GCE AS/A LEVEL

WJEC GCE AS/A Level in

BUILT ENVIRONMENT

APPROVED BY QUALIFICATIONS WALES

SAMPLE ASSESSMENT MATERIALS - UNIT 3

Teaching from 2022

For A level award from 2024

Contents

Candidate Name	Centre Number					Candidate Number				

GCE A LEVEL
BUILT ENVIRONMENT

UNIT 3

MATERIALS, TECHNOLOGIES AND TECHNIQUES

SAMPLE ASSESSMENT MATERIALS

2 hours 30 Minutes

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator.

INSTRUCTIONS FOR CANDIDATES

Answer **ALL** questions.

Write your name, centre number and candidate number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this booklet.

Use black ink or black ball-point pen.

Do not use pencil or gel pen.

Do not use correction fluid.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part question. You are advised to divide your time accordingly.

The total number of marks available is 100.

You are reminded of the need for good English and orderly, clear presentation in your answers. The quality of your written communication, including appropriate use of punctuation and grammar, will be assessed in your answer to question 7.

Useful formulae

Area formulae of 2D shapes:

- square = side x side
- rectangle = length x breadth
- triangle = ½ base x height
- circle = πr^2
- sector of a circle: angle/360^o x $\pi r2$
- rhombus = ½ pq (where p and q are the two diagonals)
- parallelogram = base x height

Perimeter formulae of 2D shapes:

- regular polygon = side x number of sides
- irregular polygon = sum of all sides
- circle = $2\pi r$

Surface area formulae of 3D shapes:

- surface area of a cube = $6a^2$ (where a is the length of each side)
- surface area of a rectangular prism = 2ab+2bc+2ac (where a, b and c are the lengths of the three sides)
- surface area of a sphere = $4\pi r^2$
- surface area of a cylinder = $2\pi r^2 + 2\pi rh$ (where h is the height of the cylinder)

Volume formulae of 3D shapes:

- volume of a cube = a^3 (where a is the length of each side)
- volume of a rectangular prism = length x width x height
- volume of a sphere = $4/3\pi r^3$
- volume of a cylinder = $\pi r^2 h$

Formulae to calculate the maximum bending moment of:

- simply supported beams:
  - point load in centre WL/4
  - point load, off centre Wab/L
  - uniformly distributed load $wL^2/8$
- cantilever beams:
  - point load WL
  - uniformly distributed load $wL^2/2$

Energy consumption of an appliance or item of plant: P=1000E/t

*Answer **all** questions.*

1. (a) Outline the following properties of building construction materials: 3 x [2]
(i) brittleness
(ii) malleability
(iii) ductility.

(i) brittleness: ……

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(ii) malleability: ……..

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(iii) ductility: ……

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(b) Describe how materials used in building construction may respond if they are exposed to high levels of humidity over a long period of time. [6]

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2. The outer walls of a house and garage are to be constructed from brick.

(a) Describe the properties of brick which make it suitable as a construction material. [6]

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(b) The side wall of the garage is to be built using standard sized bricks of length 215mm and height 65mm. The bricks are to be laid lengthwise and a 10mm mortar joint is to be used in the construction. [5]

The wall is 5.84m long and 2.39m high. It includes an opening for one window 1.35m wide and 1.125m high, and an opening for one door 0.9m wide and 2.25m high.

Calculate the minimum number of bricks required to build the wall, assuming the window and door are positioned to minimise waste and allow the use of only whole or half bricks in the construction.

Show all calculations.

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3. Thermal comfort is important in the design and construction of a building.

(a) Describe how environmental factors may affect thermal comfort in a building. [6]

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(b) Describe the factors which need to be taken into account when controlling heat flow in a building, and the controls required for a heating system to regulate the operation of equipment. [6]

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(c) Explain how the impact of temperature change on users of residential buildings can vary with type of building construction, and may be compounded by social and economic factors. [6]

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4. (a) Loads on structures may be classified as live loads or dead loads. Describe, with examples, the difference between these two classifications of load. [6]

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(b) The flat roof of a building is supported by a series of horizonal beams. Each beam carries a uniformly distributed load of 2.9kN/m, is 3.5m long and is simply supported at each end.

(i) Calculate the maximum bending moment in each beam. [4]

(ii) Calculate the distance from the left-hand wall to the position of the maximum bending moment in each beam. [1]

Show all calculations.

(i) ……..

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(ii) ……..

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5. Describe the main elements of integrated passive design and discuss the barriers to and the drivers for the widespread use of passive house design in Wales. [14]

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6. A medium-rise building has previously been let as residential units. The owner has decided to undertake a full refurbishment and convert the building into a mixed-use development.

The ground floor will be converted into a number of small commercial units and one large unit which will operate as a bar with a live-music licence. The remaining four floors will contain residential units.

(a) Reducing noise pollution in the refurbished building is an important consideration.

Explain how the owner can ensure that sound is managed appropriately in the refurbished building to address the comfort of residents in the building and neighbouring properties, and to fulfil relevant legal responsibilities. [8]

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(b) Explain the different types of artificial lighting the owner could install in communal areas, such as walkways and stairways, of the four floors containing residential units. [6]

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7. The external envelope of a building is constructed from steel, timber and brick. The building is to be refurbished because these materials have degraded over time. [20]

Describe the possible causes of degradation in steel, timber and brick and recommend measures which could be taken to solve potential issues in this building, and prevent or reduce further degradation after refurbishment.

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MARK SCHEME

Guidance for examiners

Positive marking

It should be remembered that candidates are writing under examination conditions and credit should be given for what the candidate writes, rather than adopting the approach of penalising them for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based, the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

Mark schemes often list points which may be included in candidates' answers. The list is not exhaustive. *The inclusion of 'Credit any other valid response.*' (or similar instruction) within mark schemes allows for the possible variation in candidates' responses. Credit should be given according to the accuracy and relevance of candidates' answers.

Appropriate terminology is reflected in exemplar responses in mark schemes. However, unless there is a specific requirement within a question, candidates may be awarded marks where the answer is accurate but expressed in their own words.

Banded mark schemes

For band marked questions, mark schemes are in two parts: the indicative content and the assessment grid.

The indicative content suggests the range of points and issues which may be included in candidates' answers. It can be used to assess the quality of the candidate's response. As noted above, indicative content is not intended to be exhaustive and candidates do not have to include all the indicative content to reach the highest level of the mark scheme.

However, in order to reach the highest level of the mark scheme a candidate must meet the requirements of the highest mark band. Where a response is not creditworthy, that is, it contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

In GCE Built Environment, each question will address one or more assessment objectives: from AO1, AO2 or AO3. Where appropriate, the assessment grid subdivides the total mark that may be allocated for a question into individual assessment objectives. These are shown in bands in the mark scheme. For each assessment objective, descriptors will indicate the different skills and qualities at the appropriate level.

Candidates' responses to questions are assessed against the relevant assessment objectives. Where a question addresses more than one assessment objective, candidates may achieve different bands within that question. In these cases, a mark will be awarded for each assessment objective then totalled to give an overall mark for the question.

The marking of banded mark questions should always be positive. This means that, for each candidate's response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

Examiners should first read and annotate the candidate's answer to pick out the evidence that is being assessed in that question. The mark scheme can then be applied. This is done as a two-stage process.

Stage 1 – Deciding on the band

Beginning at the lowest band, examiners should look at the candidate's answer and check whether it matches the descriptors for that band. If the descriptors at the lowest band are satisfied, examiners should move up to the next band and repeat this process for each band until the descriptors match the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the candidate's response should be used to decide on the mark within the band. For instance, if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content.

Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Stage 2 – Deciding on the mark

During standardising (the marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a candidate's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Question		Answer	AO1	AO2	AO3	Total Mark
1.	(a)	*Outline the following properties of building construction materials:* *(i) brittleness* *(ii) malleability* *(iii) ductility.*	6			6
		(i) brittleness: Award **one** mark for a basic outline of brittleness, for example: • brittleness is when a material breaks rather than bends when subject to a load • brittleness is when a material fractures under load rather than deforms. Award **two** marks for a more developed outline of brittleness, for example: • brittleness is when a material breaks rather than bends when subject to a load and it is not good at resisting impacts • brittleness is when a material fractures under load rather than deforms and it is not good at resisting vibrations. (ii) malleability: Award **one** mark for a basic outline of malleability, for example: • malleability is when a material can be shaped by applying a compressive force • malleability is when a material can be hammered into thin sheets. Award **two** marks for a more developed outline of malleability, for example: • malleability is when a material can be shaped by applying a compressive force, for example by hammering or rolling, without fracturing • malleability is when a material such as a metal can be hammered into thin sheets, twisted or bent without breaking. (iii) ductility: Award **one** mark for a basic outline of ductility, for example: • ductility is when a material can be stretched by applying a tensile force • ductility is when a material can be pulled into a thinner shape/section. Award **two** marks for a more developed outline of ductility, for example: • ductility is when a material can be stretched into a smaller section/a wire by applying a tensile force, without fracturing • ductility is when a material such as a metal can be pulled into a longer and thinner shape/section without breaking. Credit any other valid response.				

Question		Answer	AO1	AO2	AO3	Total Mark
	(b)	*Describe how materials used in building construction may respond if they are exposed to high levels of humidity over a long period of time.*	6			6

		Answers may refer to the following issues that could occur when building materials are exposed to high levels of humidity over time:
		• condensation may form on the material from airborne moisture
		• mould growth may occur on the material because of excessive air moisture
		• mildew staining may occur if there is inadequate circulation
		• damage to finishes may occur, such as
		  • wall paint may bubble and peel
		  • wall paper may peel
		  • staining or growths on wood
		• metal may corrode at very high levels of humidity
		• there may be decay of the building fabric, such as roof or external cladding materials
		• there may be decay of wooden fittings
		• there may be a reduction in the thermal performance of insulation materials.
		
		Credit any other valid response.				

Band	AO1
3	**5-6 marks** A very good description which shows: • thorough knowledge and understanding of how materials may respond if they are exposed to high levels of humidity over time • a confident grasp of the effects when these materials are used in building construction.
2	**3-4 marks** A good description which shows: • generally secure knowledge and understanding of how materials may respond if they are exposed to high levels of humidity over time • a generally secure grasp of the effects when these materials are used in building construction.
1	**1-2 marks** A basic description which shows: • some knowledge and understanding of how materials may respond if they are exposed to high levels of humidity over time • some grasp of the effects when these materials are used in building construction.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
2.	*The outer walls of a house and garage are to be constructed from brick.*					
	(a)	*Describe the properties of brick which make it suitable as a construction material.*	6			6
		Answers may refer to the following properties of brick which make it a suitable construction material: • bricks are formed of a hard material and do not deform easily in a construction • bricks are durable and have a long service life • the durability of bricks is directly related to the material hardness • bricks have a high compressive strength and are well suited to use for load bearing walls • the flexural tensile strength of brick makes it suitable for use in situations where bending loads may be imposed on the structure • bricks can resist water percolation which leads to good levels of frost resistance. Credit any other valid response.				

Band	AO1
3	**5-6 marks** A very good description which shows: • thorough knowledge and understanding of the properties of brick • a confident grasp of which properties of brick make it suitable as a construction material.
2	**3-4 marks** A good description which shows: • generally secure knowledge and understanding of the properties of brick • a generally secure grasp of which properties of brick make it suitable as a construction material.
1	**1-2 marks** A basic description which shows: • some knowledge and understanding of the properties of brick • some grasp of which properties of brick make it suitable as a construction material.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
	(b)	*The side wall of the garage is to be built using standard sized bricks of length 215mm and height 65mm. The bricks are to be laid lengthwise and a 10mm mortar joint is to be used in the construction.* *The wall is 5.84m long and 2.39m high. It includes an opening for one window 1.35m wide and 1.125m high, and an opening for one door 0.9m wide and 2.25m high.* *Calculate the minimum number of bricks required to build the wall, assuming the window and door are positioned to minimise waste and allow the use of only whole or half bricks in the construction.* *Show all calculations.*		5		5
		Assume the positioning of the window and door allow bricks to be cut in half. The sizes given, including the mortar joint directs candidates towards the standard co-ordinating size for brickwork of 225mm x 75mm. Award marks for relevant steps in the calculation as follows: • use of 225mmx75mm as the unit length and height of brick plus mortar [1] • *(The wall length and height takes account of the lack of mortar on the final bricks laid, both in terms of length and height.)* • wall is 26 bricks long by 32 bricks high = 832 [1] • door cut out saves 4 x 30 bricks = 120 [1] • window cut out saves 6 x 15 bricks = 90 [1] • total number required for wall = 622 bricks. [1] The following alternative approach should be credited, noting the calculated total is different. *(This approach relies on the candidate knowing that 60 standard bricks laid lengthwise are required for every square metre of wall, though there is no requirement within the specification for them to do so.)* • area of wall is 5.84 x 2.39 = 13.9576m^2 [1] • area of door is 0.9 x 2.25 = 2.025m^2 [1] • area of window is 1.35 x 1.125 = 1.51875m^2 [1] • area of bricks required = 10.41385m^2 [1] • total number required = 60 x 10.41385 = 624.831 / 625 bricks [1] Credit any appropriate approach to calculating the number of bricks required. Do not penalise for any errors carried forward. Credit should be given where it is clear that an appropriate mathematical method has been used.				

Question		Answer	AO1	AO2	AO3	Total Mark
3.	*Thermal comfort is important in the design and construction of a building.*					
	(a)	*Describe how environmental factors may affect thermal comfort in a building.*	6			6

		Answers may refer to the following environmental factors that could affect thermal comfort in a building:
		• air temperature: the temperature of the air surrounding a person may impact on whether they feel too hot, too cold or comfortable
		• radiant temperature: if there are heat sources in the building, such as radiators or items of equipment (for example, oven, tumble dryer), radiant temperature can have a bigger influence than air temperature on how a person gains (or loses) heat to the environment, and therefore may have a significant impact on thermal comfort
		• air velocity: the movement of air can have a significant impact:
		  • still or stagnant air in buildings that are artificially heated may affect thermal comfort by making the environment feel stuffy for users
		  • moving air can increase heat loss through convection; in warm conditions this may improve thermal comfort, in cooler conditions this may make the environment feel uncomfortably cold
		  • physical activity may increase air movement so needs to be taken into account when aiming for ideal conditions in a building
		  • even small air movements in cooler environments may appear to be a draught which can affect thermal comfort
		• relative humidity: low levels of relative humidity are unlikely to have a significant impact on thermal comfort, however high levels of humidity in warm conditions may make it more difficult for a person to cool down, impacting on their thermal comfort.
		Credit any other valid response.				

Band	AO1
3	**5-6 marks** A very good description which shows: • thorough knowledge and understanding of environmental factors within a building • a confident grasp of how environmental factors may affect thermal comfort in a building.
2	**3-4 marks** A good description which shows: • generally secure knowledge and understanding of environmental factors within a building • a generally secure grasp of how environmental factors may affect thermal comfort in a building.
1	**1-2 marks** A basic description which shows: • some knowledge and understanding of environmental factors within a building • some grasp of how environmental factors may affect thermal comfort in a building.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
	(b)	*Describe the factors which need to be taken into account when controlling heat flow in a building, and the controls required for a heating system to regulate the operation of equipment.*	6			6

		Answers may refer to the following factors which need to be taken into account when controlling heat flow in a building:
		• the presence or otherwise of:
		  • insulation and how effective that insulation is
		  • (localised) thermal bridges which allow heat to flow from warm areas to cooler ones (for example, wall ties and junctions between walls and floors)
		  • air leakage (for example, where the envelope of the building is damaged/compromised allowing heat to flow)
		• solar radiation/gain through windows exposed to direct sunlight, or reflected sunlight, can affect the heat flow in a building
		• in a well-insulated building, the interior heat generated by occupants and activities can have an effect on heat flow.
		
		The description should refer to the following controls required to regulate the operation of equipment:
		• a sensing device to compare the actual state of the building with target/desired state
		• a control system to process input data to determine what action is required within the building.
		
		Credit any other valid response.				

Band	AO1
3	**5-6 marks** A very good description which shows: • thorough knowledge and understanding of the factors which need to be taken into account when controlling heat flow in a building • a confident grasp of the controls required for a heating system to regulate the operation of equipment.
2	**3-4 marks** A good description which shows: • generally secure knowledge and understanding of the factors which need to be taken into account when controlling heat flow in a building • a generally secure grasp of the controls required for a heating system to regulate the operation of equipment.
1	**1-2 marks** A basic description which shows: • some knowledge and understanding of the factors which need to be taken into account when controlling heat flow in a building • some grasp of the controls required for a heating system to regulate the operation of equipment.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
	(c)	*Explain how the impact of temperature change on users of residential buildings can vary with type of building construction, and may be compounded by social and economic factors.*		6		6

		Answers may refer to the following when explaining the impact of temperature change on residential building users:
		
		• residential buildings with poor thermal insulation will gain and lose heat quickly, potentially exposing users to uncomfortably hot conditions in summer and uncomfortably cold conditions in winter
		• older buildings may have less efficient heating/cooling facilities than newer buildings
		• residential buildings such as high-rise flats may become uncomfortably hot in summer and users may not have easy access to outside spaces
		• temperature change within a building can be impacted by the availability of green space and shading surrounding the building; shading may reduce solar gains and minimise temperature change
		
		• different users' tolerance to temperature change can be compounded by social and economic factors:
		  • age of user – older users may find it more difficult than younger users to adapt to temperature change
		  • health of user – users living with illness may find it more difficult than healthy users to adapt to temperature change
		  • income of user – users living on a low income / with little disposable income may struggle to afford to heat a cold house to a comfortable level, may have less efficient or poorly maintained heating systems
		  • social isolation of user – users who are socially isolated may not leave their home often and are therefore affected by conditions within the building 24 hours a day.
		
		Credit any other valid response.				

Band	AO2
3	**5-6 marks** A very good explanation which shows: • thorough knowledge and understanding of how the impact of temperature change on users of residential buildings can vary with type of building construction • a confident grasp of how the impact of temperature change may be compounded by social and economic factors.
2	**3-4 marks** A good explanation which shows: • generally secure knowledge and understanding of how the impact of temperature change on users of residential buildings can vary with type of building construction • a generally secure grasp of how the impact of temperature change may be compounded by social and/or economic factors.
1	**1-2 marks** A basic explanation which shows: • some knowledge and understanding of how the impact of temperature change on users of residential buildings can vary with type of building construction • some grasp of how the impact of temperature change may be compounded by social or economic factors.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
4.	(a)	*Loads on structures may be classified as live loads or dead loads. Describe, with examples, the difference between these two classifications of load.*	6			6
		Answers may refer to the following when describing the two classifications of load and the difference between them: • live loads (applied/imposed loads) often result from the use of a structure • dead loads (permanent/static loads) result from the weight of a building's structural elements • a live load may vary over time and move, while a dead load remains constant over time and is static. Examples of live loads include: • people in buildings • vehicles on bridges • loads being lifted into place by a crane. Examples of dead loads include: • the weight of an upper floor/roof on the walls of a building • the weight of the structure of a building on its foundations • immovable fixtures such as machinery within a factory. *Accept environmental loads such as wind on the wall of a building or snow on the roof of a house as live loads.* Credit any other valid response.				

Band	AO1
3	**5-6 marks** A very good description which shows: • thorough knowledge and understanding of the difference between live loads and dead loads, illustrated with highly appropriate examples • a confident grasp of relevant concepts related to the classification of loads on structures.
2	**3-4 marks** A good description which shows: • generally secure knowledge and understanding of the difference between live loads and dead loads, illustrated with appropriate examples • a generally secure grasp of relevant concepts related to the classification of loads on structures.
1	**1-2 marks** A basic description which shows: • some knowledge and understanding of the difference between live loads and dead loads • some grasp of relevant concepts related to the classification of loads on structures.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
	(b)	*The flat roof of a building is supported by a series of horizonal beams. Each beam carries a uniformly distributed load of 2.9kN/m, is 3.5m long and is simply supported at each end.* *(i) Calculate the maximum bending moment in each beam.* *(ii) Calculate the distance from the left-hand wall to the position of the maximum bending moment in each beam.* *Show all calculations.*		4 1		5
		Award marks for relevant steps in the calculations as follows: (i) • use of $wL^2/8$ [1] • correct value for w of 2.9 used in formula [1] • correct value for L of 3.5 used in formula [1] • $2.9 \times (3.5)^2 / 8 = 4.4406$kN/m [1] Do not penalise for any errors carried forward. Credit should be given where it is clear that an appropriate mathematical method has been used. (ii) • 3.5 / 2 = 1.75m [1] Award the mark if the candidate shows the distance of 1.75m without calculation as they will have demonstrated understanding that the maximum bending moment of a UDL is at the mid-point of a simply supported beam.				

Question	Answer	AO1	AO2	AO3	Total Mark
5.	*Describe the main elements of integrated passive design and discuss the barriers to and the drivers for the widespread use of passive house design in Wales.*	6		8	14

	Answers may refer to the following elements of integrated passive design, which help ensure buildings require little energy for heating and cooling:
	• orientation – to control solar gains and maximise daylighting (delivery of natural light to the interior of the building)
	• glazing – installation of windows which minimise heat loss, maximise solar gain and include facilities for shading
	• thermal mass – the use of materials such as concrete which are high in thermal mass so the building absorbs, stores and releases heat over time
	• insulation – achieving high levels of thermal insulation through choice of material and use of thick external walls
	• natural ventilation – the use of window, door and vent openings rather than mechanical ventilation in the summer months
	• control of air flows – to avoid losing warm air or introducing cold air, and achieve airtightness
	• zoning – planning a building's layout by considering how rooms will be used.
	
	Answers may refer to the following barriers to the use of passive design in Wales:
	• suitability for residential buildings in Wales may be restricted by current housing type and size:
	  • existing homes vary but include terraced and pre-fabricated structures
	  • many areas of Wales have old housing stock which is not well suited for incorporating passive design
	• social and economic factors within some areas of Wales may affect suitability for widespread use:
	  • current high demand for inexpensive social housing
	  • low-income households/social housing occupants (though likely to benefit long-term) are not able to afford to install passive design features
	• indifferent attitude of owner/occupier towards passive design
	• many new homes are built by regional/national building developers who do not incorporate passive design as standard.
	
	Answers may refer to the following drivers for the use of passive design in Wales:
	• increasing awareness of environmental responsibilities among the population
	• smaller developers may offer opportunities for passive house schemes
	• positive attitude of owner/occupier towards passive design
	• government initiatives (existing or future) to improve housing/well-being in Wales.
	
	Credit any other valid response.				

Band	AO1	AO3
4	There are no band 4 marks for this assessment objective. Six marks are awarded as for mark band 3.	**7-8 marks** An excellent discussion which shows: • perceptive and informed judgements about the barriers to and the drivers for the widespread use of passive house design in Wales • confident and detailed consideration of relevant factors, fully exploring their potential influence on the use of passive house design in Wales.
3	**5-6 marks** A very good description, which shows: • thorough knowledge and understanding of the main elements of integrated passive design • a confident grasp of relevant concepts related to integrated passive design.	**5-6 marks** A good discussion which shows: • reasoned judgements about the barriers to and the drivers for the widespread use of passive house design in Wales • thorough consideration of relevant factors, exploring their potential influence on the use of passive house design in Wales.
2	**3-4 marks** A good description, which shows: • generally secure knowledge and understanding of the main elements of integrated passive design • a generally secure grasp of relevant concepts related to integrated passive design.	**3-4 marks** A basic discussion which shows: • generally valid judgements about the barriers to and/or the drivers for the widespread use of passive house design in Wales • straightforward consideration of mostly relevant factors and their potential influence on the use of passive house design in Wales.
1	**1-2 marks** A basic description, which shows: • some knowledge and understanding of the main elements of integrated passive design • some grasp of relevant concepts related to integrated passive design.	**1-2 marks** A limited discussion which shows: • little evidence of judgements about the barriers to or the drivers for the widespread use of passive house design in Wales • little consideration of factors and their potential influence on the use of passive house design in Wales.
	0 marks Response not creditworthy or not attempted.	**0 marks** Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
6.	*A medium-rise building has previously been let as residential units. The owner has decided to undertake a full refurbishment and convert the building into a mixed-use development.* *The ground floor will be converted into a number of small commercial units and one large unit which will operate as a bar with a live-music licence. The remaining four floors will contain residential units.*					
	(a)	*Reducing noise pollution in the refurbished building is an important consideration.* *Explain how the owner can ensure that sound is managed appropriately in the refurbished building to address the comfort of residents in the building and neighbouring properties, and to fulfil relevant legal responsibilities.*		8		8

		Answers may refer to the management of sound to reduce noise pollution for residents and neighbours.
		
		Sound can be managed in the refurbishment of the building by:
		• designing the refurbished building acoustics to mitigate the effects of noise pollution within the building and outside of it
		• ensuring separating walls have sufficient mass or density to reduce the transmission of sound/achieve suitable levels of acoustic insulation
		• ensuring separating floors:
		  • include acoustic insulation materials to reduce the transmission of sound
		  • have a resilient layer as protection against impact noise
		• installing additional independent panel walls and ceiling structures with absorbent materials and double boarded finish for increased mass.
		
		Answers may also refer to:
		• the owner's responsibilities to ensure the building is compliant with relevant regulations, and in particular that:
		  • Building Regulations apply to refurbishment of this property
		  • approved Document E sets out standards for the resistance to the passage of sound in flats.
		
		Credit any other valid response.				

Band	AO2
4	**7-8 marks** An excellent explanation which shows: • thorough knowledge and understanding of how the owner can ensure that sound is managed appropriately in the refurbished building, along with relevant legal responsibilities • a confident grasp of key concepts relating to the comfort of residents in the building and neighbouring properties.
3	**5-6 marks** A good explanation which shows: • generally secure knowledge and understanding of how the owner can ensure that sound is managed appropriately in the refurbished building, along with relevant legal responsibilities • a generally secure grasp of key concepts relating to the comfort of residents in the building and neighbouring properties.
2	**3-4 marks** A basic explanation which shows: • some knowledge and understanding of how the owner can ensure that sound is managed appropriately in the refurbished building, along with relevant legal responsibilities • some grasp of key concepts relating to the comfort of residents in the building and/or neighbouring properties.
1	**1-2 marks** A limited explanation which shows: • little knowledge and understanding of how the owner can ensure that sound is managed appropriately in the refurbished building, or of relevant legal responsibilities • little grasp of key concepts relating to the comfort of residents in the building or neighbouring properties.
	0 marks Response not creditworthy or not attempted.

Question		Answer	AO1	AO2	AO3	Total Mark
	(b)	*Explain the different types of artificial lighting the owner could install in communal areas, such as walkways and stairways, of the four floors containing residential units.*		6		6
		Answers may refer to the types of artificial lighting the owner could install in communal areas of the residential units: • overhead lights in the ceilings to provide uniform illumination throughout the length of walkways and stairways • ambient lighting to provide gentle illumination within specific areas where a bright light might be uncomfortable, such as a lift • accent lighting, such as by using spotlights to draw attention to items or notices on display in a communal area • emergency lighting, to provide sufficient illumination for safe evacuation of the building • security lighting, to illuminate the entrance to stairways. Credit any other valid response.				

Band	AO2
3	**5-6 marks** A very good explanation which shows: • thorough knowledge and understanding of the types of artificial lighting which are suitable for use in communal areas of residential units • a confident grasp of the reasons for using specific types of artificial lighting in the given context**.**
2	**3-4 marks** A good explanation which shows: • generally secure knowledge and understanding of the types of artificial lighting which are suitable for use in communal areas of residential units • a generally secure grasp of the reasons for using specific types of artificial lighting in the given context**.**
1	**1-2 marks** A basic explanation which shows: • some knowledge and understanding of the types of artificial lighting which are suitable for use in communal areas of residential units • some grasp of the reasons for using specific types of artificial lighting in the given context**.**
	0 marks Response not creditworthy or not attempted.

Question	Answer	AO1	AO2	AO3	Total Mark
7.	*The external envelope of a building is constructed from steel, timber and brick. The building is to be refurbished because these materials have degraded over time.* *Describe the possible causes of degradation in steel, timber and brick and recommend measures which could be taken to solve potential issues in this building, and prevent or reduce further degradation after refurbishment.*	8		12	20
	Answers may refer to the following possible causes of degradation in steel, timber and brick: steel: • steel may corrode when protective coatings are damaged • water damage can cause steel to corrode • air pollution/acid gases can accelerate the corrosion of steel timber: • water damage can cause natural timber to rot and timber products such as plywood to de-laminate • prolonged exposure to sunlight can cause timber to bleach its colour and degrade brick: • frost damage can cause brick degradation where moisture has penetrated inside a brick. Answers may refer to the following measures which could be taken to solve the material degradation: steel: • chemically or physically remove corrosion present in steel • replace defective and/or loose fixings in the steelwork in the building timber: • where there is wet rot treat the timber with a fungicide • reduce moisture content/fix leaks • replace degraded timbers brick: • replace broken or spalled bricks • repair damaged mortar joints • install additional ties where existing ties have failed.				

Question	Answer	AO1	AO2	AO3	Total Mark

	Answers may refer to the following measures which could be taken to prevent or reduce further degradation after the building's refurbishment:
	
	steel:
	• protect from further corrosion by:
	  • applying protective paints or coatings
	  • reducing exposure to rain or seawater where possible
	  • using corrosion inhibiting chemicals
	
	timber:
	• protect from further degradation by:
	  • coating the timber with preservative treatments against decay and insect attack
	  • keeping water content at an appropriate level
	  • painting timber exposed to sunlight
	
	brick:
	• protect from further degradation by:
	  • using masonry sealant designed to allow bricks to breathe /preventing the bricks becoming saturated with water
	  • using replacement bricks of an appropriate type/specification.
	
	Credit any other valid response.				

Band	AO1	AO3
4	**7-8 marks** An excellent description which shows: • thorough knowledge and understanding of the possible causes of degradation in steel, timber and brick • a confident grasp of how steel, timber and brick may degrade when used in the external envelope of a building.	**10-12 marks** An excellent response which includes: • perceptive and informed recommendations for measures which could be taken to solve potential issues in the building • confident and detailed engagement with the principles of solving potential issues and preventing or reducing further degradation. • Writing is very well structured and organised, using accurate grammar, punctuation and spelling. • A range of specialist terminology is used with accuracy.
3	**5-6 marks** A good description which shows: • generally secure knowledge and understanding of the possible causes of degradation in steel, timber and brick • a generally secure grasp of how steel, timber and brick may degrade when used in the external envelope of a building.	**7-9 marks** A good response which includes: • reasoned recommendations for measures which could be taken to solve potential issues in the building • thorough engagement with the principles of solving potential issues and preventing or reducing further degradation. • Writing is generally well structured and organised, using mainly accurate grammar, punctuation and spelling. • Specialist terminology is used with accuracy.
2	**3-4 marks** A basic description which shows: • some knowledge and understanding of the possible causes of degradation in steel, timber and brick • some grasp of how steel, timber and brick may degrade when used in the external envelope of a building.	**4-6 marks** A basic response which includes: • generally valid recommendations for measures which could be taken to solve potential issues in the building • straightforward engagement with the principles of solving potential issues and/or preventing or reducing further degradation. • Writing shows some evidence of structure though some errors in grammar, punctuation and spelling affect meaning. • Basic use of specialist terminology.
1	**1-2 marks** A limited description which shows: • little knowledge and understanding of the possible causes of degradation in steel, timber and brick • little grasp of how steel, timber and brick may degrade when used in the external envelope of a building.	**1-3 marks** A limited response which includes: • little evidence of recommendations for measures which could be taken to solve potential issues in the building • little engagement with the principles of solving potential issues or preventing or reducing further degradation. • Some errors in grammar, punctuation and spelling, which affect clarity of communication. • Limited use of specialist terminology.
	0 marks Response not creditworthy or not attempted.	**0 marks** Response not creditworthy or not attempted.

Mapping of questions to specification content and assessment objectives

Unit 3

Question			Specification content (main focus)									Mark allocation			
			Section								Part	Total Marks	AO1 Marks	AO2 Marks	AO3 Marks
			2.3.1	2.3.2	2.3.3	2.3.4	2.3.5	2.3.6	2.3.7	2.3.8	2.3.9				
1	(a)	(i)	2									(a)	**2**	2	0	0
		(ii)	2									(a)	**2**	2	0	0
		(iii)	2									(a)	**2**	2	0	0
	(b)		6									(b)	**6**	6	0	0
2	(a)			6								(a)	**6**	6	0	0
	(b)						5					(c)	**5**	0	5	0
3	(a)							6				(a)	**6**	6	0	0
	(b)							6				(a) (b)	**6**	6	0	0
	(c)					6						(b)	**6**	0	6	0
4	(a)					6						(a)	**6**	6	0	0
	(b)	(i)				4						(a)	**4**	0	4	0
		(ii)				1						(a)	**1**	0	1	0
5											14	(d) (e)	**14**	6	0	8
6	(a)								8			(b) (c)	**8**	0	8	0
	(b)									6		(a)	**6**	0	6	0
7					20							(a) (b) (c)	**20**	8	0	12
Total marks			**12**	**6**	**20**	**17**	**5**	**12**	**8**	**6**	**14**		**100**	**50**	**30**	**20**