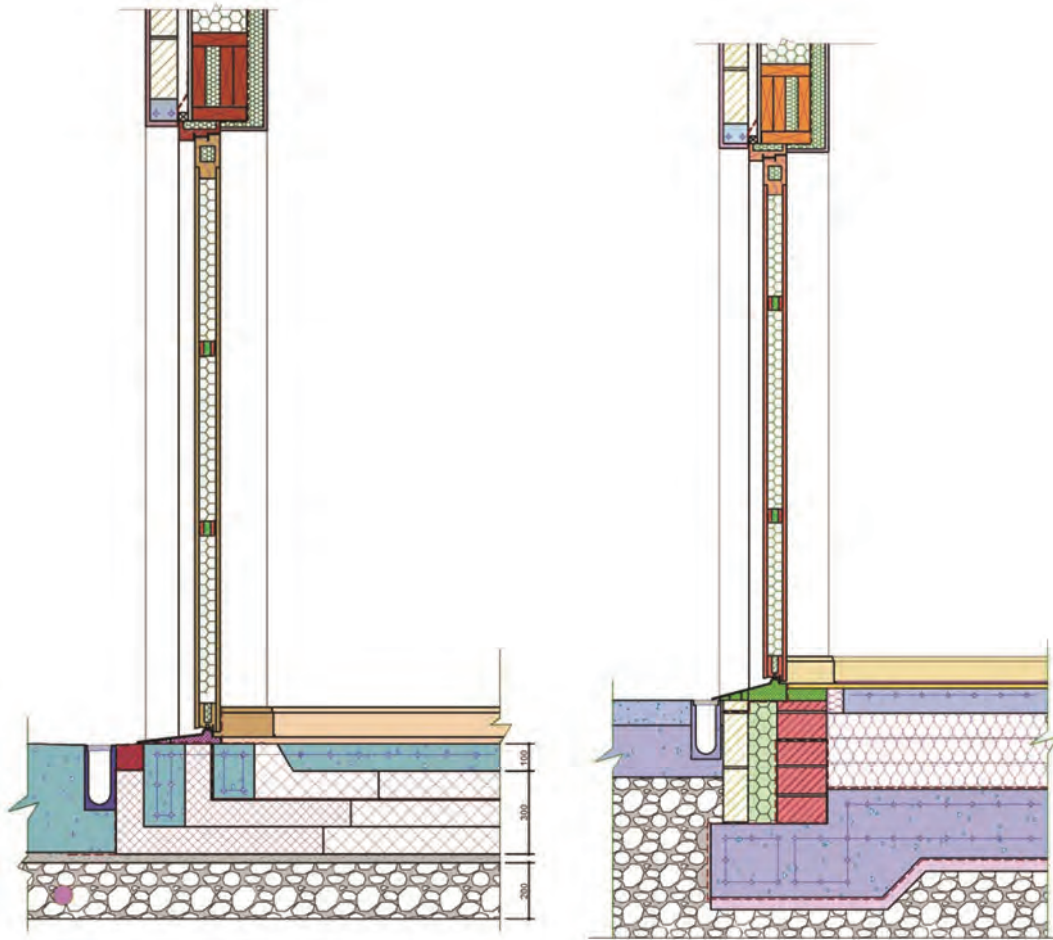
Door, door frame and threshold

- 150 mm × 70 mm door frame //
- thermally broken door //
- proprietary threshold max. height 15 mm / max. slope 10° //
- proprietary drainage channel //
- 1200 mm × 1200 mm level area outside door // etc.

\*\* Accept any other appropriate answer(s).

**Question 1 (cont'd.)**

(b) (cont'd.)

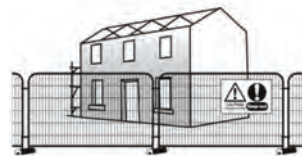
Design detailing for ease of access

## Question 2

(60)

2. (a) Discuss in detail the importance of **each** of the following in ensuring the safety of all workers on a construction site:

- safety statement
- teamwork.



(16)

Two safety requirements: (2 × 8m)

For each:

Point: (2m)

Discussion: (6m)

### Possible Answers

#### ① Safety statement

- a safety statement is a plan, in writing //
- it identifies the hazards and assesses the risks //
- it identifies the controls to be put in place, the persons responsible and the resources necessary to secure the safety of persons at work //
- health and safety is important because it protects the wellbeing of employers and employees //
- visitors are also covered by the Health and Safety Acts //
- workplaces which neglect health and safety risk prosecution, may lose staff, and may increase costs and reduce profitability //
- appropriate information, instruction, training and supervision are provided //
- where hazards cannot be eliminated, adequate arrangements, including the provision of suitable protective clothing and equipment, will be put in place to reduce the risk of injury //
- emergency plans are prepared and revised //
- welfare facilities are provided and adequately maintained //
- competent personnel to advise and assist in securing the safety, health and welfare of employees are employed when required // *etc.*

\*\* Accept any other appropriate answer(s).

#### ② Teamwork

- peer-to-peer training; inexperienced workers paired with experienced and properly trained personnel //
- trust between management and employees - good communication //
- development of a shared responsibility for health and safety in the workplace //
- develop a climate of openness and trust; workers encouraged to make suggestions //
- each worker is part of a team and given work suitable to their skills //
- foster a positive atmosphere towards health and safety in the workplace - buddy system - *esprit de corps* // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 2 (cont'd.)

- (b) Discuss in detail, using notes and freehand sketches, **two** specific safety procedures that should be observed when carrying out the following:

- laying pipes in a deep trench
- fitting a window lintel in the second storey of a dwelling house.

(32)

Two safety procedures: (4 × 8m)

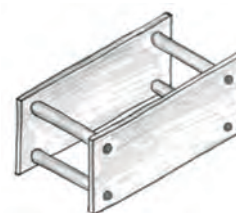
For each:

Notes: (4m)

Sketches: (4m)

Possible Answers**①** laying pipes in a deep trench

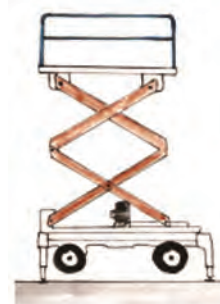
- use a trench box to protect workers //
- sloping back (battering back) the sides of the trench reduces the risk of the trench collapsing //
- create an exclusion zone around open trench with railings and warning signs to prevent workers, machinery or pedestrians from falling in - temporary covering for safety // etc.



\*\* Accept any other appropriate answer(s).

**②** fitting a window lintel in the second storey of a dwelling house.

- ensure a safe work platform such as scaffolding //
- max. 25 kg lifting load per person //
- use correct lifting procedure to minimise back injury //
- have enough personnel to lift the lintel safely into place //
- use a lifting system such as a cherry picker / teleporter to transport the lintel to the second storey //
- ensure the correct platform height to reduce the risk of injury from above-shoulder lifting // etc.



\*\* Accept any other appropriate answer(s).

- (c) Recommend **three** best practice guidelines that should be observed when using electrical tools on a construction site.

(12)

Three recommended guidelines: (3 × 4m)

Possible Answers

- all tools should be regularly serviced and properly earthed //
- all power tools on site must use a 110 volt supply //
- double insulated for external use //
- using a 110 volt supply greatly reduces the risk of electrocution //
- cabling should be correctly sized and free from damage //
- ensure cabling does not constitute a trip hazard //
- wear correct PPE equipment - insulated footwear and gloves //
- use waterproof cabling suitable for outdoor use and ensure all connections are sealed //
- personal safety equipment such as earmuffs and safety glasses must be used //
- keep electrical equipment covered and dry in between uses //
- don't use electrical tools outside when wet //
- ensure all damaged electrical equipment is removed from service and sent for repair // etc.

\*\* Accept any other appropriate answer(s).

## Question 3

(60)

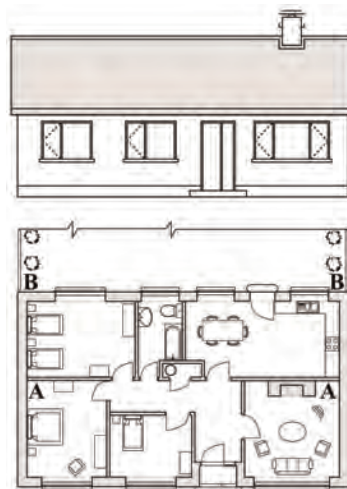
3. The drawing shows the plan and front elevation of a bungalow built in the 1970s. The house is of traditional construction with a slated cut roof and a 300 mm external cavity wall of concrete block construction. The internal walls are of 100 mm solid block construction and the internal wall **A-A** is a load bearing wall. The rear wall of the house **B-B** is south facing. The owners intend to build an extension to the kitchen at the rear of the house. Consideration at the design stage is to be given to:

- optimising daylight potential into **both** the extension and the existing kitchen
- redesigning the layout of the interior to maximise solar gain.

- (a) Using notes and freehand sketches, show a proposed design layout that incorporates **each** of the above requirements.

Notes: (10m)

Sketches: (10m)



(20)

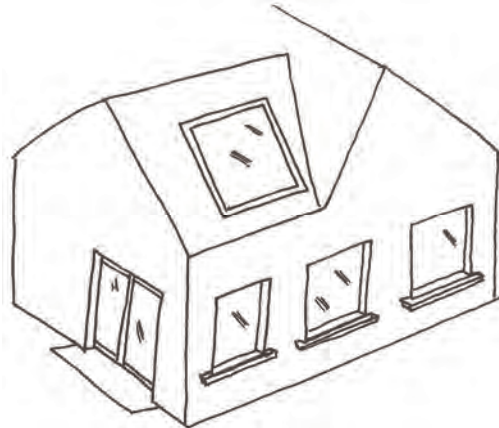
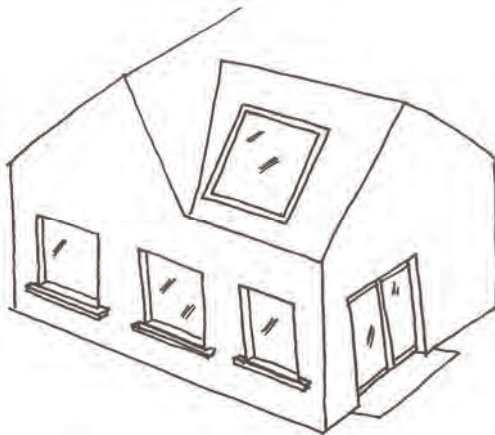
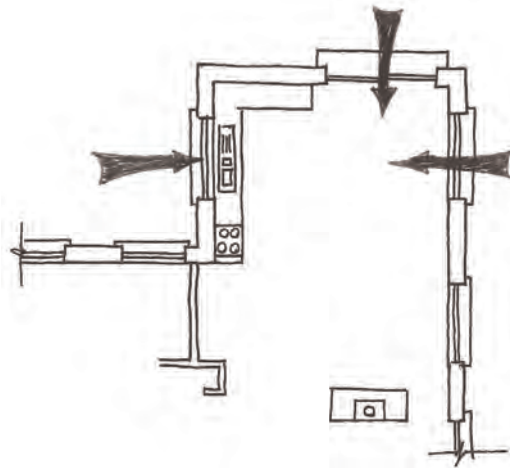
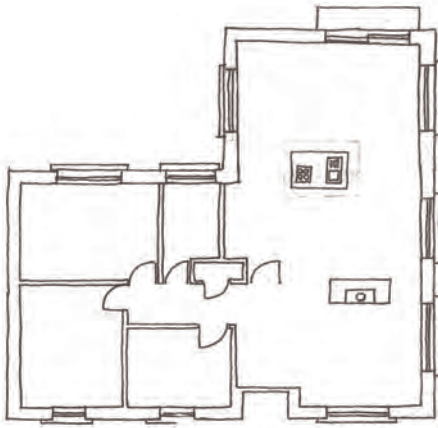
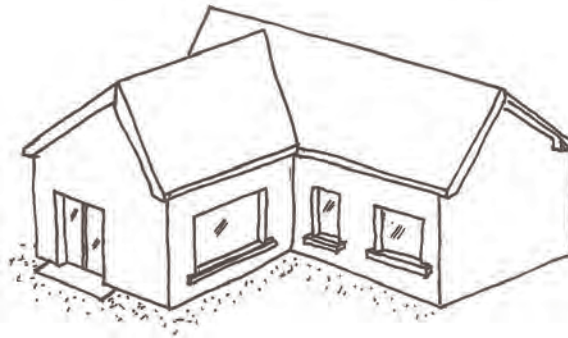
Possible Answers

- B-B rear is south facing - glazed area of extension to the south for sunlight and daylight //
- roof light windows on extension to allow natural light to both extension and kitchen //
- rear window removed and opening formed to allow open-plan layout //
- opening to be widened for open-plan design - lintels over opening //
- glazing increased at southern, eastern and western elevations //
- floor to ceiling glazing and roof lights to increase natural light //
- install high-performance windows - low-e, triple glazing //
- remove a portion of the rear wall of the house to allow sunlight and solar gain deep into the original kitchen / dining area - must be completed in accordance with structural engineer's specification //
- allows a visual connection between the old and new areas, giving a greater sense of space //
- sliding, folding or swing doors to garden to bring outside in and to link garden / nature to extension for wellbeing of occupants //
- kitchen / dining area is maintained with a seating / family area in the extension - this allows a connection between family members while activities such as cooking / playing / homework / watching TV are taking place //
- maintaining existing kitchen / dining area also reduces expense //
- extensions such as described can reduce the levels of natural light and solar gain to the existing kitchen / dining room. Including roof lights, offsetting extension or increasing roof pitch with roof lights as indicated are examples of how levels of natural light and solar gain can be maintained // *etc.*

\*\* Accept any other appropriate answer(s).

**Question 3 (cont'd.)**

(a) (cont'd.)



## Question 3 (cont'd.)

- (b) Discuss, using notes and freehand sketches, **three** advantages of natural light in a kitchen area. (30)

Three advantages: (3 × 10m)

For each:

Notes: (5m)

Sketches: (5m)

Possible Answers

- countertops are the primary task areas in kitchens - careful design to provide natural light allows even lighting while avoiding excessive glare //
- careful placement of windows to increase natural light reduces dependence on artificial lighting //
- natural light aids positive mental attitude and a general sense of wellbeing //
- natural light and sunlight enhance occupant comfort, creating a calm environment //
- natural light connects occupants with the outdoors //
- natural light enhances clarity and colour definition - photopic vision // etc.

\*\* Accept any other appropriate answer(s).



- (c) The proposed extension will reach further into the garden area of the dwelling. Discuss **two** advantages of linking a space with the rear garden. (10)

Two advantages: (2 × 5m)

Possible Answers

- increased sense of wellbeing from closer contact with nature //
- satisfaction of increased awareness of the changing seasons on a daily basis //
- engaging the senses - sound, touch, sight - full enjoyment from location //
- formative educational benefits for children //
- health benefits of ongoing exposure to natural light //
- increases use made of the valuable space outside //
- provides a greater sense of spaciousness with little extra investment // etc.

\*\* Accept any other appropriate answer(s).

## Question 4

(60)

4. (a) Discuss, using notes and freehand sketches, **three** functional requirements of a roof suitable for a new dwelling house. (24)

Three functional requirements: (3 × 8m)

For each:

Notes: (4m)

Sketches: (4m)



Possible Answers

- weather resistant: should be able to protect the building from the elements – rain, snow, wind and sun //
- structural stability: must be capable of supporting all imposed loads - both dead and live loads - and designed to resist lateral movement //
- durability: the structure should be long-lasting and require little maintenance. Joists pressure-treated with boron preservative to ensure longevity //
- thermal insulation: should provide a level of thermal comfort for its occupants, keep heat in during the winter and resist excessive heat gain during the summer //
- ventilation: the roof must be adequately ventilated in order to prevent condensation build-up and possible fungal attack //
- fire resistant: the roof should resist fire to allow time for occupants to escape //
- sound insulation: the structure should resist the infiltration of noise from outside //
- accommodate services such as a water tank, attic storage // etc.

\*\* Accept any other appropriate answer(s).

- (b) Using notes and freehand sketches, show **two** different types of pitched roof structure suitable for a dwelling house with an internal span of 7.0 metres and one internal supporting wall. Show the design detailing required to ensure the stability of the roof and include the typical dimensions of **three** roof members for **each** roof type selected. (24)

Any 2: (2 × 12m)

For each:

Name: (3m)

Notes: (3m)

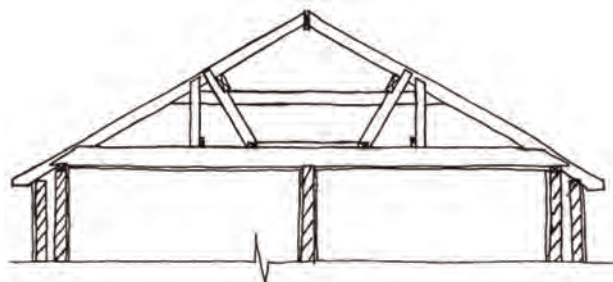
Sketches: (3m)

3 typical dimensions: (3m)

Possible Answers

① Traditional cut / purlin roof

- rafter - 200 mm × 50 mm //
- ceiling joist - 225 mm × 50 mm //
- strut - 125 mm × 50 mm //
- runner - 125 mm × 50 mm //
- hanger - 125 mm × 50 mm //
- purlin - 175 mm × 75 mm //
- wallplate - 100 mm × 75 mm

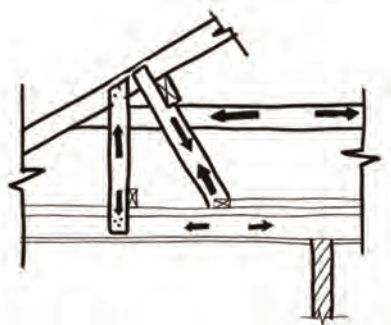


Structural stability

- the purlin supports the rafter //
- the strut supports the purlin //
- the load-bearing wall supports the ceiling joist and strut // etc.

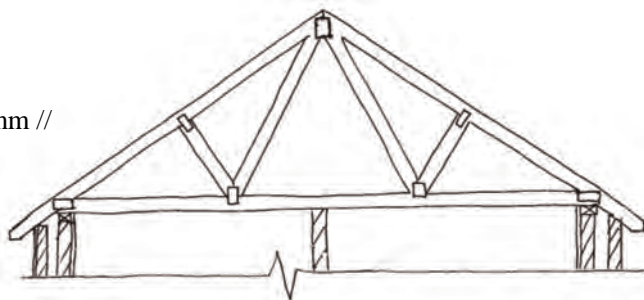
## Question 4 (cont'd.)

(b) (cont'd.)

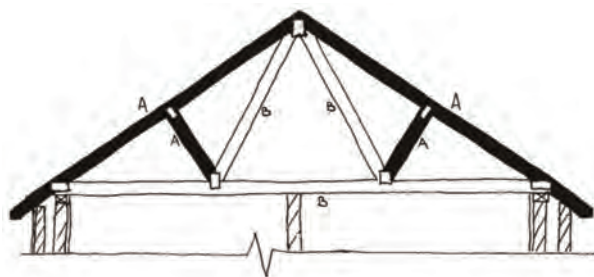


## ② Prefabricated roof (W truss)

- rafter - 170 mm × 45 mm //
- ceiling tie - 220 mm × 45 mm //
- compression webs - 120 mm × 45 mm //
- tension webs - 120 mm × 45 mm //
- bracing - 100 mm × 25 mm //
- wallplate - 100 mm × 75 mm //
- gang nail plate

Structural stability

- principle of triangulation //
- webs under compression and tension ensure a rigid structure // etc.



(c) Recommend a preferred roof structure for a new dwelling house and give **two** reasons for your choice.

(12)

Recommendation: (4m)

Two reasons: (2 × 4m)

● Purlin / cut roof

- can be designed for conversion of the attic space to living accommodation later //
- does not require the use of mechanical assistance during construction //
- less chance of an error as it is marked out on site //
- easy to convert the attic space for storage //
- local labour employed in cutting and erection //
- does not require specialist equipment / mechanical presses to manufacture // etc.

\*\* Accept any other appropriate answer(s).

**Question 4 (cont'd.)**

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(c) (cont'd.)

- Prefabricated trussed roof
  - fast and easy to erect //
  - less time on site - almost independent of weather //
  - economical use of material (section size is small) - environmentally sustainable //
  - structural integrity guaranteed for span - forces calculated //
  - stress-graded, pre-seasoned wood used //
  - accurate, uniform factory-made trusses //
  - ideal for open-plan layouts //
  - no load-bearing internal wall required // *etc.*
- \*\* Accept any other appropriate answer(s).

## Question 5

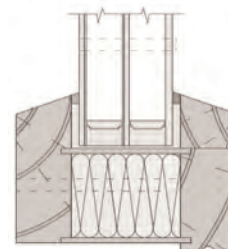
(60)

5. A section through a triple-glazed, high performance wooden window is shown. The frame is a thermally broken, insulated frame as shown. Two of the panes of glass have a low-emissivity (low-e) coating and the spaces between the panes are filled with argon gas.

(a) Calculate the U-value of **each** of the following, given the following data:

- the thermally broken frame
- the triple-glazed argon-filled glazing unit.

Glass	thickness	4 mm
Space between panes of glass	each space	20 mm
Wood in thermally broken frame	each piece	35 mm
Rigid insulation	thickness	50 mm



**Thermal data of thermally broken frame:**

Resistance of external surface of frame	(R)	0.950 m <sup>2</sup>	°C/W
Conductivity of wood	(k)	0.150 W/m	°C
Conductivity of rigid insulation	(k)	0.021 W/m	°C
Resistance of internal surface of frame	(R)	1.400 m <sup>2</sup>	°C/W

**Thermal data of triple-glazed unit:**

Resistance of external surface of glass	(R)	0.075 m <sup>2</sup>	°C/W
Conductivity of glass	(k)	1.050 W/m	°C
Conductivity of argon gas	(k)	0.160 W/m	°C
Resistance of internal surface of glass	(R)	0.110 m <sup>2</sup>	°C/W
Total resistance of the low-e panes of glass	(R)	3.400 m <sup>2</sup>	°C/W

(30)

Correct tabulation: (2m)

- The thermally broken frame

Material Element	Conductivity k	Resistivity r	Thickness t	Resistance R
External surface (1m)				0.950
Wood (3m)	0.150	6.667	0.07	0.467
Insulation (3m)	0.021	47.62	0.05	2.381
Internal surface (1m)				1.400
Answer (2m)				5.198 R <sup>t</sup>
– Formula U	=	1/R <sup>t</sup> //		
– U-value	=	1/5.198 //		
	=	0.1924 W/m <sup>2</sup> /K (3m)		

\*\* For U-value, if correct formula is given with incorrect answer, award 1 mark.

## Question 5 (cont'd.)

(a) (cont'd.)

- The triple-glazed argon-filled glazing unit

Material Element	Conductivity k	Resistivity r	Thickness t	Resistance R
External surface (1m)				0.0750
Glazing unit (3m)	1.050	0.9523	0.004	0.0038
Argon gas (3m)	0.160	6.25	0.040	0.25
Low-e glass (2m)				3.400
Internal surface (1m)				0.110
Answer (2m)				3.8388 R <sup>t</sup>
– Formula U	=	1/R <sup>t</sup> //		
– U-value	=	1/3.8388 //		
	=	0.260498 W/m <sup>2</sup> /K (3m)		

\*\* For U-value, if correct formula is given with incorrect answer, award 1 mark.

(b) Using the U-value of the triple-glazed argon-filled glazing unit obtained at 5(a) above and the following data, calculate the heat lost annually through the glazed unit:

Area of glazing	90 m <sup>2</sup>	
Average internal temperature	17 °C	
Average external temperature	6 °C	
U-value of glazing unit	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	1 kJ per second.	(15)

\*\* For each calculation below, if correct formula is given with incorrect answer, award 1 mark.

Heat loss formula: (3m)

$$= \text{U-value} \times \text{area} \times \text{temp. diff}$$

$$= 0.260498 \times 90 \times 11 = 257.89 \text{ Watts (joules / sec)}$$

Heating period p/a: (3m)

$$= 60 \times 60 \times 8 \times 7 \times 38$$

$$= 7,660,800 \text{ seconds (2,128 hours)}$$

Kilo joules p/a: (3m)

$$= \frac{7,660,800 \times 257.89}{1000}$$

$$= 1,975,643.712 \text{ kJ}$$

Litres p/a: (3m)

$$= (\text{Note: Calorific value of 1 litre oil} = 37,350 \text{ kJ})$$

$$= 1,975,643.712 / 37,350 \text{ kJ}$$

$$= 52.895 \text{ litres}$$

Cost of loss p/a: (3m)

$$= (\text{Note: 1 litre of oil costs 94 cent})$$

$$= 52.89 \times 0.94$$

$$= €49.72$$

**Question 5 (cont'd.)**

- (c) Using notes and freehand sketches, show best practice design detailing to prevent the ingress of water at the window head. (15)

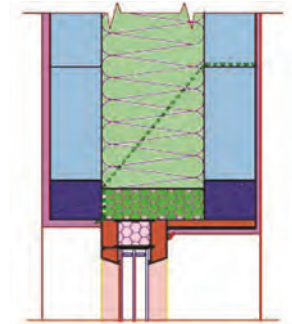
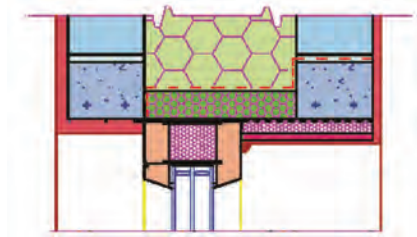
Notes: (8m)

Sketches: (7m)

Possible Answers

- stepped DPC across the cavity. This will direct any water that enters the cavity safely to the outside //
- mastic strip along joint between window and wall //
- patent reveal may be used to protect against driving rain // *etc.*

\*\* Accept any other appropriate answer(s).



## Question 6

(60)

6. The drawing shows a dwelling house, which has three bedrooms and a bathroom upstairs. The house is of timber frame construction with an external rainscreen of native larch. The house is designed to be eco-friendly.

- (a) Using notes and freehand sketches, discuss in detail **three** features of the given design that contribute to making the house eco-friendly.

Any 3: (3 × 10m)

Notes (5m), Sketches (5m)

Possible Answers

① Glazing / Orientation

- low-e triple glazing //
- large areas of high-performance windows on southern elevation allow for maximum solar gain //
- fewer and smaller windows on the northern elevation reduce heat loss //
- west-facing window allows evening sunlight to the living area - less heating required as solar gain is maximised //
- solar efficient - long elevation on an east-west axis //
- designed to maximise solar gain and thermal comfort //
- high thermal-performance units, *e.g.* frames with thermal breaks and triple-glazed, argon gas-filled, low-e soft-coated glazing //
- the area and orientation of the fenestration supports the use of passive solar gain to complement space heating //
- high thermal mass materials on floor to retain heat and release slowly //
- passive heating reduces costs and the demand for scarce and expensive fossil fuels // *etc.*

\*\* Accept any other appropriate answer(s).

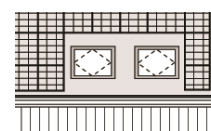
② Roof lights

- provide about three times more daylight over a longer period than dormers //
- reduced need for artificial light //
- reduced demand for fossil fuels and reduced lighting costs //
- no shading, unobstructed light for longer // *etc.*

\*\* Accept any other appropriate answer(s).



(30)

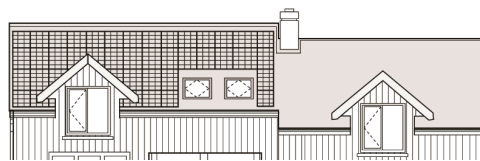


## Question 6 (cont'd.)

(a) (cont'd.)

③ Steep-pitched roof

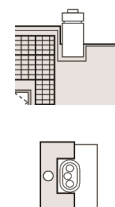
- allows for three bedrooms and bathroom, which is economical in terms of space and materials required //
- one compact foundation - two floors and roof space //
- reduced costs and energy requirements - small footprint with attic space used //
- enables maximum use of attic as a habitable space //
- less materials as form is compact - lower embodied energy, lower CO<sub>2</sub> //
- solar panels fitted at optimum angle of 45° - roof used to collect solar energy // *etc.*



\*\* Accept any other appropriate answer(s).

④ Chimney / fireplace

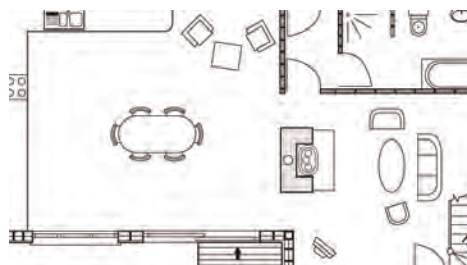
- chimney stack on internal wall radiates stored heat to adjoining spaces //
- positioning of solid-fuel heater and flue on an internal wall optimises the conservation of heat within the house //
- wood-burning stoves are carbon neutral //
- stoves are up to 70% efficient - open fires are at best 30% efficient //
- can heat radiators throughout house //
- wood-burning stove to maximise efficiency // *etc.*



\*\* Accept any other appropriate answer(s).

⑤ Open-plan design / flexibility of design / compact

- reduces materials in construction //
- allows direct sunlight into entire building //
- frequently used rooms on southern elevation //
- doors can be fitted to reduce open plan making it easier to heat //
- small internal spans allow for ease of redesign and lower costs - standard materials //
- largely open-plan living, kitchen and dining areas to facilitate ease of movement for persons of all ages and degrees of reduced mobility - temporary or permanent //
- entire ground floor at one level - no ground floor steps - allowing for ease of movement - more versatility with fewer obstacles //
- the compactness of the design reduces the volume of the air for space heating // *etc.*



\*\* Accept any other appropriate answer(s).

## Question 6 (cont'd.)

(a) (cont'd.)

⑥ Timber frame

- the high level of insulation provided by the timber frame construction reduces energy use for space heating, thus reducing the use of fossil fuels //
- timber reduces use of concrete - concrete has a high embodied energy - reduces CO<sub>2</sub> / damage to the environment //
- much less energy is required to process materials like wood as compared to cement, which requires large amounts of energy to manufacture //
- using materials that are renewable, that grow and replenish, that are capable of being harvested between 25 and 40 years from managed forests - ensures that there will be an ample supply of building materials for future generations //
- renewable materials have a smaller impact on the environment //
- locally grown timber has less embodied energy costs and reduced transport costs //
- some timbers are more naturally durable, *e.g.* European larch, Douglas fir, cedar do not require treatment with chemical preservatives //
- less fossil fuels used during production of renewable materials // *etc.*

\*\* Accept any other appropriate answer(s).

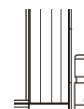
⑦ Limited use of concrete

- concrete made from Portland cement has a high embodied energy //
- Portland cement produces 900 kg of CO<sub>2</sub> emissions for 1000 kg of cement //
- Ground Granulated Blast furnace Slag / Cement (GGBS) is manufactured from a waste product produced by the steel industry - recycling / upcycling //
- concrete made from GGBS cement has a low embodied energy //
- low-carbon concrete uses 50% normal Portland cement and 50% GGBS cement, which reduces the CO<sub>2</sub> emissions by almost 40% //
- while GGBS is imported into Ireland, the embodied energy value is still considerably low compared to that required to extract raw material from the landscape and its subsequent manufacturing costs //
- concrete or concrete products should ideally be manufactured using low-carbon concrete //
- lack of outside concrete footpaths, walls, *etc.* - concrete significantly reduced // *etc.*

\*\* Accept any other appropriate answer(s).

⑧ Rainwater harvesting system

- reduce quantity / encourages the economical use of costly drinking water //
- rainwater butts may be used //
- for new build, an integrated rainwater harvesting system should be considered //
- rainwater is collected from front and rear roof surfaces and stored in above-ground tanks //
- above-ground storage system - reduced installation costs //
- modular storage units allow for increased storage capacity at minimum cost //
- inexpensive system to install //
- water can be used to water gardens, wash cars //
- water fitted with a filter can be used to flush toilets //
- saves on mains supply //
- minimises run-off, equalises the return of water to the environment and reduces the requirement for provision of additional drainage infrastructure //
- has potential for the replacement of treated water by grey water for certain purposes in the house, reducing the requirement for pre-treated water through the mains supply or well // *etc.*



\*\* Accept any other appropriate answer(s).

## Question 6 (cont'd.)

(a) (cont'd.)

9 Native larch rainscreen

- the use of wood and other organic materials reduces carbon emissions and acts as a carbon store over the life of the building //
- wall can be built to any specified width, allowing higher levels of thermal insulation, reduced heat loss and faster heat-up time //
- it avoids the use of chemical-based plasters on the external wall //
- it can help to reduce noise from outside //
- an increased range of wall finishes available - stains and preservatives //
- a sustainable material that can be sourced locally, so lower transportation costs //
- can be added after the build to improve performance and can easily be repaired and replaced when necessary //
- natural weathering of rainscreen will allow the building to blend into surroundings // *etc.*

\*\* Accept any other appropriate answer(s).

10 General

- the overall height of the house makes it less obtrusive in the landscape //
- the external surface area is reduced due to the two-storey form //
- many renewable materials are carbon neutral, *e.g.* hemp (it absorbs carbon from the atmosphere as it grows) // *etc.*

\*\* Accept any other appropriate answer(s).

(b) Using notes and freehand sketches, discuss the importance of **each** of the following when designing an eco-friendly house:

(20)

- scale and layout
- flexibility of the design
- choice of materials.

Discussions: (7m + 7m + 6m)

For each:

Notes: (4m + 4m + 3m)

Sketches: (3m + 3m + 3m)

Possible Answers1 Scale and layout

- the footprint of the building should be small. Minimal quantities of materials and reduced building costs //
- a building one room in depth, allows for maximum solar gain and reduced running costs //
- the living area consists of only two spaces:
  - kitchen and dining room combined - a multifunctional space
  - modest floor area to living room //
- absence of corridor space in living area - economical use of space and prevents heating of large corridor area - reduced running costs //

## Question 6 (cont'd.)

(b) (cont'd.)

- area of land (site) kept to a minimum //
- the attic area incorporates three bedrooms and a bathroom - minimising the building's footprint //
- small-scale building reduces the heating requirements and therefore running costs to a minimum - more sustainable //
- the two levels enable heating to be zoned - controlling and minimising heating requirements - reduced running costs // *etc.*

\*\* Accept any other appropriate answer(s).

**2** Flexibility of the design

- universal design principles facilitate design for people of all ages and abilities //
- small internal spans allow for ease of redesign and lower costs - standard materials //
- largely open-plan living, kitchen and dining areas to facilitate ease of movement for persons of all ages and degrees of reduced mobility - temporary or permanent //
- wooden ramp provides access to persons temporarily or permanently disabled - slope 15° //
- doors wide enough to facilitate passage of wheelchairs - 800 mm min //
- no ground floor steps, flexibility of movement for all - more versatility with fewer obstacles // *etc.*

\*\* Accept any other appropriate answer(s).

**3** Choice of materials

- locally sourced materials allow building to blend in with surroundings //
- reduced transport costs by sourcing materials locally leads to reduced CO<sub>2</sub> emissions //
- select materials with low maintenance requirements //
- naturally grown, sustainable materials reduce negative impact on the environment //
- timber from managed forests is a highly versatile material //
- can reduce the use of concrete by careful consideration of alternative materials //
- local materials worked on by local craftspeople ensures local building traditions are passed on to next generation //
- economic benefits to local community resulting from higher levels of spending by local craftspeople // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 6 (cont'd.)

- (c) Discuss in detail **two** advantages of designing nearly zero energy buildings (NZEB) in the 21st century. (10)

Any 2: (2 × 5m)

Possible Answers

- to help halt and reverse climate change induced by human activity and thus to avoid the consequences for the planet and humanity //
- NZEB should not be seen as a stand-alone solution but as one important element of a broad range of actions needed to assure sustainability into the future //
- sustainability in building cannot be brought about without co-ordinated, suitably enforced standards being developed //
- it is sensible to believe, if human activity is to be sustainable long-term, that humanity needs to return to more sustainable energy use and carbon release despite the considerable rise in world population //
- NZEB is necessary not just due to the scarcity of fossil energy resources, but due to the absolute need to leave large proportions of the surviving fossil resources in the ground to avoid the release of additional free carbon into the environment //
- the increasing scarcity of resources and the consequent rising cost of energy for heating and air conditioning is another reason for designing for NZEB //
- there is a moral imperative to provide fairness and equity in the use of resources, including energy resources worldwide, within the constraints of sustainable living //
- the additional energy resources required to provide equity in energy redistribution towards people in less-developed areas of the planet should be provided by reductions in energy use in industrialised countries //
- the raised and justified expectations of the growing world population, most especially in the developing world, is a reason for NZEB design, the alternative being a major lowering of expectations for all //
- there is a need to provide enhanced lifestyles for all, not just those in the privileged countries //
- there is an imperative to provide not just a short-term fix but a sustainable long-term solution to the prospect of run-away climate heating, to guard against the widespread impairment of civilization if not the extinction of humanity itself //
- there may be an achievable positive outcome to the problem of human-induced climate change if NZEB, together with a range of other actions, can be assured // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 7

(60)

7. The top portion of a closed-string wooden stairs leads to a first floor landing, as shown. The landing has a tongue and groove hardwood floor, on 200 mm × 50 mm joists with a plasterboard ceiling beneath. The newel post is 100 mm × 100 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 to include the landing. Show the typical construction details through the top three steps of the stairs and the landing. Include the typical handrail height to both the stairs **and** the landing. Include **three** typical dimensions.



(52)

- Handrail height to stairs (3m)
  - handrail to stairs: 60 mm × 60 mm to 120 mm × 70 mm
- Handrail height to landing (3m)
  - handrail to landing: 60 mm × 60 mm to 120 mm × 70 mm

Drawing

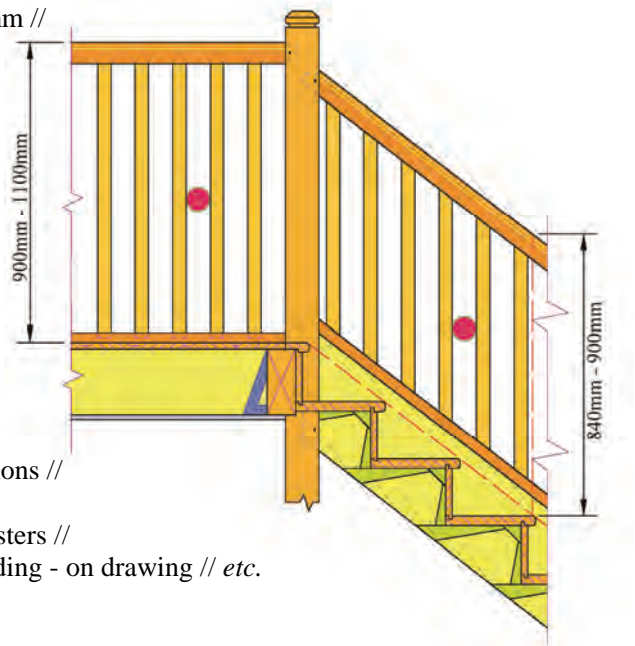
Scale and draughtsmanship: (6m)

Any 10 details: (10 × 4m)

Possible Answers

- string: 250 mm × 50 mm or similar //
- thread: 225 mm (plus nosing) - 30 mm + or similar //
- riser: 175 mm plus tongue or similar - 20 mm //
- newel post: 100 mm × 100 mm //
- nosing to thread: 30 mm or similar //
- saddle piece with groove to string - at base of balusters //
- trimmer to landing: 200 mm × 75 mm or similar //
- floor joist: 200 mm × 50 mm //
- hangers to joists - metal or alternative detail - notched //
- hardwood floor to landing: 100 mm × 20 mm or similar //
- glue blocks: 60 mm × 60 mm or similar //
- wedges to threads and risers //
- handrail and string fixed to newel using tenons //
- pitch line - less than 42° //
- sphere 100 mm Ø not to pass between balusters //
- minimum handrail heights to stairs and landing - on drawing // etc.

\*\* Accept any other appropriate material.



## Question 7 (cont'd.)

- (b) On your drawing, show **two** design features that ensure that the stairs is safe for all users.

(8)

Any 2: (2 × 4m)

Possible Answers

- going: 220 mm min. (250 mm optimum) //
- rise: 220 mm max. (175 mm optimum) //
- minimum headroom 2 m when measured from pitch line //
- should not allow a 100 mm sphere to pass through any of the openings //
- 2R+G to be between 550 mm and 700 mm //
- maximum pitch 42° //
- a landing to be provided at the top of every flight //
- handrails should be at a height of 840 mm-900 mm (when measured from the pitch line) //
- guarding on landing should be a minimum height of 900 mm //
- nosing to reduce trip hazard // *etc.*

\*\* Accept any other appropriate answer(s).

\*\* Answer should be indicated on drawing.

## Question 8

(60)

8. A wood-burning stove is to provide central heating for a new two-storey dwelling house. The stove combined with a solar collector will provide hot water for the dwelling.

- (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.



(40)

① Drawing

Any 9 details: (9 × 4m)

Possible Answers

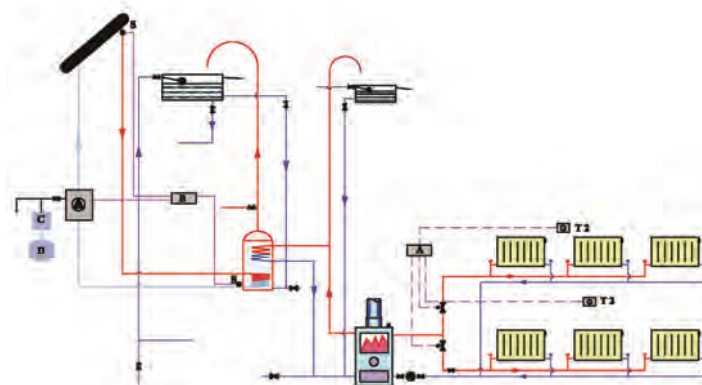
- wood-burning stove //
- flow and return to radiators //
- radiators //
- zone control valves //
- zone thermostats //
- header / expansion / storage tank //
- feeds to expansion tanks //
- cold feeds from expansion tanks //
- expansion pipes or expansion vessels //
- primary flow and return //
- pump and valves (any two of - radiator, isolating, drain-off) //
- solar panel //
- solar flow and return //
- solar pump //
- cylinder (twin-coil) //
- control panel //
- thermal-reducing vessel // *etc.*

\*\* Accept any other appropriate answer(s).

② Typical sizes (2 × 2m)

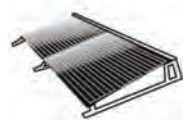
- 22 mm flow and return //
- 15 mm on up stands //
- 28 mm expansion //
- 300 litre capacity hot water twin-coil cylinder //
- 230 litre cold water storage // *etc.*

\*\* Accept any other appropriate answer(s).



## Question 8 (cont'd.)

- (b) The location of a solar collector is an important consideration to ensure its maximum efficiency. Using notes and freehand sketches, show a preferred location for a solar collector on a newly constructed dwelling.



(8)

Any 2: (2 × 4m)

Possible Answers**①** Orientation

- sun path in northern hemisphere is east to west //
- panels to be orientated facing south //
- tolerance of 15° east or west of south // *etc.*

\*\* Accept any other appropriate answer(s).

**②** Angle of inclination

- angle of incidence of the sun varies throughout the year, with the highest in the summer //
- water heating - optimum angle of inclination is approximately  $0.7 \times \text{latitude}$  (e.g. Dublin  $0.7 \times 53.35 = 37.3^\circ$  angle of solar collector) //
- space heating - optimum angle of inclination is equal to the latitude (e.g. Dublin =  $53.35^\circ$  angle of solar collector) //
- rule of thumb for Ireland - inclination of panels -  $45^\circ$  // *etc.*

\*\* Accept any other appropriate answer(s).

**③** Location

- avoid shading for optimum performance //
- general location on roof - may be located on gable walls or ground mounted //
- located close to cylinder to minimise pipe runs //
- electronic solar control panel and pump station located in an easily accessible area //
- additional weight of panels and associated pipework may require additional structural support works // *etc.*

\*\* Accept any other appropriate answer(s).

**④** Sizing

- general rule of thumb  $1.0 \text{ m} - 1.5 \text{ m}^2$  of panel per person //
- evacuated tube collectors efficient for Irish climate //
- avoid oversizing panels as it can lead to stagnation of solar fluid // *etc.*

\*\* Accept any other appropriate answer(s).

**Question 8 (cont'd.)**

---

- (c) Using notes and sketches, discuss **two** considerations that should be taken into account at the design stage of the house when selecting the location for the stove which would be used to provide central heating and hot water for the house. (12)

Any 2: (2 × 6m)

Possible Answers

- centrally located to ensure maximum heat output within the home //
- forms focal point in the dwelling //
- a stove can radiate heat in all directions due to its sealed nature //
- high thermal mass of chimney breast will allow heat to be stored and released when needed //
- locate the stove and the hotpress as close to each other as possible to minimise pipework between them // *etc.*

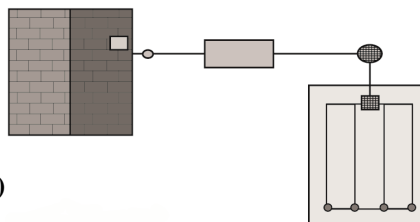
\*\* Accept any other appropriate answer(s).

## Question 9

(60)

9. The drawing shows a layout for an on-site wastewater treatment system for a new single dwelling house.

- (a) Describe in detail, using notes and freehand sketches, the operating principles of a conventional septic tank system.



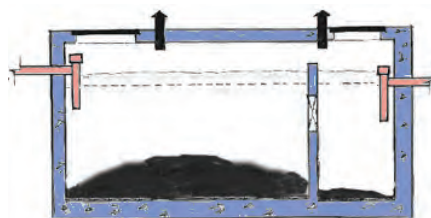
(28)

Discussion of operating principles: (2 × 14m)

\*\* Notes (7m), Sketches (7m).

Possible answers

- septic tank is a primary settlement tank providing a limited amount of anaerobic digestion //
- it must be prefabricated and not in-situ constructed //
- the septic tank is located 7.0 m minimum from house and 10.0 m from percolation area //
- the size is dependent on house occupancy - designed for minimum of four persons //
- the tank must provide adequate retention time for settlement of suspended solids and adequate volume for sludge storage //
- the tank incorporates two chambers, which are separated by means of a dividing wall that has openings located about midway between the floor and roof tank //
- the wastewater enters the first chamber of the tank, where the solids settle and the scum floats. The settled solids are broken down by anaerobic bacteria, reducing the volume of solids //
- the liquid component flows through the dividing wall into the second chamber, where further settlement takes place, with the excess liquid then draining in a relatively clear condition from the outlet into a percolation area //
- the wastewater is carried through a series of perforated percolation pipes which are laid in gravel //
- on passing through the gravel, aerobic bacteria further break down the remaining impurities and the liquid then percolates the soil //
- wastewater must be free from all contaminants before entering groundwater //
- septic tanks must be covered with a watertight cover and ventilated to prevent a build-up of methane // etc.



\*\* Accept any other appropriate answer(s).

## Question 9 (cont'd.)

- (b) Show, using notes and freehand sketches, the typical design detailing for the percolation area to ensure the safe treatment of waste from the septic tank. Include dimensions as appropriate. (20)

Any 4: (4 × 4m)

For each:

Notes: (2m)

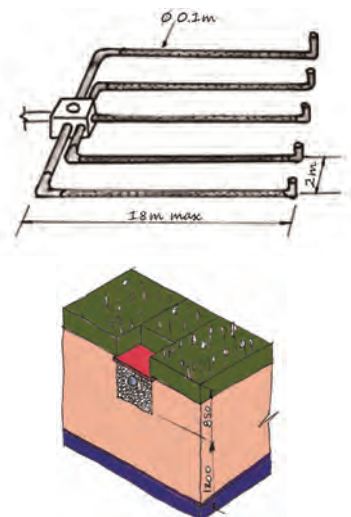
Sketches: (2m)

Dimensions: (2 × 2m)

Possible answers

- topsoil covering with geotextile layer beneath //
- distribution box to distribute flow evenly to min. 4 percolation pipes //
- 100 - 110 mm perforated percolation pipe - 8 mm holes at 4, 6 and 8 o'clock and 75 mm centres //
- pipe runs not to exceed 18.0 m //
- gravel surround to each percolation pipe with 2.0 m spacing between pipes //
- vents to allow for the safe discharge of gases //
- the effluent filters initially through the gravel and then percolates into the subsoil, where it undergoes further biological and chemical interactions that treat the contaminants // *etc.*

\*\* Accept any other appropriate answer(s).



- (c) Discuss in detail **three** reasons why a proposed site for a dwelling house may be unsuitable for a conventional septic tank wastewater treatment system. (12)

Any 3 reasons: (3 × 4m)

Possible answers

- site not large enough to accommodate the septic tank and percolation area //
- unsuitable or shallow subsoil, gravels and clays may percolate wastewater too quickly or too slowly //
- located close to a stream, river, lake, well, wetland, beach, boundary, house or other percolation area //
- site too steep //
- inaccessible for emptying tank
- water table too high - 2.0 m below original ground surface // *etc.*

\*\* Accept any other appropriate answer(s).

## Question 10

(60)

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

- wall design
- windows and glazing
- space heating demand.



(32)

Any 2: (2 × 16m)

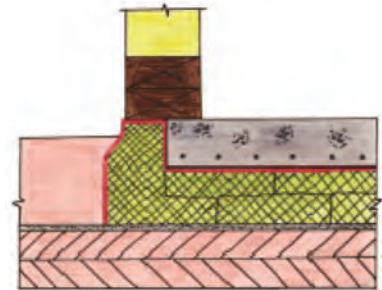
For each:

Notes: (8m)

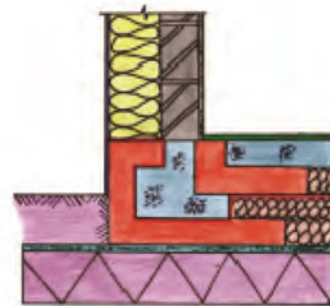
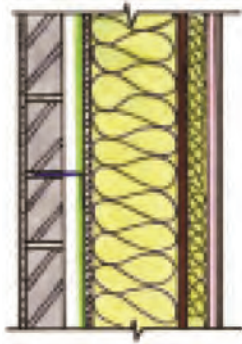
Sketches: (8m)

Possible Answers

- Wall design
  - highly insulated external walls //
  - thermal bridges eliminated //
  - timber frame or concrete may be used //
  - all openings to be made airtight //
  - continuity of insulation //
  - block inner leaf with internal plaster finish will improve thermal mass of the building //
  - in the case of timber frame Passive Houses, consideration must be given to alternative methods of maximising heat storage such as Trombe wall, high-mass floor screeds, internal block walls // etc.



\*\* Accept any other appropriate answer(s).

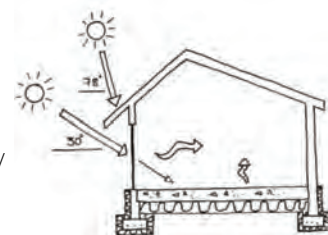
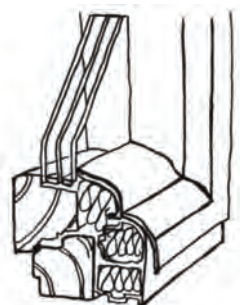


## Question 10 (cont'd.)

(a) (cont'd.)

- Windows and glazing

- increase glazing on southern and western elevations of dwelling //
- ensure junctions between windows and walls are airtight //
- shutters / heavy curtains to retain heat at night //
- tinted glass to reduce glare //
- the U-value of Passive House windows lower than  $0.8 \text{ W/m}^2/\text{K}$  with triple glazing //
- design for reduced north-facing glazing //
- the use of larger areas of glazing on the southern elevation to maximise the amount of sunlight available, especially in the short days of winter //
- high solar energy transmittance of glass ( $g \geq 50$ ), which allows solar radiation to penetrate the glass and contribute towards heating of the dwelling //
- a low-emissivity (low-e) soft coating on panes, which reduces solar radiation back out through the glass //
- the frame must be well insulated and also be thermally broken //
- design to prevent overheating in summer - blinds, brise soleil, overhangs, awnings, deciduous trees to south, *etc.*, which allow low sun to enter in winter but prevent the high sun entering in summer // *etc.*



\*\* Accept any other appropriate answer(s).

- Space heating

- space heating demand is the energy required to maintain an indoor temperature of  $20^\circ\text{C}$  all year round //
- space heating refers to the heating of the indoor spaces. It does not include hot water heating or other energy needs //
- space heating demand for a Passive House is specified at  $\leq 15 \text{ kWh/m}^2/\text{a}$  //
- heating load is the energy required to maintain an indoor temperature of  $20^\circ\text{C}$  on a given day - the heating load must not exceed the amount of heat that can be supplied to the house via the fresh air required for good indoor air quality //
- heating load is specified at  $\leq 10 \text{ W/m}^2$  //
- the primary energy demand is the total energy consumed for all requirements (*i.e.* space heating, water heating, ventilation and electricity) //
- primary energy is the energy required to deliver usable energy to the home - this includes the energy consumed during extraction, conversion, transport *etc.* //
- in Ireland the primary energy conversion factor for electricity is currently 2.58. This means that for every unit of electrical energy consumed in the home, 2.58 units of energy have to be produced //
- primary energy demand is specified at  $\leq 120 \text{ kWh/m}^2/\text{a}$ ; however, many Passive Houses perform better than this and would achieve a primary energy demand of between 60 and  $70 \text{ kWh/m}^2/\text{a}$  // *etc.*

\*\* Accept any other appropriate answer(s).

**Question 10 (cont'd.)**

- (b) Using notes and freehand sketches, discuss the importance of orientation in the siting of a Passive House. Show the sun path in your sketch. (12)

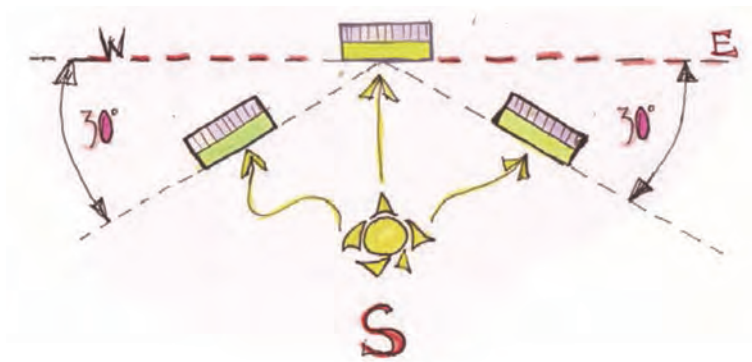
Notes: (6m)

Sketches: (6m)

Possible Answers

- ideally, glazed facade of Passive House faced directly south //
- glazed facade not more than  $30^\circ$  off the east/west axis //
- long glazed facade on east/west axis - facing south //
- house one room in depth ideally, to maximise solar gain – so no rooms faced only towards sunless north //
- if ideal orientation not possible, insulation has to be increased //
- careful positioning of the fenestration to ensure maximum solar gain and minimum heat loss through the building fabric //
- to prevent overshadowing, spacing from other houses 1.5 to 2.5 times height of building - for 2- to 4- storey buildings 25 – 30 metres between buildings - urban street width of 25 to 30 metres // *etc.*

\*\* Accept any other appropriate answer(s).



## Question 10 (cont'd.)

- (c) Avoiding overheating in summer is an important consideration in Passive House design. Using notes and freehand sketches, show **two** design details that would reduce the possibility of overheating.

(16)

Any 2: (2 × 8m)

Notes: (4m)

Sketches: (4m)

Possible Answers

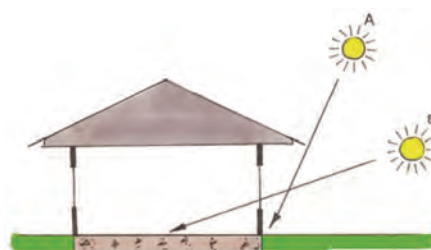
- carefully designed solar shading filters the direct rays of the sun and helps prevent overheating and glare //
- overheating occurs in Passive design if internal temperature greater than 25°C for 36 days (10%) annually // *etc.*

**1** Thermal mass

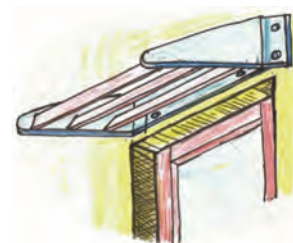
- the ability of a material to absorb and store heat //
- concrete floors and concrete block walls most common form of thermal mass in a Passive House //
- thermal mass regulates indoor temperature //
- solar gain is absorbed by the concrete floor and walls - a heat sink //
- in the summer, this helps to stabilise the internal temperature and prevent overheating //
- in winter solar energy absorbed by the floor and walls is released back into the building and helps to heat the home and reduce energy consumption //
- surplus heat can be temporarily stored in the structure and then released when air temperatures fall // *etc.*

**2** Extended roof overhang

- an overhang / extended eaves to reduce the amount of solar heat gain in summertime //
- the angle of the sun (A) is higher during the summer than it is during the winter (B). By using a correctly designed overhang, the amount of solar heat gained from the summer sun is reduced. Due to the lower angle of the winter sun, winter solar heat gain will not be affected //
- the maximum angle of the summer sun can be calculated by using the following formula:  $90^\circ - \text{latitude} + 23.5^\circ = \text{maximum sun angle}$  //
- the minimum angle of the winter sun can be calculated by using the following formula:  $90^\circ - \text{latitude} - 23.5^\circ = \text{minimum sun angle}$  // *etc.*

**3** Brise soleil

- this works on the same principle as the overhang and is used to reduce the amount of summer sun entering a building // *etc.*



## Question 10 (cont'd.)

(c) (cont'd.)

④ Adjustable brise soleil

- movable shading can be adjusted to suit the weather conditions at a particular time //
- sliding brise soleil as design feature - see sketch //
- external roller blinds, awnings and sliding screens are the most common types // etc.

⑤ Dynamic glass

- standard float glass with an electrochromic coating applied on one of the surfaces //
- automatically adjusts its tint in response to environmental conditions //
- eliminates the need for blinds or shades //
- allows visible light to enter the building while filtering out infrared and ultraviolet light //
- can be used in any situation where excessive solar heat gain is likely to be an issue, e.g. southfacing glazing and conservatories //
- dynamic glass allows control over the amount of infrared light as well as solar gain that enters the building //
- occupants can manually control tint of glass by apps on smart phones / tablets or by wall switches //
- achieves a reduction of up to 20% in energy consumption //
- provides an important advancement in sustainable design //
- thermochromic glass reacts and tints to the heat of the sun // etc.

⑥ Adequate ventilation

- use of efficient electrical appliances and low-energy lighting //
- insulate cylinders and pipework // etc.

⑦ Balconies

- balconies must be designed and sized to filter the light and reduce overheating // etc.

⑧ Blinds and shutters

- not as effective, but assist in reducing overheating // etc.

\*\* Accept any other appropriate answer(s).

OR

## Question 10 (cont'd.)

10. Ireland's historic houses are an important part of our social, cultural and architectural heritage. They are an essential thread of our national story and a great source of local community pride. Historic houses provide a passageway to the past, and help preserve our unique cultural and built heritage tradition.

**An Action Plan for the Sustainable Future of the Irish Historic House in Private Ownership** – Foreword by Heather Humphreys, T.D.  
Published by: Department of Culture, Heritage and the Gaeltacht, 2015.

Discuss the above statement in detail and propose **three** best practice guidelines that would promote the use and preservation of historic buildings in Ireland. (60)

Discussion: **(30m)**

Three points: (3 × 10m)

For each:

Point: (4m)

Discussion: (6m)

Guidelines: **(30m)**

Three recommendations: (3 × 10m)

For each:

Point: (4m)

Discussion: (6m)

### Discussion

#### Possible Answers

- distinctive heritage buildings express a continuity with the past, reflecting the style, construction techniques and materials of the past //
- heritage buildings express a value system of design and craft excellence. Such buildings become exemplars of best practice and repositories of learning for future generations of architects, engineers and craftpersons //
- heritage buildings of distinctive character need to be preserved as far as possible unchanged. These buildings bestow a sense of character on many villages, towns and cities. Such heritage buildings give a distinctive character and unique sense of place - genius loci - to many villages and towns //
- heritage towns and villages attract tourism, giving a vibrancy to the community //
- restoring an old building develops, in the present generation, a sense of care for the past and can help avoid unnecessary one-off developments //
- heritage buildings provide a location for the acquisition and practice of preservation skills and techniques. The buildings become sites of learning for the next generation of conservation architects, engineers and craft persons - preservation knowledge can be handed on from the specialists, along with being an exemplar to promote modern energy conservation in older buildings //
- encourage developers of older buildings to engage the services of specialist architects to oversee refurbishments //
- adapting heritage buildings for new uses provides a site of learning for architects and engineers //
- the challenge posed is whether to preserve a heritage building in its original state when the reason for its use has ceased - a railway building with no train line, a church building without a congregation, a school without pupils, a courthouse with no court - or to modify and upgrade the building to make it suitable for a new use //
- if the reuse of a building is not considered, then it is likely to degrade, fall into disuse and disrepair and eventually may have to be demolished, and the heritage value is lost forever //
- buildings allowed to fall into disrepair pose a safety risk and may have to be demolished. Upgrading for reuse extends the lifespan of the building and protects some of its heritage value //

## Question 10 (cont'd.)

(c) (cont'd.)

- buildings often outlive their original uses - the present-day uses of buildings will, in many instances, be very different to the functions for which they were first designed and built - technologies change and the function of buildings changes //
- no building lasts forever; all buildings degrade over time and need continuous refurbishment - roof and floor timbers, wooden windows rot and decay, slates and stone degrade, *etc.*, so upgrading forms part of the life cycle of a building //
- many houses from the Georgian period are in need of an upgrade so that they can continue be lived in and used. Some such houses are large by today's standards and designing for reuse extends their lifespan //
- the structure of heritage buildings often needs thermal upgrading, fire upgrading, upgrading for universal access //
- rather than allow a building to fall into disrepair and disuse, best-practice guidelines for reuse encourage uses that meet a need today, and remodelling is necessary to make the building suitable for a new use //
- guidelines aim to ensure that such sensitive modifications are allowed and that these do not provide an unnecessary impediment to reuse //
- careful inspection of older buildings to ensure viable future following refurbishment //
- as a general rule, the original building should be legible and the new alterations should not mask or distort the integrity of the original structure //
- adaptation and remodelling should be respectful of the structure, aesthetic and beauty of the original building and interventions should, where possible, be reversible //
- costs are important and should not be so prohibitive as to deter the modification and remodelling of an old building //
- energy conservation to provide a workable solution to increasing energy costs associated with building //
- remodelling should take account of the immediate surroundings of the building to be refurbished //
- in some cases the interior of the building may have to be reconfigured to make the building useful - the focus should be on maintaining the integrity of the exterior of the building, the interior being re-imagined to suit the priorities imposed by the new use of the building //
- upgrading heritage buildings in both rural and urban areas helps to bring back the charm of urban living and breathes new life into derelict buildings and areas //
- architects can re-imagine new uses and new layouts by creative, yet realistic, plans //
- the upgrading and reuse of a heritage building can bring new uses, new tenants, new businesses and a new vitality to the surrounding area //
- restoring a heritage building as a mixed-use building for young and old, together with provision for the arts, artists' studios, art galleries, cafes, *etc.*, can bring back life and energy to a derelict area //
- modifications often require some intrusion, such as fitting a lift, widening doors, toilets for universal design, to make the building suitable for universal access. These have to be carefully considered //
- successful upgrading of existing buildings can lead to a new vitality in the areas upgraded, provide examples of good practice and offer a pattern for how such approaches could be adopted //
- building on past experience should lead to the avoidance of mistakes and should result in a new appreciation of the importance of tradition, having heritage buildings envisioned in new ways, light-filled, lean, beautiful, delightful and a joy to behold //
- increased availability of grants for renovation and refurbishment of older buildings would promote the continued use, reuse and preservation of historic buildings // *etc.*

## Question 10 (cont'd.)

(c) (cont'd.)

GuidelinesPossible Answers

- successful refurbishments/adaptations should be promoted as exemplars of best practice and should encourage others to follow example - dissimulation of skills learned in restoration work //
- conservation grants and financial supports should be provided for individuals and organisations undertaking a refurbishment for reuse of a heritage building //
- centres of excellence for designers and craft persons should be established to train professionals in conservation methods and techniques //
- guidelines for best practice should be widely disseminated to ensure broad design-based expertise //
- conservation architects / designers should form part of the design team to ensure best advice //
- the new use to which it is proposed to put the building should be specified, clearly stating those elements that are essential if the building is to successfully meet the new requirements //
- all works identified as essential to the successful re-use of the building should be incorporated into a refurbishment plan //
- the refurbishment should be as true as practicable to the original layout, materials and construction processes used in the initial construction //
- the new should be distinct, discernible and legible, with quality materials equal to that of the original //
- priority should be given to the successful adaptation of the building to a new use or uses - successful upgrading is dependent on the extent to which the building meets the requirements of its new function //
- where appropriate, public money and resources should be used to encourage thoughtful refurbishment //
- the wider community benefits when the amenity value of a street or area is enhanced by refurbishment and reuse of a heritage building // *etc.*

\*\* Accept other relevant discussion and guidelines supported by reasonable argument.

**Notes:**

**Notes:**

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