

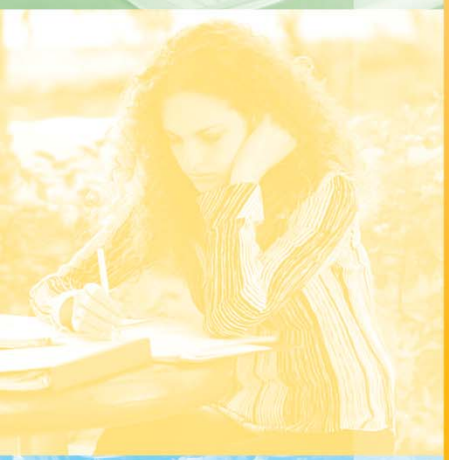


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Pre-Leaving Certificate Examination, 2013

Construction Studies – Part 1 (Theory)

Marking Scheme

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Pre-Leaving Certificate Examination, 2013

Construction Studies – Part 1 (Theory)

Ordinary Level
Marking Scheme (200 marks)

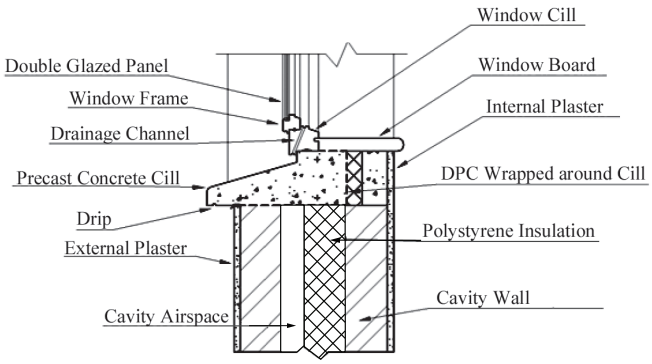
Answer Question 1 and **three** other questions. **All Questions 50 Marks**

1. A new building as shown in the sketch, is fitted with double-glazed windows. The external wall is a 350 mm cavity wall. The wall is plastered on both sides.

(50)

(a) To a scale of 1:5, draw a vertical section through the cill detail of the window. Show the typical construction details from 300 mm below to 200 mm above the concrete cill. Include **three** typical dimensions.

Construction details
Any 10: **(10 × 3m)**



– external plaster, 19 mm //
– outer leaf, 100 mm //
– cavity air space, 50 mm //
– insulation, 100 mm //
– inner leaf, 100 mm //
– internal plaster, 13 mm //
– DPC wrapped around cill //
– precast concrete cill //
– throating //
– concrete backfill //
– window cill //
– double glazing //
– window board //
– cavity closed with proprietary cavity barrier //
– insulation at back cill (to prevent cold bridge) // *etc*.

** Any alternative detailing which complies with current building regulations is acceptable.

Any 3 typical dimensions **(3 × 2m)**
Draughtsmanship, accuracy and scale **(6m)**

** Excellent 6 marks, Good 4 marks, Fair 2marks.

(b) On your drawing, show one method of preventing the cold bridge effect at the window.

Any 1: **(8m)**
– DPC wrapped around cill //
– insulation in position to prevent cold bridge // *etc*.

** Accept any other appropriate answer(s).

2. Thermal insulation is widely used in the construction of all new domestic dwellings. (50)

(a) Discuss **three** advantages of using thermal insulation at the construction stage of new buildings.

Any 3: **(3 × 6m)**
– helps to reduce heat loss in a building //
– saves money on heating costs //
– higher U-value for the dwelling //
– improves comfort levels in building //
– helps to reduce danger of condensation on surfaces //
– eliminates cold bridge effect at windows and doors //
– insulation on pipes helps prevent pipes bursting due to freezing // *etc.*

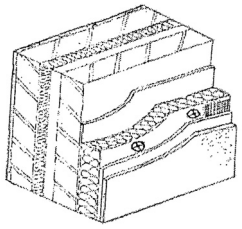
** Accept any other appropriate answer(s).

(b) Using notes and neat freehand sketches, show how the un-insulated external walls of a dwelling house can be fitted with thermal insulation using the following **two** methods:

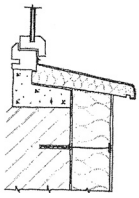
- an external insulation system **(16m)**

** Notes (8m), Sketch (8m).

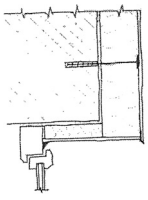
– walls //
  – the wall is brushed and cleaned
  – all downpipes are removed
  – a base coat of adhesive is applied over the existing external plaster / rendering
  – a layer of rigid phenolic foam / expanded polystyrene bonded to the external wall
  – PVC / stainless steel anchor bolts are used to fix the insulation to the wall
  – fibreglass mesh is attached to the insulation boards
  – two coats of polymer / acrylic specialist renders are applied
  – a specialist angle bead is fitted at external corners and plinths
  – a mastic type sealant is used at the doors, windows and soffits // *etc*.



– window cill //
  – the existing cill is cut flush with the existing wall if required
  – a preformed phenolic foam / stainless steel cill is fitted over the existing cill
  – a base coat adhesive is applied before fitting a preformed aluminium / PVC cladding window cill
  – sealant is applied to all junctions between the cill and the wall // *etc*.



– windows and door head //
  – a high density rigid phenolic foam is fitted to the head and reveals using a proprietary adhesive
  – two coats of acrylic external renders are applied
  – proprietary angle bead is fitted to all external corners
  – a mastic sealant is used at all junctions // *etc*.

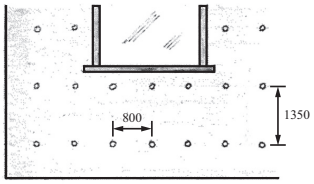


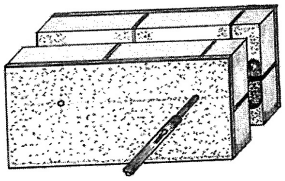
** Accept any other appropriate material.
** Accept any appropriate sketch.

- injecting insulation into the cavity of the external walls. **(16m)**

  ** Notes (8m), Sketch (8m).
  – this operation is carried out by specialist companies registered with SEAI and specialising in insulation of houses
  – holes of 22 mm diameter are drilled through the external leaf
  – these holes are spaced at 800 mm horizontally and at 1350 mm vertically
  – extra holes are drilled beneath window cills and above window and door heads, to ensure proper filling of the cavity
  – the insulation in the form of polystyrene bead is then pumped into the cavity
  – as the pumping takes place, a light coating of strong glue is applied to the beads
  – when the glue sets, the beads will form a solid structure
  – when the pumping is complete, the holes are filled and blended in with the external finish // *etc*.

  ** Accept any other appropriate material.
  ** Accept any appropriate sketch.





3. It is necessary to replace an old water storage tank in the attic with a new tank. (50)

(a) Using notes and neat freehand sketches, explain how the new tank will be fitted. Label the components and give their typical sizes.

Include the following in your sketch:

- tank in position
- rising main
- overflow pipe
- expansion pipe
- cold water feed to hot water cistern / bathrooms
- ball valve.

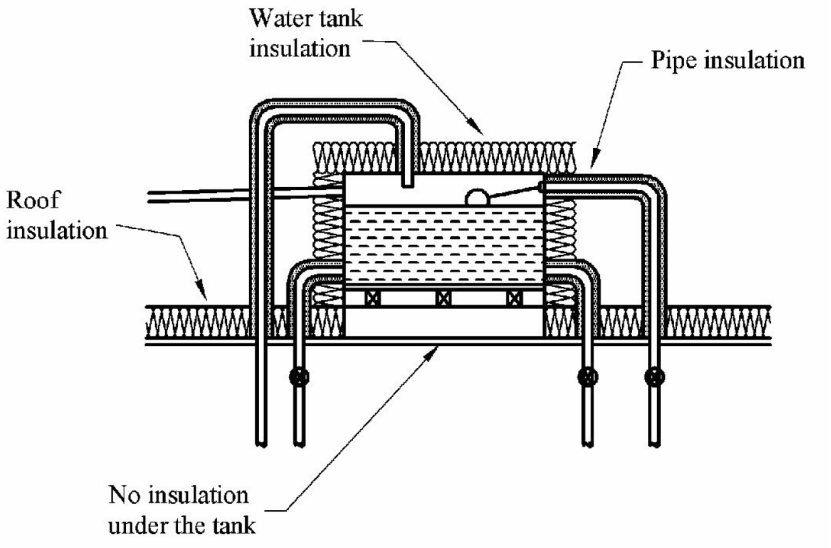
Any 8: **(8 × 4m)**

– the mains water supply to tank is turned off at stopcock //
– all water is drained out of tank //
– all pipes are disconnected //
– the old tank is removed //
– the new tank is positioned on bearers to distribute weight //
– the rising main is connected //
– the ball-valve is connected //
– all other pipes are connected //
– the mains water supply is turned on and tank fills up //
– all connections checked for any leaks // *etc.*

** Any alternative detailing which complies with current building regulations is acceptable.

Any 3 typical dimensions **(3 × 2m)**
Draughtsmanship, accuracy and scale **(6m)**

** Excellent 6 marks, Good 4 marks, Fair 2marks.



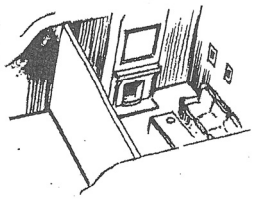
(b) Include in your sketch **two** design details that would prevent the water in the storage tank from freezing during very cold weather.

Any 2: **(2 × 3m)**

– insulation wrapped and tied around all pipes //
– insulate the top and sides of the tank but not underneath the tank //
– install a frost thermostat or heating device in the attic //
– the tank and all pipes should be placed centrally in the attic space where possible // *etc.*

** Accept any other appropriate material.

4. A large room in a dwelling house is to be sub-divided to make two smaller rooms by constructing a non-load-bearing timber stud wall as shown in the sketch. The partition will be finished with plasterboard on both sides.



(50)

(a) Describe, using neat freehand sketches, how the internal stud wall is constructed. Indicate on the sketches the name and sizes of all parts.

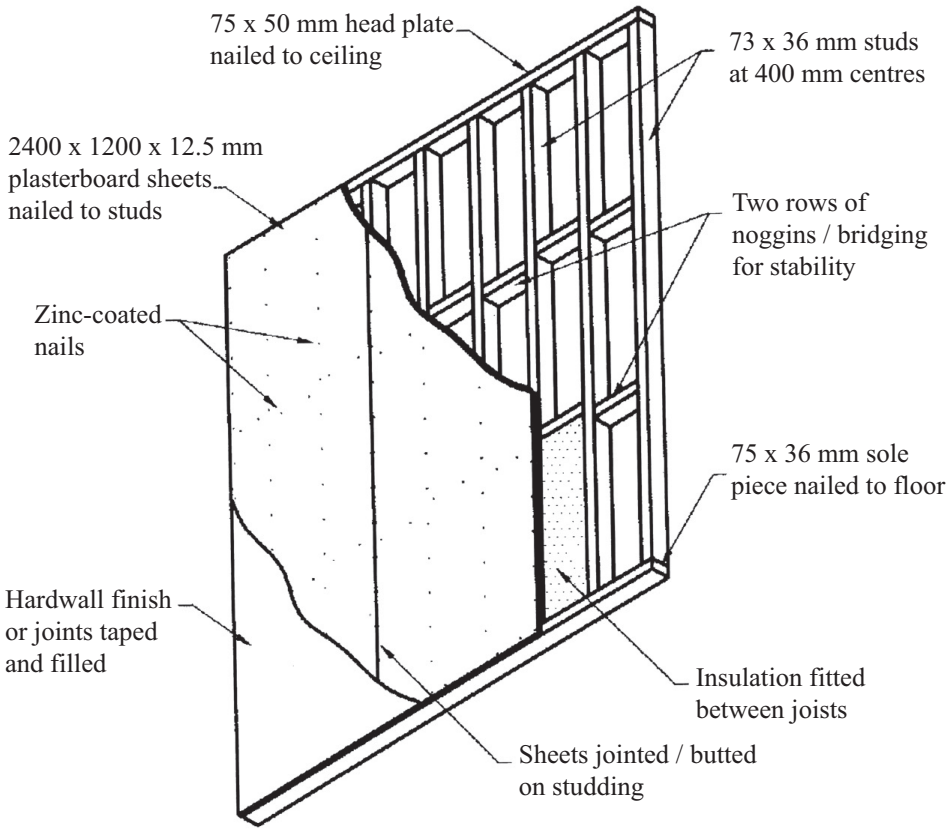
Component parts
Any 6: **(6 × 3m)**

– head of partition //
– sole plate //
– studs //
– noggins //
– insulation //
– plasterboard //
– joint taping //
– hardwall finish //
– skirting board // *etc*.

** Any alternative detailing which complies with current building regulations is acceptable.

Any 3 typical dimensions **(3 × 2m)**
Draughtsmanship, accuracy and scale **(6m)**

** Excellent 6 marks, Good 4 marks, Fair 2marks.



(b) Describe in detail how the stud partition is constructed from start to finish.

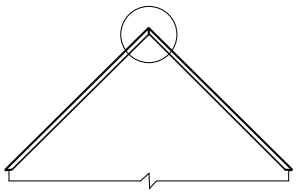
Any 10: **(10 × 2m)**

– the line of the sole plate is marked //
– the sole plate is fixed into position, with care taken to note the position of any services //
– the frame head and sole plate are fixed into position with nails / screws //
– a vertical straight edge is used to locate the line of the head plate //
– the head plate is secured to the ceiling //
– the end studs are fixed to the walls using plugs and screws //
– the length of studs required are measured and cut //
– the studs are fixed at 400 centres for plasterboard //
– the studs are made rigid by including two rows of noggins, they are staggered and double-nailed into position //
– standard size of studs 75 mm × 50 mm, minimum size of studs is 75 mm × 36 m //
– any necessary holes for services are cut //
– sheets of plasterboard are fitted to one side using appropriate fixtures, *e.g.* nails or screws //
– the plasterboard is cut 13 mm shorter than ceiling-to-floor height to allow for variations //
– insulation should be fitted //
– the other side is fitted with plasterboard //
– jointing tape is put over the plasterboard joints and a thin layer of coating plaster is applied // *etc*.

** Accept any other appropriate material.

5. The sketch shows the traditional cut roof, of a dwelling house, with a pitch of 45°. The roof, which is insulated, is covered with concrete roof tiles which are supported on 200 mm x 50 mm rafters. (50)

(a) To a scale of 1:5, draw a vertical section through the ridge of the tiled roof. Show the typical construction details from the top of the ridge to a level 150 mm below the collar tie and include **three** courses of tiles at the ridge.
Include **three** typical dimensions.



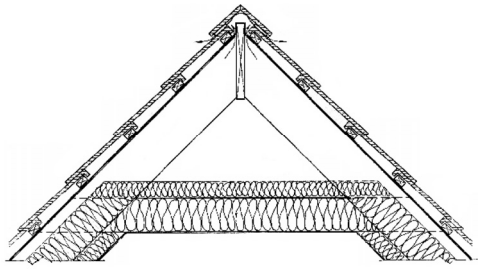
Any 8: **(8 × 4m)**

– ridge tile //
– ridge vent //
– ridge board 300 × 32 mm //
– concrete tiles //
– tile lap //
– softwood battens 50 × 25 mm or 44 × 30 mm //
– microporous vapour barrier //
– rafters 200 × 50 mm //
– collar tie 125 × 50 mm //
– insulation between and over collar ties //
– insulation between rafters with air space // *etc.*

** Any alternative detailing which complies with current building regulations is acceptable.

Any 3 typical dimensions **(3 × 2m)**
Draughtsmanship, accuracy and scale **(6m)**

** Excellent 6 marks, Good 4 marks, Fair 2marks.

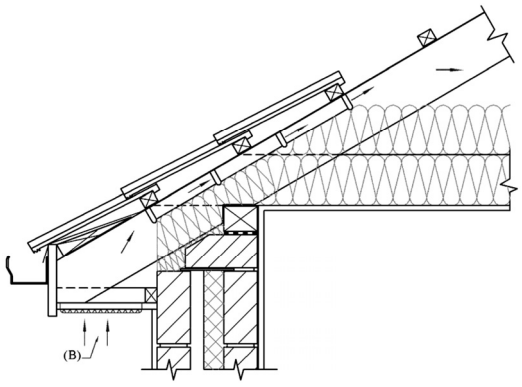


(b) Outline **one** method of providing ventilation to the roof members.

Any 1: **(6m)**

– 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).



6. **(a)** List **two** specific safety precautions that should be observed in **each** of the following situations and give **one** reason for each safety precaution listed: (50)

- placing fibreglass between ceiling joists in an attic space

Safety precautions **(2 × 4m)**
Reasons **(2 × 3m)**

Any 2:

– always wear gloves and protective clothing, *e.g.* a dust mask //
– ensure the area is well lit //
– ensure that access to the attic space is secure and safe //
– check that adequate walking boards are provided in the loft area // *etc*.

- excavating a foundation trench for a dwelling house

Safety precautions **(2 × 4m)**
Reasons **(2 × 3m)**

Any 2:

– safety clothing to be worn at all times, *i.e.* hard hats, steel toe-cap boots, reflective jackets //
– all workers must have adequate training //
– there must be suitable access and egress to and from trench //
– check for any underground pipes or services, *e.g.* water, electricity, phones //
– the material is to be removed in layers //
– a suitable trench support is required when a deep excavation is necessary //
– all heavy traffic must be kept well back from trench excavation // *etc*.

- using a router to put moulding on a piece of timber

Safety precautions **(2 × 4m)**
Reasons **(2 × 3m)**

Any 2:

– always use the correct safety protection, *i.e.* ear muffs, safety glasses, dust protection //
– ensure the cutter is fixed correctly in machine //
– ensure the cable is away from cutter while the machine is in operation //
– ensure the cutter has fully stopped before resting the machine on the bench //
– switch off the power supply when making any adjustments to the cutter //
– all leads and cutters should be safe and in perfect condition // *etc*.

** Reason must be appropriate to safety precaution given.
** Accept any other appropriate answer(s).

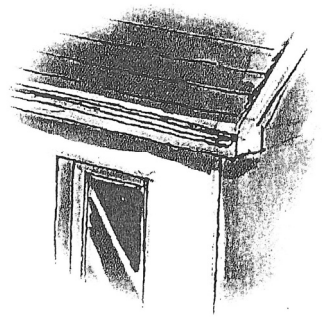
(b) Outline **two** specific safety precautions that should be observed when using electrical tools outdoors.

Any 2: **(2 × 4m)**

– ensure dry conditions for work //
– check that all electrical tool leads are in good condition //
– check that all connections are good //
– use 110V-powered equipment //
– ensure the correct safety equipment is worn // *etc*.

** Accept any other appropriate answer(s).

7. The sketch shows a pitched roof for a dwelling house. (50)



(a) Using notes and neat freehand sketches, show how the rainwater is collected from the pitched roof and discharged to ground level. Label all components and give their typical sizes.

Notes:
Any 4: **(4 × 4m)**

– rainwater runs down the roof surface into a 125 mm gutter //
– the gutter is connected to a 65 mm downpipe using an offset bend //
– the gutter is fitted with stopends to prevent rainwater falling out of gutter //
– rainwater flows down inside the downpipe //
– the rainwater then flows into the inlet gully //
– it runs from the gully in a 100 mm underground pipe to the discharge point, *i.e.* a soak-away / storage tank / river, *etc.* // *etc.*

** Accept any other appropriate answer(s).

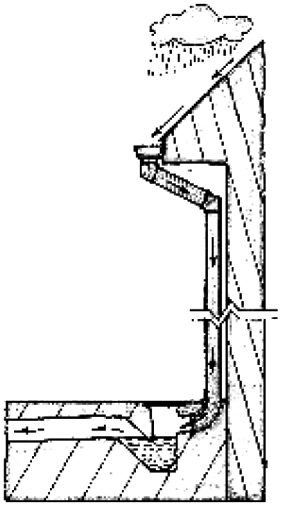


Diagram:
Any 4: **(4 × 4m)**

– eave gutter //
– offset bend //
– downpipe //
– gully trap //
– underground pipe //
– sump // *etc*.

** Accept any other appropriate answer(s).

Draughtsmanship, accuracy and scale **(6m)**

** Excellent 6 marks, Good 4 marks, Fair 2marks.

(b) Suggest **one** suitable use for this stored water.

Any 1: **(4m)**

– ideal for gardening, watering plants, *etc.* //
– can be used in toilets, washing machines, *etc.* //
– suitable for outdoor cleaning, *e.g.* washing cars, pavements, *etc.* // *etc*.

** Accept any other appropriate answer(s).

(c) Discuss **one** advantage to the home owner using this stored rainwater.

Any 1: **(8m)**

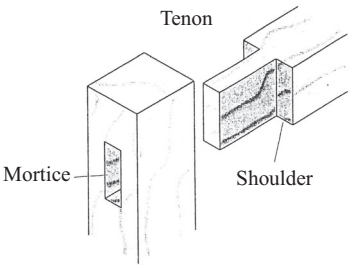
– it reduces domestic water consumption //
– it causes less water running in drainage system and reduces the risk of flooding //
– it raises awareness of climate change and water shortage //
– it reduces the wastage of chlorinated drinking water //
– it can be less damaging to appliances //*etc*.

** Accept any other appropriate answer(s).

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

Any 5: **(5 × 10m)**

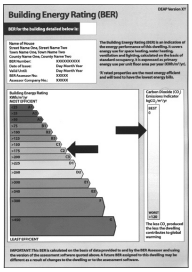
- mortice and tenon



** Note (5m), Sketch (5m).
– a strong joint //
– used in door and joinery work //
– the mortice taken out by hand or machine //
– there are various types of mortice and tenon //
– the joint is normally glued and clamped // *etc*.

** Accept any other appropriate answer(s).

- energy rating



** Note (5m), Sketch (5m).
– this tells the energy performance of the building //
– referred as the BER (Building Energy Rating) of a dwelling //
– takes into account CO_2 emissions with energy use //
– runs from a scale of A to G //
– A is most efficient, G is least //
– a BER certificate has to be provided for all houses being sold // *etc*.

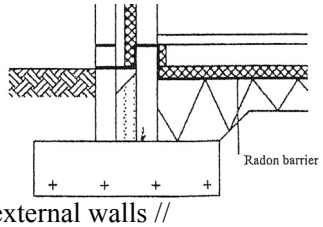
** Accept any other appropriate answer(s).

- wall tie

** Note (5m), Sketch (5m).
– a fitting used in the construction of cavity walls //
– it links the internal and external leafs in a cavity wall //
– ensures that the inner and outer leaves act as one unit //
– can be made from stainless steel or polypropylene //
– used to hold insulation in position //
– typically placed at 900 mm apart horizontally and 450 mm vertically // *etc*.

** Accept any other appropriate answer(s).

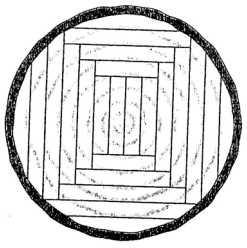
- radon barrier



** Note (5m), Sketch (5m) tile.
– the barrier is installed by specialist companies //
– the radon barrier is a complete, sealed barrier //
– a barrier that stops the penetration of radon gas into the building //
– it covers the whole area of the floor of the building //
– it is a flexible membrane placed under the floor and the external walls //
– care must be taken not to damage the barrier during building work //
– careful fitting and sealing around service pipes is also important, *i.e.* no gaps // *etc*.

** Accept any other appropriate answer(s).

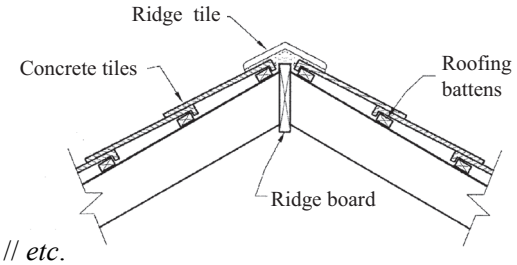
- tangential sawing



** Note (5m), Sketch (5m).
– method to convert logs into useable timber //
– produces stable good-strength boards //
– produces attractive grain pattern (flame grain) //
– a more expensive method of sawing //
– smaller boards produced // *etc*.

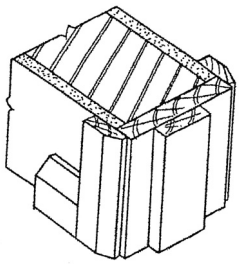
** Accept any other appropriate answer(s).

- ridge board
  ** Note (5m), Sketch (5m).
  – it is the horizontal member at the top of the roof //
  – the top of the rafters are fixed to it //
  – it is generally made of softwood and treated with a preservative //
  – size varies from 150 mm to 175 mm wide and 25 mm to 40 mm thick //
  – it is supported at the ends by gable ends // *etc*.



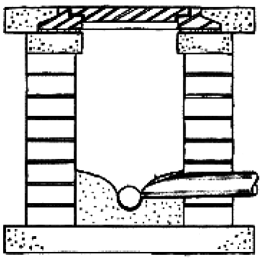
  ** Accept any other appropriate answer(s).

- architrave
  ** Note (5m), Sketch (5m).
  – this is a special moulded wooden strip fixed to the internal door uprights //
  – it is also fixed along the top of the door and wall //
  – architrave may be made of hardwood or softwood //
  – the section size of architrave may vary and there is a wide variety available //
  – it may be glued, nailed or screwed into position //
  – a paint or varnish finish is normally applied to the architrave // *etc*.



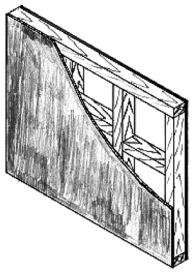
  ** Accept any other appropriate answer(s).

- inspection chamber
  ** Note (5m), Sketch (5m).
  – used to gain access to the underground drains //
  – it is used for the cleaning of blockages in the drain system //
  – the chamber may be constructed of brick, block, concrete or PVC //
  – inspection chambers are used at the head of the drain, at a change in direction or for a change of level //
  – the chamber can be used for drains of depth up to 1m //
  – when the depth exceeds 1m, it is called a manhole // *etc*.



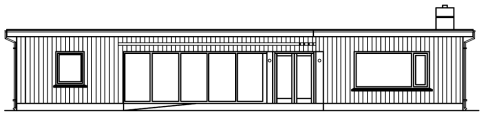
  ** Accept any other appropriate answer(s).

- plasterboard
  ** Note (5m), Sketch (5m).
  – used for ceilings, partitions and dry lining //
  – plasterboard is made using gypsum plaster //
  – the plaster is bonded between two sheets of special paper //
  – it is available in a range of thicknesses but 12 mm and 10 mm are the most common //
  – the sheets vary in size with the most common size being 2400 × 1200 mm //
  – the edge of the board is finished with square, tapered or rounded edges //
  – plasterboard has one ivory and one grey face and this allows for direct paint or plaster finishes //
  – insulated dry lining plasterboard may also be used // *etc*.



  ** Accept any other appropriate answer(s).

9. The sketch shows the elevation of a dwelling designed to have low environmental impact. The external walls have been finished with wooden cladding.



(50)

(a) Choose a suitable timber for the external cladding and give **two** reasons for your choice.

Wood **(3m)**
Reasons **(2 × 4m)**

Any 1:

– cedar // Any 2:
  – ideal for outdoor use as it is very resistant to decay //
  – easy to work and glue together //
  – pleasant appearance //
  – easily finished with oil or other suitable treatment //
  – it is lightweight, making it suitable for cladding // *etc*.

– red deal / scots pine // Any 2:
  – easy to work, plane and cut //
  – provides good finish when painted or varnished //
  – reasonably priced //
  – strong and stable //
  – easily available // *etc*.

– larch // *etc.* Any 2:
  – naturally durable for outdoor use //
  – looks well with red heartwood //
  – it is resistant to water //
  – it is easily grown in Ireland // *etc*.

** Reasons given must be appropriate for chosen wood.

(b) Recommend a suitable applied finish for the cladding.
Describe, using notes and neat freehand sketches, the steps to be followed when applying the recommended finish.

Finish **(3m)**
Sketch **(6m)**
Description **(4 × 4m)**

Any 4:
– if the finish is to be applied outdoors, make sure weather conditions are correct - dry calm day //
– ensure that the wood has a moisture content of less than 18% //
– make sure the surface of the wood is clean, dry and free from dust and dirt //
– timber should be sanded to provide a smooth surface for paint //
– all dust should be removed using a clean cloth and white spirits //
– apply the finish using a good quality brush //
– apply even coats and finish in the direction of the grain //
– lightly sand between coats // *etc*.

** Description given must be appropriate for chosen finish.

(c) Outline using notes **two** other considerations to be taken into account when designing buildings to have low environmental impact on an area.

Any 2: **(2 × 7m)**

– size of the building //	– small buildings use less material // – small buildings cause less excavation // – small buildings create less embodied energy // *etc*.
– materials used //	– should be renewable // – ensure they are durable // – should be locally sourced when possible // *etc*.
– insulation //	– ensure high levels of insulation to reduce heat loss and reduce heating costs // *etc*.
– site //	– good site position // – house positioned correctly on site to utilise daylight and sunlight // – the house should be designed to suit the surroundings // *etc*.

** Accept any other appropriate answer(s).

DEB exams

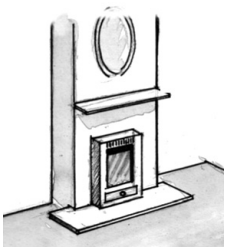
Pre-Leaving Certificate Examination, 2013

Construction Studies – Part 1 (Theory)

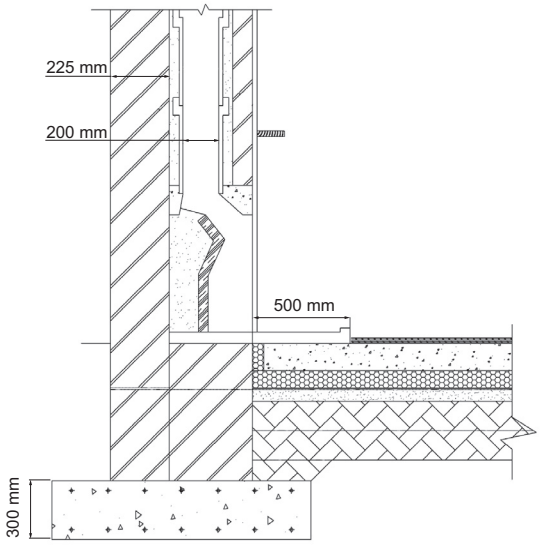
Higher Level
Marking Scheme (300 marks)

Answer Question 1 and **four** other questions. **All Questions 60 Marks**

1. The fireplace of a dwelling house is located on an internal party wall between two rooms, as shown in the accompanying sketch. The party wall is a 225 mm solid block and is supported on a traditional strip foundation. The house has an insulated solid concrete floor with 25 mm hardwood timber flooring. (60)



(a) To a scale of 1:5, draw a vertical section through the party wall, fireplace and hearth. The section should show the typical constructional details from the base of the foundation to the top of the first flue liner.



Vertical through fireplace
Any 10: **(10 × 4m)**

** Drawing (3m), Notation (1m).
– extended foundation //
– party wall //
– hardcore minimum 150 mm //
– blinding sand //
– radon barrier / DPM //
– 100 / 150 mm polystyrene insulation or equivalent //
– 150 mm concrete floor //
– 25 mm tongue and groove flooring //
– hearth //
– fireback and fill //
– flue gathering / lintel //
– smoke shelf //
– throat //
– flue liners //
– fill around flue liners // *etc*.

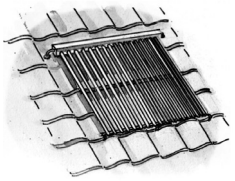
Any 4 typical dimensions **(4 × 1m)**
Scale **(4m)**, Draughtsmanship **(4m)**

(b) Indicate on your drawing the design detailing that ensures efficient functioning of the fireplace.

Any 2: **(2 × 4m)**
– smoke shelf clearly shown //
– correct detailing of fireback //
– precast flue gathering lintel //
– flue liners with a minimum 194 mm diameter //
– correct sizing of throating // *etc.*

** Accept any other appropriate material.

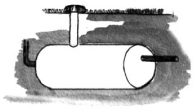
2. Increased fuel costs and the introduction of household charges have lead to many homeowners utilising natural resources to reduce their household costs. (60)



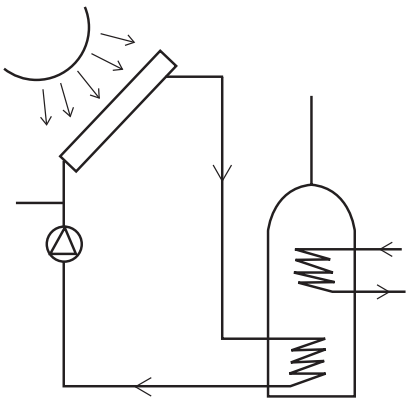
(a) Show, using notes and freehand sketches, how a homeowner could incorporate **two** of the following to reduce their household costs:

Any 2: **(2 × 20m)**

- solar panels



** Notes (10m), Sketch (10m).
– panels should be fitted onto south-facing roof surfaces //
– the panels are easily fitted onto roof //
– the flow and return pipes are attached to the hot-water cylinder //
– water flows through a coil in the cylinder //
– a power pump circulates hot water through the system //
– the use of renewable energy sources reduces energy bills //
– the use of solar collectors will reduce the output of CO_2 // *etc.*

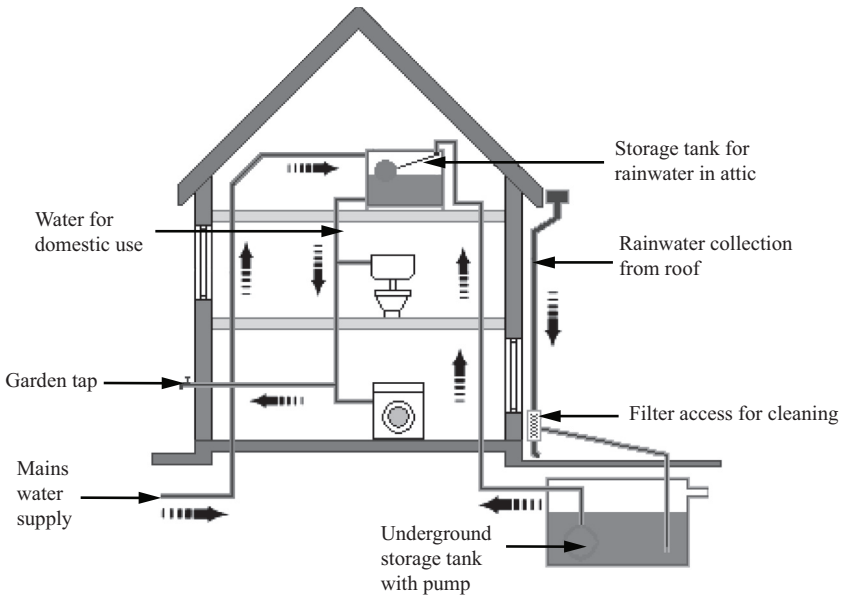


** Accept any other appropriate material.

- rain water harvesting

** Notes (10m), Sketch (10m).
– collection of rainwater in gutters of 125 mm is typical //
– stopends are fitted to gutters, causing water to run down the building in 65 mm downpipes //
– rainwater from downpipe runs into gully //
– water runs from gully through a pipe connecting to an underground storage tank //
– a filter is fitted to this pipe to trap sediment //
– an alternative filter may be located in the storage tank - it can be accessed from the top for maintenance and cleaning //
– storage tank has overflow pipe to sump //
– a submersible pump pumps the water back into the house //
– a separate water storage tank is located in the attic to store water for use //
– this tank is plumbed to provide water for use in toilets, washing machines, outdoor taps for gardening, general cleaning of pavements, cars // *etc*.

** Accept any other appropriate material.



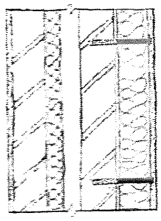
- insulation.

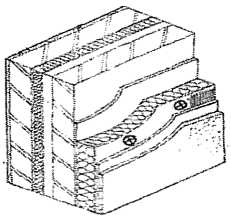
  ** Notes (10m), Sketch (10m).

  Walls

  – the wall should be cleaned and brushed
  – all downpipes should be removed
  – apply a base coat of adhesive over the existing external plaster / rendering
  – rigid phenolic foam 80 mm - 300 mm is bonded to external wall
  – PVC / stainless steel anchor bolts are used to fix insulation to the wall
  – fibreglass mesh is laid on insulation boards
  – two coats of polymer or acrylic specialist renders are applied
  – specialist angle bead is fitted at the external corners and plinth
  – mastic type sealants are used at doors, windows and soffits // *etc*.

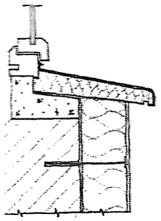
  ** Accept any other appropriate material.





  Window cill

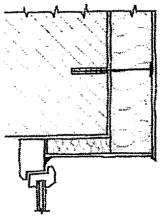
  – the existing cill may be cut flush with existing wall
  – a pre-formed phenolic foam / stainless steel window cill is fitted over existing cill
  – a base coat of adhesive is used
  – a pre-formed aluminium or PVC cladding window cill is fitted on top
  – sealant is applied to all junctions between the cill and wall // *etc*.



  ** Accept any other appropriate material.

  Window / door head

  – high density rigid phenolic foam is fitted to the head and reveals using proprietary adhesive
  – apply two coats of acrylic external renders
  – apply proprietary angle bead to all external corners
  – use mastic sealants at all junctions // *etc*.



  ** Accept any other appropriate material.

(b) Discuss in detail **two** advantages of each of your preferred solutions in **2(a)** above.

Advantages
Any 2: **(2 × 10m)**

- solar panels
  Any 2: (2 × 5m)
  – uses free sunlight to heat water, therefore reduces household bills //
  – easily fitted and connected //
  – cuts down on energy use, therefore reducing CO_2 output // *etc*.

  ** Accept any other appropriate answer(s).

- rain water harvesting
  Any 2: (2 × 5m)
  – reduces domestic water consumption //
  – less water running in drainage system and reduces risk of flooding //
  – raises awareness of climate change and water shortage //
  – reduces the wastage of chlorinated drinking water //
  – less damaging to appliances // *etc*.

  ** Accept any other appropriate answer(s).

- insulation.
  Any 2: (2 × 5m)
  – increases the U-value of wall to current building regulations //
  – upgrades the appearance of building //
  – no loss of internal space //
  – higher BER rating achieved //
  – maintenance-free // *etc*.

  ** Accept any other appropriate answer(s).

3. **(a)** The average daylight in a living room is to be increased from 90 lux to 150 lux by enlarging an existing window. Determine by degree of efficiency method, or any other suitable method, the approximate area of the new window. The living room is 4.8 m long by 4.0 m wide. Assume an unobstructed view and the illumination of a standard overcast sky to be 5000 lux. (60)

Any 7 lines: **(7 × 2m)**
Correct area calculation **(2m)**

Degree of efficiency method

Li	=	Lux required
Lo	=	Standard Overcast Sky (C.I.E. = 5,000 Lux)
WF	=	Window factor is the reduction in incident light due to Window Position on a Vertical Wall. Constant value of 0.5
E	=	Efficiency coefficient: - Reduction for Reflections, Obstructions, Glass, *etc.* Constant value of 0.4
W	=	Window Area
Increased lux required	=	150 lux

– formula: Li = $\text{Lo} \times \text{WF} \times \text{E} \times \frac{\text{Window area}}{\text{Floor area}}$

– 150 = $5{,}000 \times 0.5 \times 0.4 \times \frac{\text{W}}{4.8 \times 4.0}$

– 150 = $5{,}000 \times 0.5 \times 0.4 \times \frac{\text{W}}{19.2}$

– 150 = $1{,}000 \times \frac{\text{W}}{19.2}$

– 150 = $\frac{1{,}000\,\text{W}}{19.2}$

– 150×19.2 = 1,000 W

– 2,880 = 1000 W

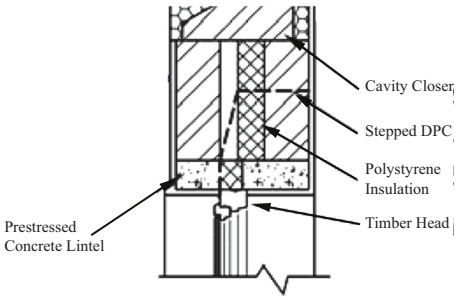
– $\frac{2{,}880}{1{,}000}$ = W

– Window area = 2.880 m²

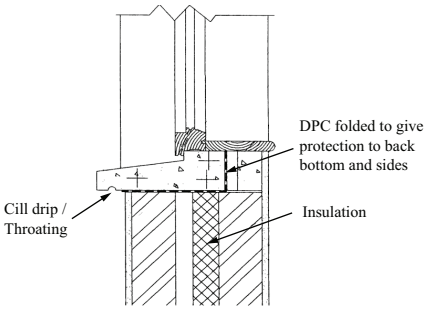
(b) Describe in detail, using notes and freehand sketches, the typical design detailing which will prevent the formation of thermal bridges at **each** of the following locations:

Description **(2 × 14m)**

- head of the new window
  - ** Notes (7m), Sketch (7m).
  - – stepped DPC //
  - – cavity sealed with insulation // *etc*.
  - ** Accept any other appropriate answer(s).



- cill of the new window
  - ** Notes (7m), Sketch (7m).
  - – DPC wrapped around cill //
  - – insulation placed at the back of the cill // *etc*.
  - ** Accept any other appropriate answer(s).



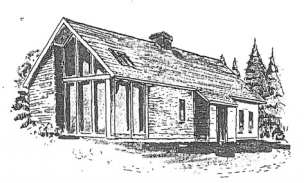
(c) Discuss in detail **two** environmental considerations that should be taken into account when choosing materials for the new window frame.

Any 2: **(2 × 8m)**

– make the window frame out of a renewable material. Renewable materials generally have low embodied energy, *e.g.* wood requires a lot less energy to produce than aluminium //
– sustainability, *e.g.* local, easily replaced, easily coated / painted //
– using materials with good insulation characteristics will reduce heat loss and hence reduce the amount of fossil fuels needed to heat the house //
– using durable materials that are resistant to the elements will have to be replaced less frequently. Weather-resistant finishes, *e.g.* cladding the timber in an aluminium skin greatly increases its lifespan //
– end-of-life use, *e.g.* biodegradable or can be recycled // *etc.*

** Accept any other appropriate answer(s).

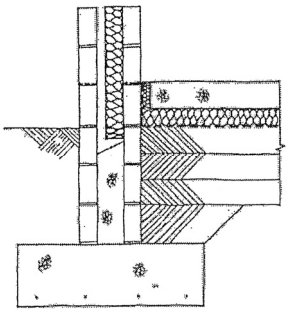
4. A new dwelling house is to be constructed on a site with moderately firm clay subsoil. The external walls are 350 mm concrete block with insulated cavity. (60)



(a) Show, using notes and freehand sketches, **two** different foundation types suitable for the dwelling house. Show clearly on your drawing the position of the reinforcing and indicate typical dimensions for each foundation type.

Any 2: **(2 × 20m)**

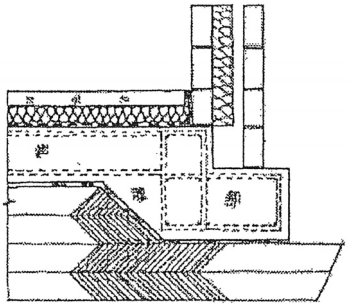
<u>Strip foundation</u>



** Drawing (10m), Notation (10m).
– width of foundation should be three times the wall width //
– adequate depth below ground level //
– concrete fill in cavity below ground level //
– insulation correctly fitted in the wall // *etc.*

** Accept any other appropriate answer(s).

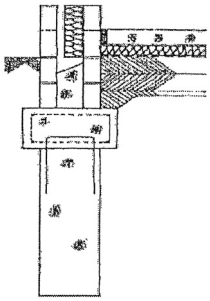
<u>Raft foundation</u>



** Drawing (10m), Notation (10m).
– 200 mm / 400 mm concrete reinforced slab over the required area //
– slab deepened under walls //
– contains a lot of reinforcement // *etc.*

** Accept any other appropriate answer(s).

<u>Short pile foundation</u>



** Drawing (10m), Notation (10m).
– pile holes are drilled with Auger 300 mm diameter to required depth //
– piles are drilled at junctions and positions to support building loads //
– steel reinforcement is placed in the hole and concrete is poured //
– a ground beam 500 mm × 300 mm is run around the building outline //
– the cavity wall is built on the ground beam // *etc.*

** Accept any other appropriate answer(s).

(b) Recommend a preferred solution and give **three** reasons in support of your recommendation.

Any 1: **(20m)**

** Preferred solution (5m), Reasons (3 × 5m).

– strip foundation //
  – suitable for moderately firm soil //
  – easily constructed, filled and levelled //
  – perimeter load carried evenly //
  – economical way to support load //
  – environmentally sustainable //
  – low embodied energy // *etc*.

  ** Accept any other appropriate answer(s).

– raft foundation //
  – suitable for soils of poor load-bearing capacity //
  – loads spread evenly over the whole area //
  – settlement reduced //
  – less deep excavation required //
  – easy to set out // *etc*.

  ** Accept any other appropriate answer(s).

– short pile foundation //
  – used when soil near surface has poor load-bearing capacity but deeper down is of sufficient bearing capacity //
  – area where soil is prone to movement //
  – easily constructed //
  – less excavation on site, hence less waste //
  – less chance of trench collapse // *etc*.

  ** Accept any other appropriate answer(s).

5. A house built in the 1970s has an un-insulated external cavity wall. The wall is finished with cement rendering and internally with a plaster finish. (60)

(a) Calculate the U-Value of the external wall, given the following data:

Cement rendering	thickness	19 mm
Concrete block outer leaf	thickness	100 mm
Un-insulated cavity	thickness	100 mm
Concrete block inner leaf	thickness	100 mm
Plaster finish	thickness	16 mm

Thermal data of external wall:

Resistance of external surface	(R)0.048	m^2	°C/W
Conductivity of external rendering	(k) 0.460	W/m	°C
Conductivity of concrete blocks	(k) 1.440	m^2	°C/W
Resistance of cavity	(R)0.170	m^2	°C/W
Conductivity of internal plaster	(k) 0.460	W/m	°C
Resistance of internal surface	(R)0.122	m^2	°C/W

Any 7 lines: **(7 × 4m)**
Correct U-value calculation **(3m)**

Layer	Thickness	Conductivity	Formula	Resistance
Units	Metres	W/m °C		m^2 °C /W
External surface				0.0480
Cement rendering	0.019	0.460	T/K	0.0413
Concrete block outer leaf	0.100	1.440	T/K	0.0694
Cavity				0.1700
Concrete block inner leaf	0.100	1.440	T/K	0.0694
Plaster	0.016	0.460	T/K	0.0347
Internal surface				0.1220

– total resistance = 0.5548 //
– U-value = 1 / total resistance //
= 1 / 0.5548 //
= 1.80 W/m^2 °C

(b) Using the U-value of the external wall obtained at **5(a)** above and the following data, calculate the heat loss annually through the un-insulated cavity wall:

Thermal data:

Area of external wall	160 m^2
Average internal temperature	20 °C
Average external temperature	5 °C
Heating period	10 hours per day for 40 weeks per annum
Cost of oil	85 cent per litre
Calorific value of oil	37350 kJ per litre
1000 watts	1 kJ per second

Any 5: **(5 × 3m)**
Correct cost calculation **(2m)**

– formula: rate of heat loss = U-value × area of roof × temperature difference
= 1.8 × 160 × (20 – 5) //
= 1.8 × 160 × 15 //
= 4320 watts (J / s)

– heating period p/a = s × min × hr × days × weeks
- 60 × 60 × 10 × 7 × 40 = 10,080,000 s

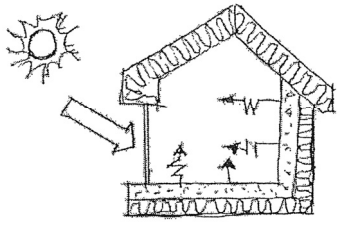
– kilo joules p/a
- $\frac{10080000 \times 4320}{1000}$ = 43,545,600 kJ

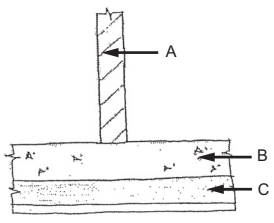
– litres p/a (calorific value of 1 litre of oil = 37350 kJ)
- $\frac{43545600}{37350}$ = 1,165.88 litres

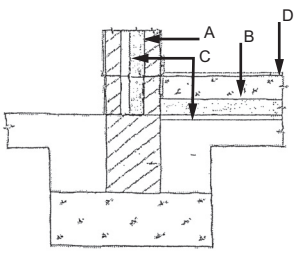
– cost p/a (1 litre costs 85 cent)
- 1,165.88 × 0.85 = €990.99 annually

(c) Discuss in detail, using notes and freehand sketches, the importance of thermal mass in improving the thermal performance of a dwelling house.

Any 2: **(2 × 6m)**
** Notes (3m), Sketch (3m).
– thermal mass improves thermal performance and enhances thermal comfort, therefore requiring less use of fossil fuels //
– dense materials such as brick, stone, concrete, glass, marble are most effective in storing and releasing substantial quantities of thermal energy //
– buildings that utilise thermal mass to increase thermal comfort depend on the principles of passive solar heating: Passive Solar Collection & Passive Solar Storage. In Ireland's mild climate, solar gain can make a substantial contribution (20%) to space heating requirements //
– thermal mass may best be utilised as a passive heating strategy in residential buildings // *etc*.



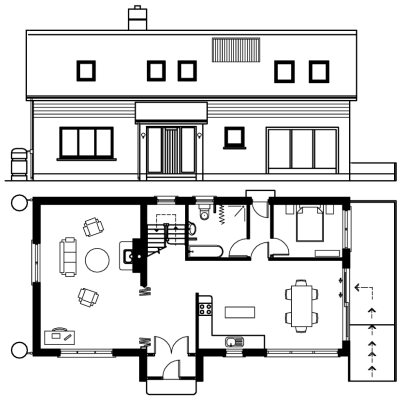




A = Concrete internal walls, B = Concrete, C = Rigid Insulation, D = Ceramic Tile,

6. The elevation and ground floor plan of a newly built house, in a rural area, are shown. The house has two additional bedrooms and a bathroom in the attic space. The external wall is of timber frame construction with a concrete block outer leaf. The house is designed to have low environmental impact. (60)

(a) With reference to the house design shown, discuss in detail, using notes and freehand sketches, **three** features in this design that contribute to reducing the environmental impact of this house.



Any 3: **(3 × 10m)**

** Notes (5m), Sketch (5m).

– economic use of space in kitchen / dining area, use fewer materials and therefore less embodied energy //
– large area of glazing on south facade utilises sunlight, allowing natural light into the building, cutting down the need for artificial lighting //
– use of roof solar panels cuts down cost of heating, panels release less CO_2 into the atmosphere //
– design of the building requires fewer materials and excavation, therefore less embodied energy used //
– the narrow plan requires less energy for heating //
– use of attic space cuts down on use of materials as overall house footprint is reduced // *etc.*

** Accept any other appropriate answer(s).

(b) Discuss in detail the importance of **each** of the following when designing an environmentally sustainable dwelling house:

- selection of materials **(10m)**
  ** Note (5m), Sketch (5m).
  – use of locally sourced material to match in with environment
  – locally sourced materials sustains local enterprise
  – use of traditional roof coverings, *e.g.* natural slate
  – renewable materials if grown in locally managed forests
  – only small amount of concrete used is good for environment
  – locally available materials reduces transport costs and emissions of CO_2
  – use of low-e triple-glaze with high U-value reduces heating costs
  – use of insulation that utilises wool and recycled paper is low-embodied energy
  – use of flat roof construction reduces the amount of materials required // *etc.*

  ** Accept any other appropriate material.

- design for lifetime use **(10m)**
  ** Note (5m), Sketch (5m).
  – good design principles to facilitate design for people of all ages
  – design to take advantage of sunlight / energy requirements
  – access ramp to front door
  – door opens wide enough for easy access for wheelchair users
  – ground floor to be kept at same level, no steps
  – all electrical fittings are at suitable heights for people of all ages and abilities
  – bathroom layout and size are suitable for elderly or wheelchair users
  – open-plan layout in kitchen / living room
  – use of solar panel to cut down energy costs
  – windows on south-facing wall to maximise use of sun
  – minimum windows on north facade of building // *etc.*

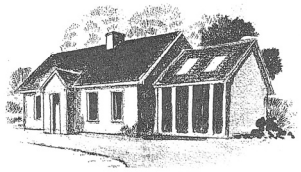
  ** Accept any other appropriate material.

- location of house **(10m)**
  ** Note (5m), Sketch (5m).

– house to be positioned correctly in landscape
– should not break the skyline
– design should not obscure or distract from landscape
– house not positioned on brow of hill
– house positioned to have shelter
– plant trees / shrubs native to the surrounding area
– conserve and retain existing stone walls
– use of local materials
– good landscaping to make the house fit in
– positioning house to utilise the energy from sun

** Accept any other appropriate material.

7. An extension has been built onto an existing dwelling house as shown in the sketch. The new extension has a solid concrete floor with a tiled finish. The existing dwelling house has an insulated suspended timber floor with a 25 mm tongued and grooved hardwood finish. The external walls of the existing are 350 mm cavity wall construction.



(60)

(a) To a scale of 1:5, draw a vertical section through the party wall. The section should show the typical construction details from the base of the existing foundation to 300 mm above the finished floor level. Both floors are finished at the same level. Include typical dimensions.

Any 12: **(12 × 4m)**

Solid floor

- tile finish //
- concrete subfloor 150 mm //
- thermal bridge //
- 100 mm insulation //
- DPM / radon barrier //
- sand blinding //
- hardcore 100 mm minimum //
- air duct pipe // *etc*.

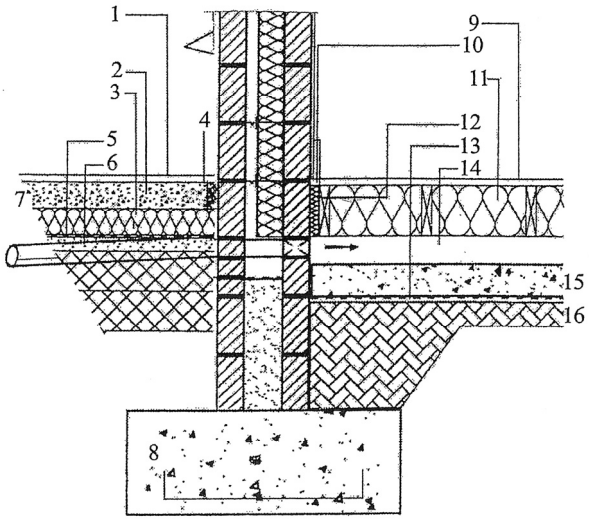
Suspended floor

- 25 mm tongued and grooved flooring //
- joists //
- insulation in floor //
- wall plate 100 mm × 75 mm //
- DPC //
- tassle wall (min 75 mm) //
- concrete subfloor 100 / 150 mm //
- radon barrier //
- blinding sand //
- hardcore 100 mm minimum //*etc*.

Party wall

- cavity wall //
- cavity insulation //
- air vent //
- DPC in wall // *etc*.

Scale **(4m)**, Draughtsmanship **(4m)**

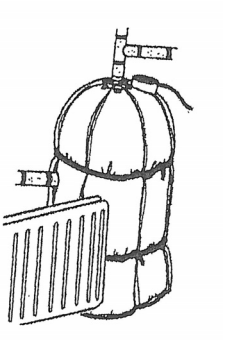


1. Floor finish (timber, floor-boards tiles, etc.
2. 150 mm concrete slab
3. 100 mm insulation of conductivity 0.03 W/m K floor insulation to tightly abut blockwork wall
4. Perimeter insulation with a min. R-value of 0.75 m^2 K/W
5. DPW radon barrier
6. Blinding sand
7. 150 mm hardcore
8. Concrete foundation
9. Floor finish (timber, floor-boards tiles, etc.
10. Seal between wall and floor air barrier with a flexible sealant or seal gap between skirting board and floor with tape or a flexible sealant
11. Insulation between joists where mineral wool quilt insulation is used. The insulaton is supported on polypropylene netting or a breather membrane draped over joists and held against their sides with staples or battens. The full thickness of insulation should extend for the width between joists, insulating cut to fit tightly beween them.
12. Perimeter insulation with a minimum R-value of 0.75 m KW DPM/radon barrier
13. Ensure block with a maximum thermal conductivity of 0.20 W/m K in the direction of heat flow is used and that block is suitable for use in foundations in all conditions. Wall insulation installed below the wall DPC must be fit for purpose with regards to water absorption
14. Ventilated subfloor
15. Concrete
16. Hardcore

(b) Show clearly on the drawing a method of providing cross-ventilation between the two floors.

** Method clearly shown on drawing. **(4m)**

8. **(a)** Show, using notes and a single-line diagram, a typical design layout for an oil-fired central heating and hot water system for a single storey dwelling house.
Show **two** radiators and give the typical sizes of the pipework.



Any 11: **(11 × 3m)**

** Drawing (2m), Notation (1m).

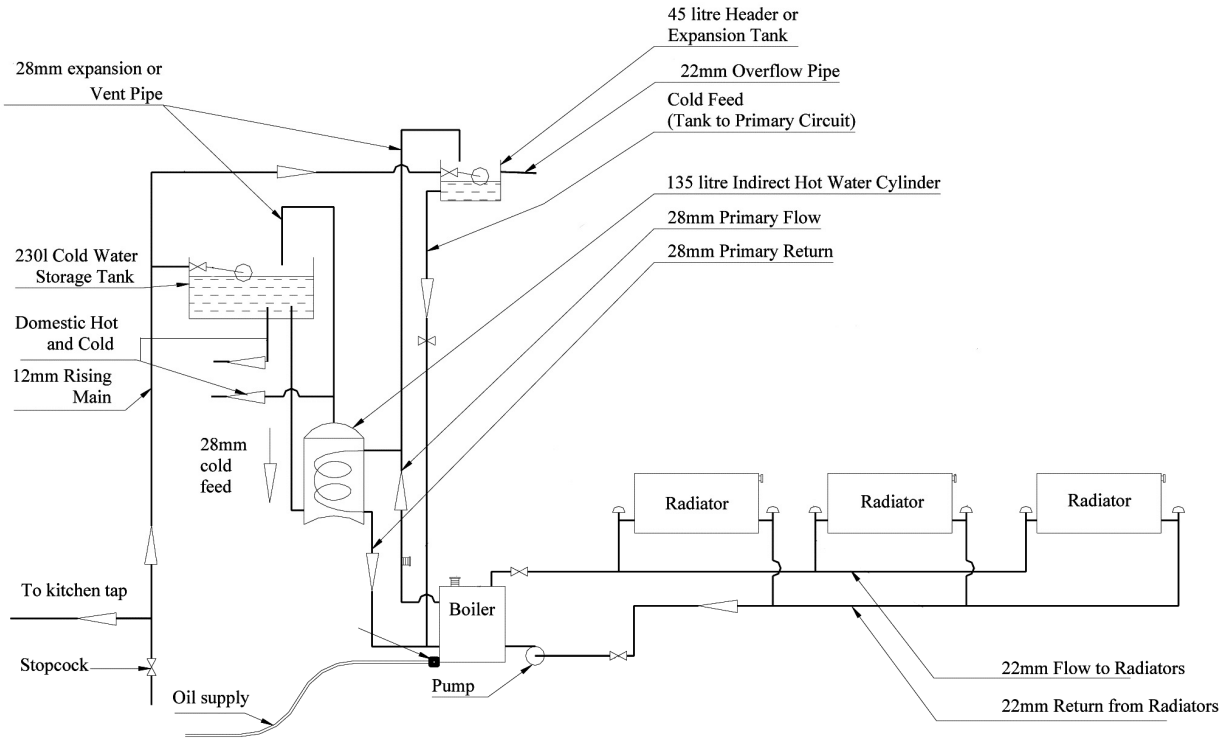
Domestic hot water supply

– rising main //
– ballcock //
– cold water storage tank //
– overflow pipe //
– hot water cylinder //
– primary flow and return //
– boiler //
– hot water draw off //
– expansion pipe // *etc*.

Central heating supply

– radiators //
– header / expansion tank //
– expansion pipe //
– pipes to radiators //
– return pipes from radiators //
– thermostatic valve //
– lockshield valve //
– gate and drain valve // *etc*.

** Award a maximum of 2 marks for pipes included without typical sizes.

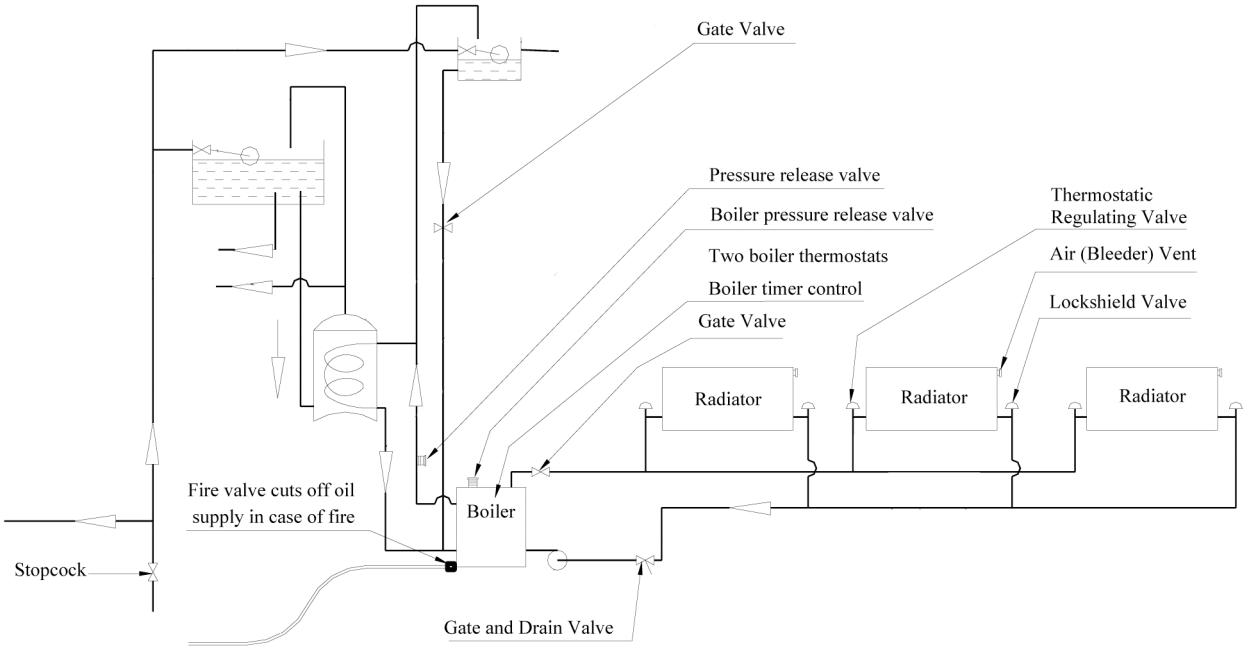


(b) Show clearly on your drawing **three** valves necessary to ensure the safe running of the system and write a short note explaining their function.

Any 3: **(3 × 4m)**

– control valves located on return //
– radiator to have hand wheel / thermostatic valves on flow //
– radiator to have lockshield valves on return //
– air bleed valve on radiators //
– isolating / drain valves located on return // *etc*.

** Accept any other appropriate answer(s).



(c) Discuss in detail **three** advantages of installing a zoned heating system in a domestic dwelling.

Any 3: **(3 × 5m)**

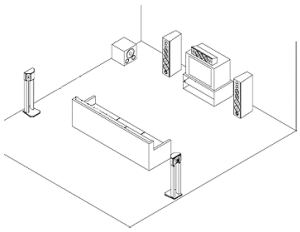
– it reduces the use of oil, thus saving on fuel use and cost //
– it allows for different temperatures to be achieved in different zones //
– it allows the on and off timing of the heat in a house to be set for the different zones //
– allows zones to be isolated for maintenance without affecting the heating in another zone //
– gives more control to a householder in heating the house // *etc*.

** Accept any other appropriate answer(s).

9. Careful design detailing is required to achieve effective sound insulation and acoustics in a contemporary dwelling house. (60)

(a) Describe **two** sound insulation principles on which effective sound insulation is based.

Any 2: **(2 × 10m)**



– Isolation //
  – creating a cavity between the two partitions opposite surfaces will reduce the transmission of sound through the structure

– Weight //
  – increasing the weight of the partition will improve the sound insulation properties and will combat the transmission of airborne noise

– Flexibility //
  – the use of an absorbent quilt in the space between the two studded partitions will reduce the amount of sound transmitting through the structure

– Completeness
  – the elimination of any small gaps and making sure the structure is airtight will improve overall insulation of the partition

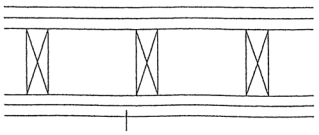
(b) A living room, as shown in the sketch, is separated from an adjacent study/office by a traditional stud partition. Using neat freehand sketches, show **two** design details that would improve the sound insulation properties of the stud partition. The walls and ceilings of the living room have a smooth hardwall plaster finish. The floor is solid concrete with a laminate wood finish.

Any 2: **(2 × 10m)**

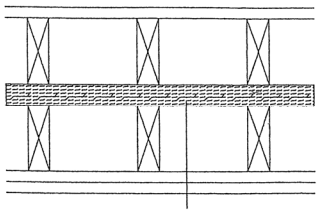
** Notation (5m), Sketch (5m).

– fit a second layer of plasterboard to the existing partition //
– create another stud partition with an insulated cavity between the two //
– create a staggered stud partition with sound insulating material between the studs //
– attach a new stud partition to the existing one //
– seal around the existing partition with silicone // *etc*.

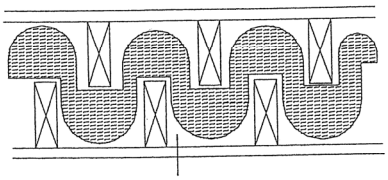
** Accept any other appropriate answer(s).



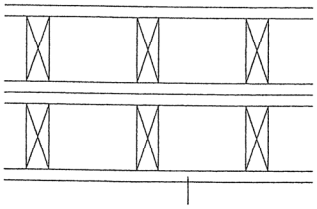
Fix a second layer of plaster-board to the existing plaster-board and stagger the joints



Create a double stud partition with a cavity and insulation separating the two partitions



Create a staggered stud partition with sound insulating material between the studs



Attach a new stud partition to the existing stud partition

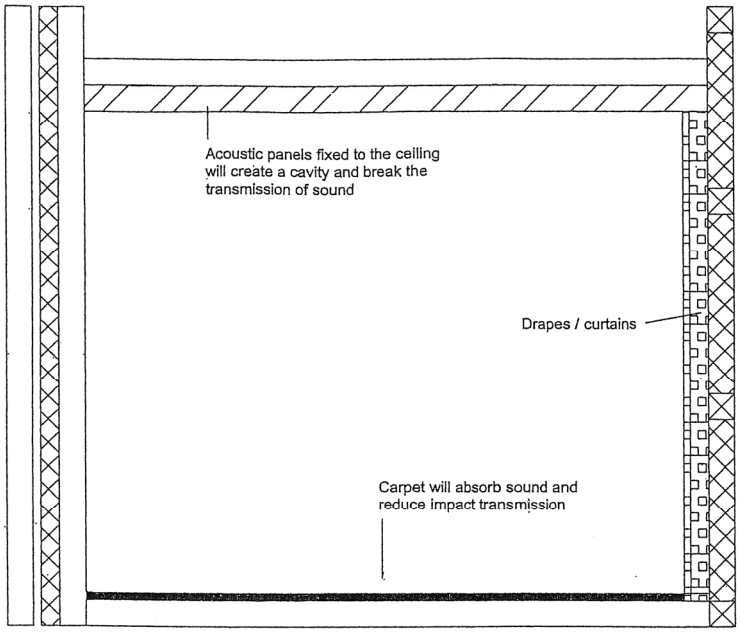
(c) Show, using notes and freehand sketches, **two** methods of enhancing the acoustic properties of the living room.

Any 2: **(2 × 10m)**

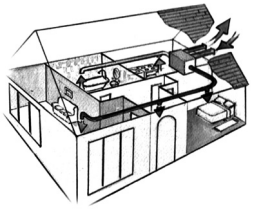
** Notation (4m), Sketch (6m).

– put a carpet on the concrete floor, as this will absorb some of the sound, thus improving the acoustic properties //
– hang curtains, drapes or other sound-absorbent materials //
– fix acoustic tiles or panels to the ceilings and walls //
– create an air space by fixing panels to the ceilings and walls //
– position the speakers carefully to avoid undesirable reflection of sound // *etc*.

** Accept any other appropriate answer(s).

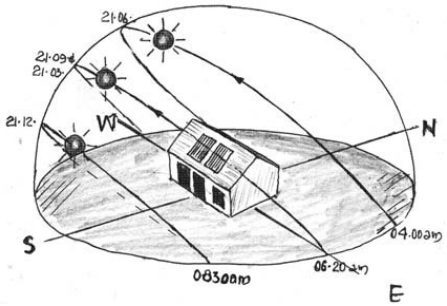


10. (a) Using notes and freehand sketches, discuss in detail the importance of any **two** of the following in the design of a Passive House: (60)



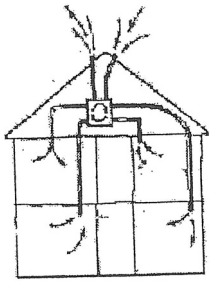
Any 2: **(2 × 12m)**

- optimum benefit from passive solar gain
  - ** Note (6m), Sketch (6m).
  - – mass of walls and floors to act as heat sink, thick concrete walls and floors, tiled floors //
  - – sun path, elevation 78° in mid summer, 30° in mid winter //
  - – reduced glazing to the north //
  - – living rooms on the southern elevation of house //
  - – compact form to minimise surface to volume ratio //
  - – solar panels on southern roof at 45° pitch to optimise solar gain //
  - – maximize glazing on southern facade to maximize solar gain - triple glazing, low-e argon filled //
  - – window and door frames to be insulated and thermally broken to prevent heat loss through frames // *etc.*



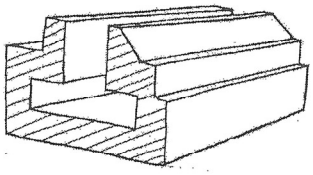
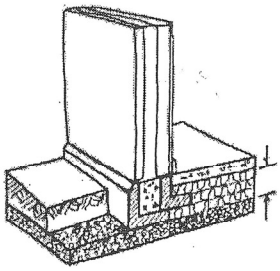
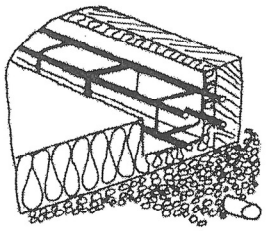
- controlled air changes
  - ** Note (6m), Sketch (6m).
  - – air leakage not to exceed 0.6 air changes per hour using 50 Pascals over pressurisation and under pressurization testing //
  - – building must be air-tight //
  - – all junctions taped //
  - – MHRV system extracts warm air from kitchen / bathrooms etc and heated by preheated air in chamber and this helps raise the temperature of incoming air //
  - – flow of air in house is mechanically controlled //
  - – fresh incoming air never mixed with stale air leaving the building //
  - – filters need to be changed to ensure fresh air // *etc.*

  ** Accept any other appropriate material.



- foundations suitable for a Passive House.
  ** Note (6m), Sketch (6m).
  – well insulated Passive Slab foundations used //
  – foundations wrapped in expanded polystyrene 100mm - 400mm in thickness to prevent cold bridge and heat loss through the structure //
  – services incorporated in foundation //
  – insulated thickened floor slab used to support internal walls //
  – less concrete used in foundation as no internal foundations //
  – hardcore should be clean and free from organic matter to help moisture pass through it quickly //
  – heat loss greatly reduced due to all cold bridges eliminated //
  – low carbon footprint // *etc.*

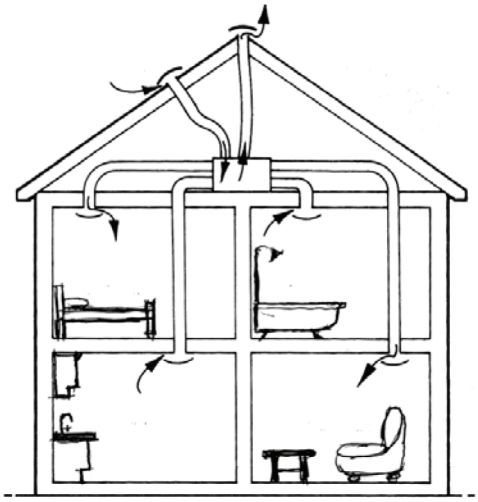
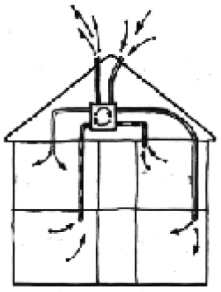
  ** Accept any other appropriate material.

(b) Describe, using notes and freehand sketches, how a Mechanical Heat recovery with Ventilation system (MHRV) operates for a Passive House. **(16m)**

** Note (8m), Sketch (8m).
– removes pre-heated air from kitchen, bathroom and utility rooms //
– conducts this pre-heated air to air exchange unit, where heat is extracted //
– the extracted heat is used to heat fresh, colder air //
– a separate ducting system distributes warm fresh air throughout the house using an independent ducting system //
– system collects up to 93% of heat from exhaust air in dwelling //
– filters are fitted to prevent allergens and pollen entering the dwelling //
– provides constant flow of fresh air around the house // *etc.*

** Accept any other appropriate material.

(c) It is important in Passive House design to eliminate possible air leakage routes.
Show, using notes and freehand sketches, the typical design detailing that will prevent air leakage at **two** locations in the house.

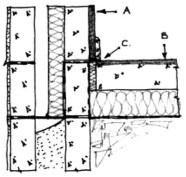
Any 2: **(2 × 10m)**

** Note (5m), Sketch (5m).

** Possible location include

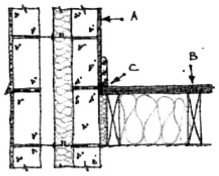
<u>Concrete ground floor and external wall</u>

– Air barrier continuity
– Seal between Wall (A) and Floor (B) barriers with a flexible sealant (C)
– Seal between skirting board and floor with flexible sealant



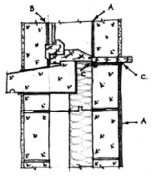
<u>Suspended timber floor with external wall</u>

– Air barrier continuity
– Seal between Wall (A) and Floor (B) barriers with a flexible sealant (C)
– Seal between skirting board and floor with flexible sealant (C)



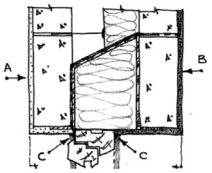
<u>Window cill detail in external wall</u>

– Air barrier continuity
– Flexible sealant (C) applied to all interfaces between internal air barrier (A) and the window frame and window board
– Seal between external wall (B) and the window frame with flexible sealant (C)



<u>Window head detail in external wall</u>

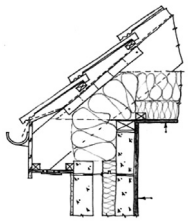
– Air barrier continuity
– Flexible sealant (C) applied to all interfaces between internal air barrier (B) and the window frame
– Seal between external wall (A) and the window frame with flexible sealant (C)



<u>Eaves / External wall</u>

– Air barrier continuity
– Seal between internal air barrier (A) between wall and ceiling plaster with an approved tape (C)

** Accept any other appropriate answer(s).



OR

10. "Architecture has always involved the creative use of natural resources to serve human purposes. There is also a long and inventive tradition in the making of buildings that are sensitive to place and to climate. In the late twentieth century, these two concepts have taken on added meaning. Buildings play a surprisingly large role in that balance and the decisions taken by architects and engineers have calculable impact."

GREEN DESIGN, SUSTAINABLE BUILDING FOR IRELAND
Office of Public Works 1996, Page 3

Discuss the above statement in detail and propose **three** guidelines that would promote the development of environmentally sustainable housing in Ireland.

Discuss:
Any 3: **(3 × 10m)**
** Point (4m), Discussion (6m)
** Points may included the following.

- using the earth's resources in a moral and ethical way, so as not to jeopardise the needs of future generations to meet their needs. This requires a changed mind-set to reduce energy needs and carbon emissions through the careful use of the finite resources of the planet
- good infrastructure, public transport and roads if possible to reduce dependency on private cars
- as oil and gas supplies are depleted and energy becomes scarce, we will need to reconfigure how we live
- schools and social amenities were often a distance from these estates and not integrated into the neighbourhood - oftentimes children could not walk to school from home
- there were no safe routes or green routes or pedestrian routes provided for children to walk safely to school
- this leads to increasing separation between home, work and town centre with consequent increased private car use, making roads unsafe for children to walk or cycle to school
- parents have to drive their children to school from the suburbs leading to increased congestion on roadways, resulting in longer journey times and increased use of depleting fossil fuels - petrol and diesel
- the suburban sprawl development is unsustainable and does not consider the energy needs of future generations - architects must design with a sense of the local area
- vernacular buildings of modest scale, careful use of resources - most sourced locally
- houses built in harmony with the environment and surrounding areas
- skills supplied by local workforce, designers, masons, carpenters, thatchers, weavers, *etc*.
- vernacular - restrained use of materials giving clean lines and simplicity of form
- contemporary know-how and intellectual cleverness - such as passive solar design, use of modern glass technology and orientation to store sun's energy, airtight and mechanical ventilation, heat recovery (MVHR) to control flow of fresh, preheated air
- smart metering and smart technologies to reduce energy needs, *e.g.* LEDS for lighting
- purposeful eco-friendly design in choice of materials having low embodied energy to reduce carbon footprint, use of green building techniques, elimination of materials using toxins such as toxins in preservatives, glues, varnishes, paints, *etc*.
- size and scale of house to meet needs of inhabitants, no trophy houses - modesty of scale
- building for longevity, accessible to all, open plan multi-use room layout, no long dark corridors, re-use and recycling of materials
- use of renewable energies - solar panels to heat water, on-site generation of electricity where possible, A-rated appliances, energy saving electrical fittings and appliances
- natural means of sewage treatment - polishing filters and reed beds
- houses as balanced part of landscape not hosted on it
- careful siting, choice of materials, scale and form of house, use of local materials, reduction in energy needs, eco-friendly design, low-environmental impact houses

** Accept other relevant points supported by reasonable argument.

Guidelines:
Any 3: **(3 × 10m)**

** Point (4m), Discussion (6m) .

– provide social areas such as parks and open green areas where people can walk and enjoy the outdoor environment
– modest scale to meet the needs of occupants
– build in clusters
– use sustainable energies / provide grants to retro fit and upgrade existing dwellings
– flexible design of buildings to meet changing lifetime use by occupants
– develop models of good practice, *e.g.* eco-village

** Accept other relevant guidelines supported by reasonable argument.