Pearson BTEC Level 3 Nationals in Construction and the Built Environment

First teaching September 2017

Sample Assessment Materials
Unit 1: Construction Principles

For use with Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Version 1.0 final pre-publication

Edexcel, BTEC and LCCI qualifications

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Pearson BTEC Level 3 Nationals	
Construction and the Built Environment **Unit 1: Construction Principles** Extended Certificate, Foundation Diploma, Diploma, Extended Diploma	
Sample Assessment Materials for first teaching September 2017 onwards. Available for first assessment May/June from 2018 onwards. Time: 1 hour 30 minutes	Total Marks 75
You must have: • a non-programmable calculator • a ruler and HB or 2B pencil to sketch • information booklet for Unit 1.	

Instructions

- Use black ink or ball-point pen.
- Fill in your name, learner registration and centre number.
- Answer **all** questions.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- Show your working when requested.

Information

- The total mark for this paper is 75.
- The marks for each question are shown in grey boxes
  - *use this as a guide as to how much time to spend on each question.*
- You may use a non-programmable calculator that does not have the facility for symbolic algebra manipulation or allow the storage and retrieval of mathematical formulae.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question, show all your working, use the appropriate units in your answers and always answer to an appropriate degree of accuracy.
- Check your answers if you have time at the end.

Some questions must be answered with a cross in a box [X]. If you change your mind about an answer, put a line through the box ~~[X]~~ and then mark your new answer with a cross [X].

Question 1

A leisure company wants to construct an indoor heated swimming pool at a holiday village.

1(a) Which is the key specification requirement for pool-lining materials?

1 mark

☐	**A**	Coefficient of thermal expansion
☐	**B**	Thermal conductance
☐	**C**	Resistance to moisture penetration
☐	**D**	Resistance to degradation

The leisure company has specified that the building housing the swimming pool will be illuminated internally by ceiling-mounted lighting.

1(b) State **one** suitable artificial light source.

1 mark

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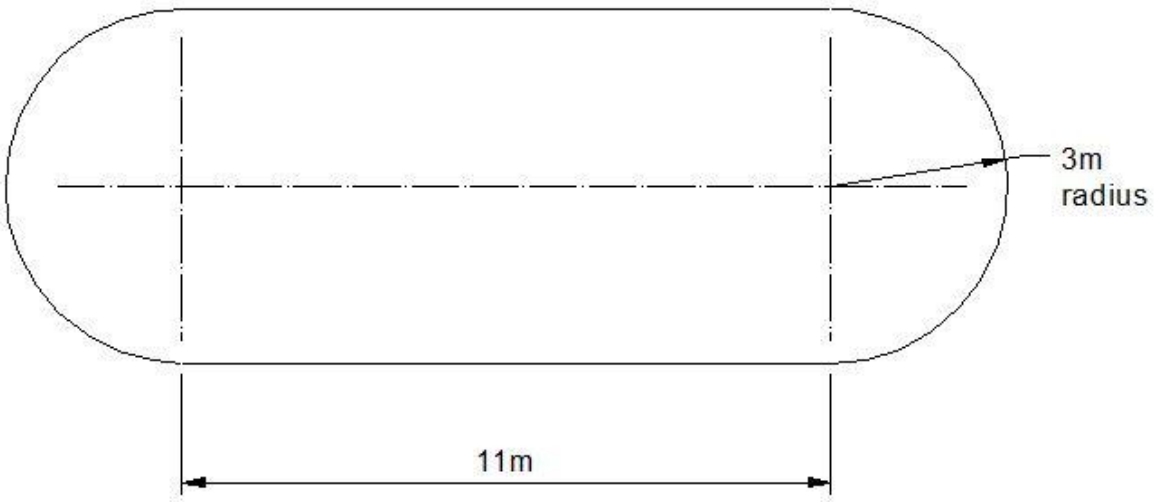
1(c) The swimming pool is 1.5 m deep.

The plan of the pool is shown in Figure 1.



(Diagram not to scale)

Figure 1: Pool plan

Calculate the volume of water required to fill the pool and the total tiled area of the swimming pool base.

Give your answer to two decimal places.

4 marks

Tiled area……………………..m^2

Volume of water……………………..m^3

1(d) A stainless steel ladder is used to get in and out of the pool.

Explain **two** reasons why stainless steel is a more suitable material than aluminium.

4 marks

1 ....

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2 ....

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END OF QUESTION 1 **(Total for Question 1 = 10 marks)**

Question 2

A construction company is planning to build a housing development of two-storey detached dwellings.

The construction company is considering the types and quantities of materials that will be used to construct the dwellings.

2(a) The construction company wants to specify materials that have low embedded energy for the dwellings.

Which **one** of the following materials has the highest embedded energy, when measured in MJ/kg?

1 mark

- ☐ **A** Timber
- ☐ **B** Cement
- ☐ **C** Glass
- ☐ **D** Concrete

2(b) The dwellings will use timber for internal applications.

State **two** causes of degradation that affect timber used for internal applications.

2 marks

1 ....

2 ....

2(c) uPVC plastic is used in the manufacture of window frames.

Explain **two** properties of uPVC plastic that make it suitable for the window frames.

4 marks

1 ....

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2 ....

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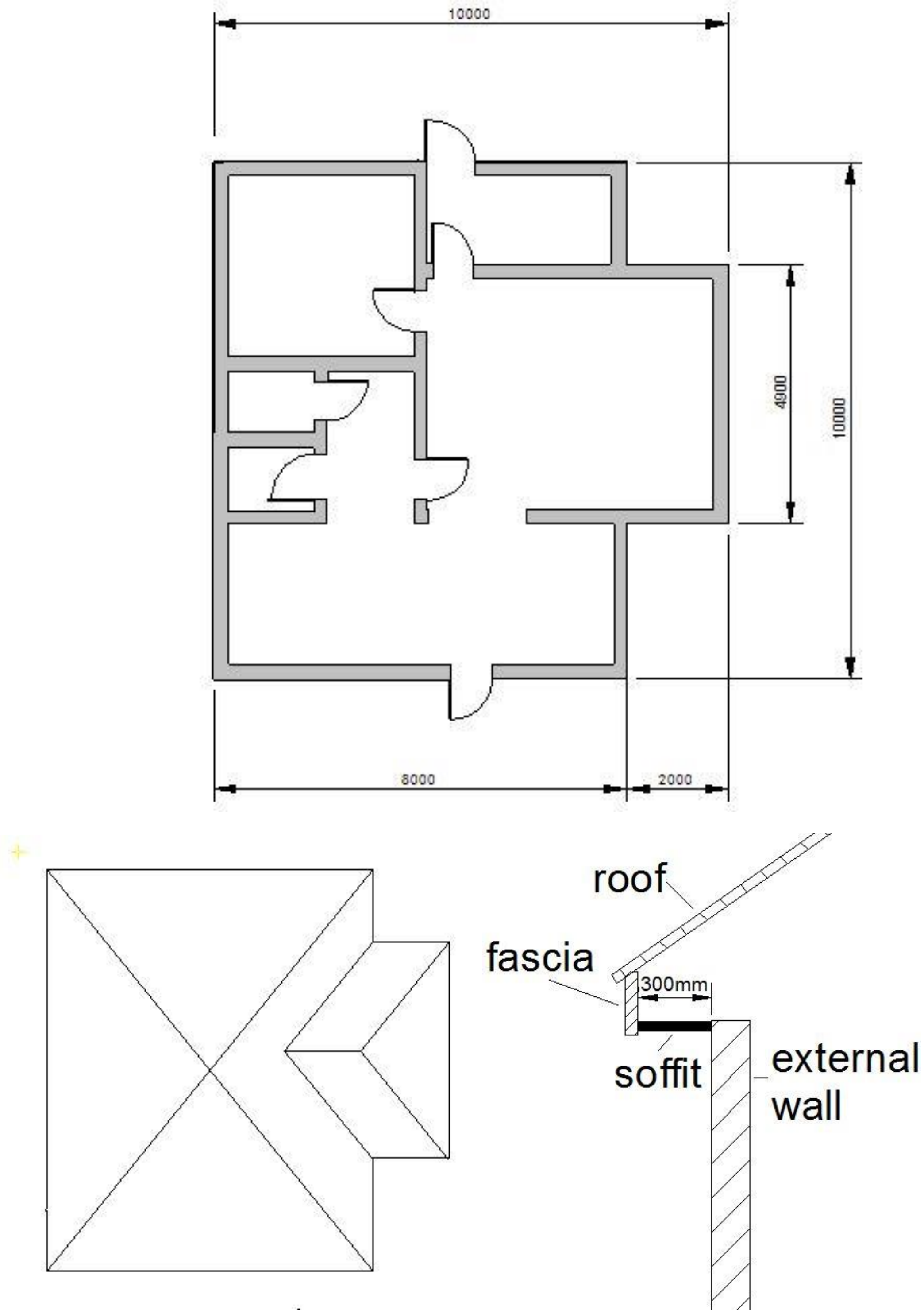
2(d) Figure 2 shows the floor plan, roof plan and eaves details for one of the dwellings in the development.

The roof of the dwelling will be cross hipped, with a 300 mm soffit overhang all around the building.

All dimensions are given in mm.



(Diagram not to scale)

Figure 2: Ground floor plan, roof plan and eaves detail

Calculate the length of soffit board required based on centre line dimensions.

5 marks

Answer: ....

END OF QUESTION 2 (Total for Question 2 = 12 marks)

Question 3

> A developer has bought a number of old warehouses for redevelopment. The developer is considering a mix of residential flats and buildings for commercial use. This will require comfortable working and living environments that provide adequate privacy and light to meet the requirements of the different building users.

3(a) Explain **one** reason for the use of a hygrometer when surveying a building.

2 marks

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3(b) The residential flats will be located close to a busy road and a railway line.

Road traffic and trains will affect the acoustic fitness for purpose of the residential flats.

Explain **one** difference between sound and noise.

2 marks

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3(c) Explain **two** approaches the developer could take to provide adequate sound insulation for the residents of the new flats.

4 marks

3 ....

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4 ....

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3(d) The developer has decided to convert one of the warehouses into flats.

The developer decides to make the most effective use of natural light throughout the building, where possible.

Explain **three** advantages of using natural light throughout the building.

6 marks

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3 ....

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END OF QUESTION 3 **(Total for Question 3 = 14 marks)**

Question 4

A developer has bought three old houses, which are large. Two of the houses are constructed of brick and the third is constructed from stone. The developer plans to convert them into smaller dwellings such as flats or retirement homes.
The developer wants to consider ways of providing comfortable, warm and dry living environments for the wellbeing and health of the residents.

4(a) The walls of the houses built with brick are 265 mm thick and have a U-value of 2.0 W/m^{2}k

Calculate the thermal conductivity of the walls.

2 marks

Answer = …………………………………………..

4(b) Some of the rooms in the houses have been identified as having problems related to condensation.

Explain **one** method of controlling condensation in the dwellings.

2 marks

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4(c) The developer plans to convert one of the large houses into flats to sell to first-time buyers of working age.

It is constructed of brick and has three floors.

Explain **two** reasons why the thermal comfort requirements for the intended home owners would be different to those for a retirement home for elderly people.

4 marks

1 ....

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2 ....

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4(d) One of the two-storey houses to be converted into flats is built of stone. This house has an attic and a cellar. There are open fireplaces throughout the house and attic. All existing window and door frames are made from timber.

Discuss the potential ways to improve the thermal efficiency of this building.

9 marks

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END OF QUESTION 4 **(Total for Question 4 = 17 marks)**

Question 5

You will need to refer to Figures 3, 4, 5 and 6 in the information booklet to answer questions 5(a) and 5(c).

The location of a new development of low-rise two- and three-floor dwellings is indicated with a red arrow in Figures 3 and 4.

Figure 3 shows mean temperature for the whole of the UK for January 1981-2010; figure 4 shows the mean rainfall for the whole of the UK for January 1981-2010.

Figures 5 and 6 give climatic information for the development location.

All dwellings will be constructed using a variety of materials, including:

- engineering bricks
- facing bricks
- thermal insulated concrete blocks.

Refer to Figures 3, 4, 5 and 6 for climatic information for the development.

5(a) Explain **two** performance requirements of the fascia used on this development.

4 marks

1 ....

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2 ....

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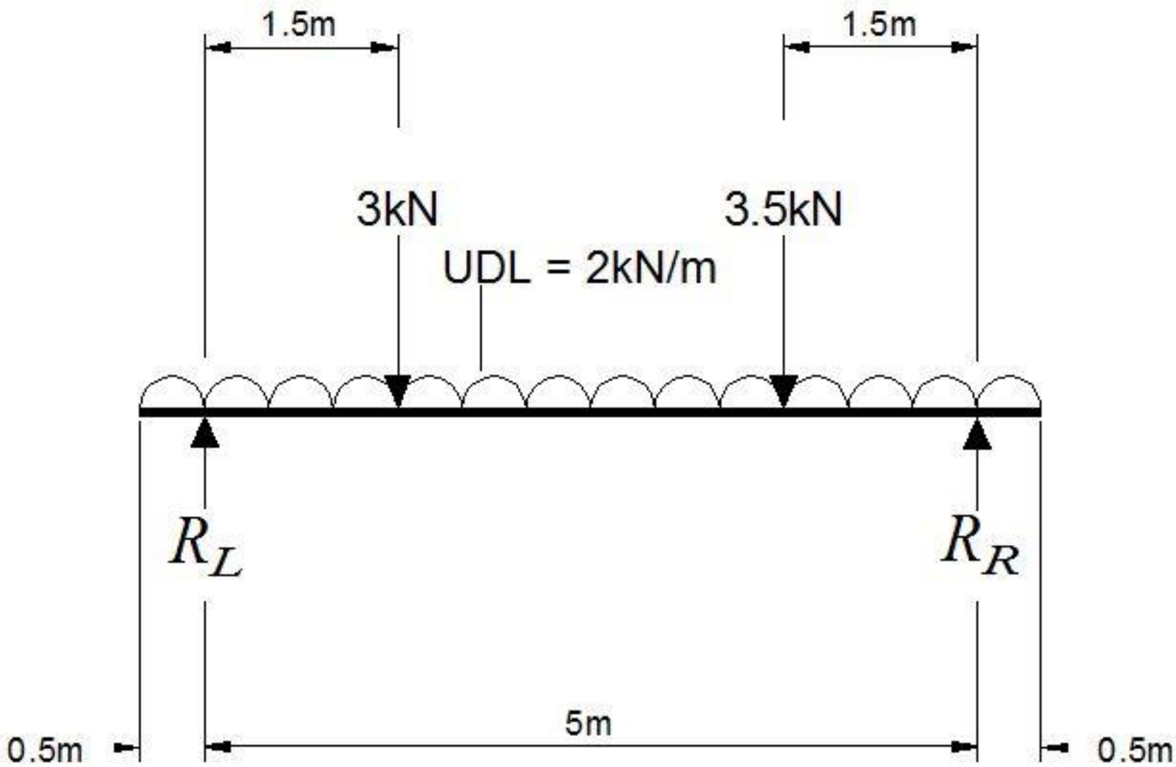
5(b) Trussed rafters are to be used in this development.

The trussed rafters exert a combination of loadings onto the load-bearing walls.

Figure 7 shows the bottom chord of one of the trussed rafters, with loadings indicated.

The beam is supported by the exterior walls of the dwelling at points R_L and R_R.



(Diagram not to scale)

Figure 7: Bottom chord of a trussed rafter

Calculate the reaction forces at points R_L and R_R.

6 marks

5(c) Refer to Figures 3, 4, 5 and 6 for climatic information.

Figure 8 details the cavity wall construction for the dwellings.

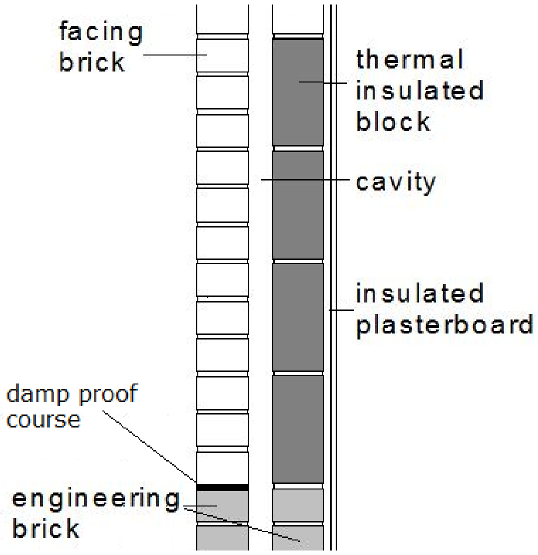


Figure 8: Dwelling cavity wall details

Evaluate the combined use of engineering bricks, facing bricks and thermal insulated concrete blocks as materials for the cavity wall of these dwellings.

12 marks

END OF EXAM

(Total for Question 5 = 22 marks)

TOTAL MARKS FOR PAPER: 75 marks

Unit 1: Construction Principles – sample mark scheme

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the mark scheme, not according to their perception of where the grade boundaries may lie.
- All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should be prepared to award zero marks if the learner's response is not worthy of credit, according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a learner's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the learner has replaced it with an alternative response.

Specific marking guidance for levels-based mark schemes*

Levels-based mark schemes (LBMS) have been designed to assess learners' work holistically. They consist of two parts: indicative content and levels-based descriptors. Indicative content reflects specific content-related points that learners might make. Levels-based descriptors articulate the skills that learners are likely to demonstrate in relation to the assessment outcomes being targeted by the question. Different rows in the levels represent the progression of these skills.

When using a levels-based mark scheme, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches learners' response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer in response to the assessment focus/objective, and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band depending on how they have evidenced each of the descriptor bullet points.

Types of marks and abbreviations

This mark scheme uses the following types of marks.

- M marks – method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- A marks – accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- B marks – are unconditional accuracy marks (independent of M marks).
- Marks should not be subdivided.

Abbreviations:

- awrt – answers which round to
- cao – correct answer only
- dp – decimal places
- ft – follow through
- oe – or equivalent (and appropriate)
- SC – special case
- sf – significant figures

Question number	Answer	Mark
1(a)	**C** – Resistance to moisture penetration.	**(1)**

Question number	Answer	Mark
1(b)	**One** suitable light source from: • incandescent lamps (1) • compact fluorescent lamps (CFLs) (1) • fluorescent tubes (1) • discharge lamps (1) • halogen lamps (1) • ballast lamps (1) • light-emitting diodes (LEDs) (1). Do not accept: • sodium vapour lamps.	**(1)**

Question number	Working	Answer	Notes	Mark
1(c)	Total area of the pool: (6 × 11) to determine area of rectangle = 66 m^2 Area of two semicircles: $A = \pi r^2$ $A = \pi \times 3^2 = 28.27\ m^2$ Area = 66 + 28.27 = 94.27 m^2 Volume = 94.27 × 1.5 = 141.41 m^3	Area = <u>94.27 m^2</u> Accept answers in the range of <u>94.25</u> m^2 <u>to 94.30</u> m^2 Volume = <u>141.41m^3</u> Apply ecf for final value of the volume if any of the previous calculations are incorrect.	M1 for calculation area of rectangle. M1 for area of semicircles. A1 for total tiled area. A1 for volume. Award 3 marks if the area is given without working; award 4 marks if the volume is given without working	**(4)**

Question number	Answer	Mark
1(d)	Any **two** explanations that include a reason why stainless steel is more suitable (1) and a linked justification of that reason (1) • Stainless steel is less prone to corrosion in treated water (1) and therefore less likely to fail/degrade/deteriorate (1). • Stainless steel components are less likely to bend/deform under loading/pressure (1) therefore less material is needed for the same performance/structural component (1). • Stainless steel has lower embodied/embedded energy (1) so it is a more sustainable construction material (1).	**(4)**

Question number	Answer	Mark
2(a)	**C** – Glass.	**(1)**

Question number	Answer	Mark
2(b)	**Two** causes of degradation from: • dry rot (1) • insect attack/woodworm (1) • wet rot (1). Do not accept answers that relate to exposure conditions, for example frost.	**(2)**

Question number	Answer	Mark
2(c)	Any **two** explanations that include a property of uPVC that makes it suitable (1) and a linked justification of that property (1) • uPVC is corrosion resistant (1) so extends the life span of the window frames (1). • uPVC is inert (1) so will not pollute rainwater run-off (1). • Specialist uPVC/containing titanium dioxide/UV screen limits the effect of sunlight (1) so reduces the structural degradation of the plastic (1). • uPVC frames do not conduct heat well (1) resulting in lower heat transfer from/to the building (1). • uPVC has plasticity when heated (1) therefore it is suitable for forming/extrusion (1). Accept any other relevant phrasing/wording that conveys the above or any other correct answer.	**(4)**

Question number	Working	Answer	Notes	Mark
2(d)	Determine perimeter of the building: Perimeter = 10 000 + 10 000 + 10 000 + 10 000 (overall width of building + overall length of building × 2) = 40 000 mm or 40 m External corner requirements: Length = 300 × 6 = 1800 mm (1.80 m) Internal corner requirements: Length = 300 × 2 = 600 mm (0.6 m) Length of soffit required = perimeter + external corners – internal corners Length = 40 + 1.8 – 0.6 = 41.2 m or Length = 40 000 + 1800 – 600 = 41 200 mm Do not accept 41.2 mm or 41 200 m	Length = <u>41.2</u> m Or <u>41 200</u> mm	M1 for calculating the perimeter of the building. M1 for calculating the external corner requirements. M1 for calculating the internal corner requirements. M1 for the process of determining the total length of soffit (centre line). B1 for correct value of perimeter/length (cao).	**(5)**

Question number	Answer	Mark
3(a)	Any **one** explanation that includes a reason for the use of a hygrometer (1) and a linked justification of that reason (1) • Indicates the humidity of air in a room (1), which will identify any historic/current problems with wet rot/condensation that will need to be resolved (1). • Identifies whether there are low humidity levels in the building (1) that would affect comfort levels and the health of residents (1). • Identifies whether there are high humidity levels (1) that can lead to problems with mildew/dust mites (1).	**(2)**

Question number	Answer	Mark
3(b)	Any **one** explanation that includes a difference between sound and noise (1) and a linked justification of that reason (1) • Sound is generally something that is desired/acceptable (1), whereas noise is unpleasant or undesired (1). • Sound is characterised by regular fluctuations of vibrations in the air (1), while noise results from irregular fluctuations of vibrations (1). • Sound is the result of vibrations in the air (1), while noise is a sound that is unwanted/excessive/obtrusive (1). • Sound is the pressure variations the ear can detect (1), while noises are uncomfortable to listen to (1). Accept definition of noise and then how sound is different, e.g. noise is unpleasant or undesired (1), whereas sound is generally desired/acceptable/pleasant (1).	**(2)**

Question number	Answer	Mark
3(c)	Any **two** explanations that include an approach the developer could take (1) and a linked justification of that approach (1) • Use of high mass materials for walls (1) will reduce the amount of noise from the road and railway (1). • Double/triple glazed windows with larger air gaps could be used in the building/use of different thicknesses of glass for panes, making up double/triple glazing (1) as each reduces different frequencies of noise (1). • Building of walls or fences to deflect the noise from the road/railway (1) can reduce intrusive noise on the ground floor (1). • Use of trees and other landscaping to buffer noise from the road/railway (1) will reduce exposure for residents on both upper and lower floors of the building (1). • The developer could plan for the flats to have bedrooms on the side of the building furthest from the road/railway (1), with less noise-sensitive rooms being closest to the sources of noise (1).	**(4)**

Question number	Answer	Mark
3(d)	Any **three** explanations that include an advantage of using natural light in the building (1) and a linked justification of that advantage (1) • Reduces the need for artificial light (1) and therefore the need for fossil fuels for electricity (1). • Natural light renders light more accurately (1), resulting in fewer potential accidents (1). • Natural light can improve the wellbeing of the residents (1) because some modern types of lamp emit radiation that can cause eye problems (1). • Variable amounts of light depending on time of the year/day/season (1), reducing the cost of lighting communal areas/flats (1).	**(6)**

Question number	Working	Answer	Notes	Mark
4(a)	U = thermal conductivity/ thickness of material Thermal conductivity = U × thickness = 2.0 × 0.265 <u>= 0.53 W/mk</u>	<u>= 0.53 W/mK</u>	M1 for rearranging formula. A1 for correct value.	**(2)**

Question number	Answer	Mark
4(b)	Any **one** explanation that includes a method of controlling condensation (1) and a linked justification of that method (1) • Use of air conditioning (1) to remove moisture from the air (1). • Heating (1) to raise the temperature of internal walls/windows (1). • Ventilation (1) allows air to flow and remove moisture to the outside (1). • Dehumidification (1) to remove water vapour from the air (1). • Use of extractor fans (1) to remove steam from kitchens and bathrooms (1). • Insulation/double glazing (1) keeps the internal temperature of the building higher (1). • Allow space for ventilation behind fitted furniture (1) to prevent warm air from being trapped (1).	**(2)**

Question number	Answer	Mark
4(c)	Any **two** explanations that include a reason the thermal comfort requirements would be different (1) and a linked justification of that reason (1) • People of working age tend to be more active (1) so increase the amount of heat output that they produce themselves (1). • Thermal comfort levels change with age (1) as the metabolic rate of individuals slows down (1). • Preferred clothing styles and weights differ with age (1), which changes the requirements for heating in a room (1).	**(4)**

Question number	Indicative content

4(d)	Answers will be credited according to learners' demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content but should be rewarded for other relevant answers.
	
	An analysis of the existing structure, stating if decisions made to improve the thermal efficiency are appropriate or not and supported by relevant points, which may include:
	• consideration of the ability to restrict heat losses through features such as external walls, windows, chimneys, etc.
	• analysis of existing building structure and heat losses:
	  ○ lack of/sufficiency of insulation (cavity/loft/roof), which would be common for an older building
	  ○ poor fitting of doors, windows (drafts) due to their age and use of timber construction
	  ○ chimneys, coal chutes etc. as sources of cold air entering the building
	  ○ wooden window frames/door casings may be rotted and allow air through
	  ○ loss of heat through the ground floor into the cellar space due to differences in temperature
	  ○ heat losses/gains can be conducted through walls because stone absorbs heat
	  ○ heat can be lost through pipework as it enters or leaves the building
	  ○ there is unlikely to be a cavity wall so heat conducts directly through the stonework between the inside and exterior of the house
	  ○ gaps in stonework where air can enter/leave the building due to the age of the building
	• methods to reduce the amount of heat loss:
	  ○ loft/roof insulation to reduce heat loss through the roof
	  ○ installation of insulated plasterboard as dry lining
	  ○ insulation between ground floor and unheated cellar space
	  ○ use of thermal insulated blocks as cavity walls between individual flats
	  ○ external cladding of walls
	  ○ installation of underfloor heating or insulated floors because heat rises through convection
	  ○ weather seals to doors and windows
	  ○ specify windows and doors with good thermal insulation properties and draught proofing.

Mark scheme (award up to 9 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–3	• Demonstrates isolated knowledge and understanding of relevant information; there may be major gaps or omissions. • Provides little evidence of weighing up competing arguments/pros and cons in context; discussion likely to consist of basic description of information. • Meaning may be conveyed but in a non-specialist way; response lacks clarity and fails to provide an adequate answer to the question.
Level 2	4–6	• Demonstrates accurate knowledge and understanding of relevant information with a few gaps or omissions. • Discussion is partially developed, but will be imbalanced; evidences the weighing up of competing arguments/pros and cons in context. • Demonstrates the use of logical reasoning, clarity, and appropriate specialist technical language.
Level 3	7–9	• Demonstrates accurate and thorough knowledge and understanding of relevant information; any gaps or omissions are minor. • Displays a well-developed and balanced discussion, demonstrating a thorough grasp of competing arguments/pros and cons in context. • Logical reasoning evidenced throughout response that is clear and uses specialist technical language.

Question number	Answer	Mark
5(a)	Any **two** explanations that include a performance requirement of fascia used in this development (1) and a linked justification of that performance requirement (1). • The fascias will need to be water resistant/waterproof (1) so that they do not degrade with rot/mould/withstand high levels of rainfall (1). • Fascias will need to accept suitable fixings (1) to support the weight of the guttering/suction effect/direct wind forces caused by the high local winds (1). • Fascias need to be frost resistant (1) to reduce the impact of freeze and thaw cycles/air frost (1). Accept any other relevant phrasing/wording.	**(4)**

Question number	Working	Answer	Notes	Mark
5(b)	Determine clockwise moments around R_L: = (2 × 5.5 × 2.75) + 3 × 1.5 + 3.5 × 3.5 = 30.25 + 4.5 + 12.25 = 47 kNm Determine anticlockwise moments around R_L: = $5R_R$ + (0.5 × 0.25 × 2) = $5R_R$ + 0.25 kNm Clockwise moments = anticlockwise moments $5R_R$ + 0.25 = 47 kNm $5R_R$ = 46.75 kNm R_R = 9.35 kN Resolve forces vertically: $R_L + R_R$ = 3 + 3.5 + (2 × 6) $R_L + R_R$ = 6.5 + 12 = 18.5 kN R_L + 9.35 = 18.5 kN R_L = 9.15 kN	<u>R_L = 9.15 kN</u> <u>R_R = 9.35 kN</u>	M1 for clockwise moments around R_L. M1 for anticlockwise moments around R_L. M1 for application of law of equilibrium for moments. A1 for calculating R_R. M1 resolving forces vertically. A1 for calculating R_L. Allow ecf for incorrect value of R_R.	**(6)**

<table>
<tr><th>Question number</th><th>Indicative content</th></tr>
<tr><td>5(c)</td><td>Answers will be credited according to learners’ demonstration of knowledge and understanding of the material, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content but should be rewarded for other relevant answers.

An evaluation of the building materials in this configuration,
its appropriateness for the location, or not, supported by relevant points, which may include:
• consideration of the climatic information related to the site, such as rainfall, wind speeds, temperatures and frost days
• construction follows a traditional building style because bricks and blocks are standard sizes
• appropriateness of engineering bricks:
  ○ can be used below the damp-proof course (DPC) due to their resistance to moisture absorption and frost
  ○ engineering bricks resist frost, acids, alkalis and abrasion that they will be exposed to throughout the year
  ○ engineering bricks have a high compressive strength and uniform crushing strength
  ○ engineering bricks are unlikely to degrade despite repeated freeze-thaw cycles and possibly saturated ground
  ○ engineering bricks could be used for the DPC due to the high level of rainfall and variation in temperatures
• appropriateness of facing bricks:
  ○ high compressive strength
  ○ wall strength dependant on the strength of the mortar, which will be specified according to the exposure levels of the location
  ○ more decorative appearance for the dwellings than using engineering bricks throughout, yet will still be resistant to weather above the DPC
• appropriateness of insulated concrete bricks:
  ○ blocks have a high strength to weight ratio making them suitable for the internal leaf of cavity walls and load bearing internal walls
  ○ blocks will increase the thermal insulation of the dwellings and reduce temperature variations inside the dwellings
  ○ may not be capable of supporting point loads or higher uniformly distributed loads (UDLs), although this is unlikely in a two- or three-storey dwelling
  ○ combined with insulated drywall boards, the thermal insulation of the dwelling should be sufficient and make the dwellings more energy efficient.</td></tr>
</table>

Mark scheme (award up to 12 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.		
Level	**Mark**	**Descriptor**
Level 0	0	No rewardable material.
Level 1	1–4	• Technical vocabulary is used but it is not used appropriately to support arguments in relation to the issues of the question. • Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario. • No conclusion is presented or it is generic.
Level 2	5–8	• Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. • There is consideration of relevant issues using logical chains of reasoning but does not reflect on their relative importance to the given scenario. • An attempt at a conclusion is presented that links arguments to the given scenario but is not justified, in that it does not reflect the careful consideration of all sides of the argument.
Level 3	9–12	• Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. • There is a balanced and wide ranging consideration of relevant issues, using coherent and logical chains of reasoning that show a full awareness of their relative importance to the given scenario. • A fully justified conclusion is presented that links arguments to the given scenario, and that reflects the careful consideration of all sides of the argument, leading to a reasoned decision.

Unit 1: Construction Principles – mapping grid

Question	Specification reference	Marks
1(a)	A1 – properties of materials	1
1(b)	C3 – Artificial light	1
1(c)	B1 – surface area of compound shapes	4
1(d)	A2 – Properties of construction materials	4
2(a)	A3 – embedded energy	1
2(b)	A4 – Degradation of timber	2
2(c)	A2 - Properties of construction materials uPVC	4
2(d)	B1 – Calculation of centre line	5
3(a)	C1 – application of hygrometer	2
3(b)	C2 – difference between sound and noise	2
3(c)	C2 – methods of sound insulation	4
3(d)	C3 – differences between natural and artificial light	6
4(a)	B1- U values	2
4(b)	C1- Methods of controlling condensation	2
4(c)	C1- thermal comfort parameters	4
4(d)	A2 - Properties of construction materials	9
5(a)	A2 – Properties of construction materials	4
5(b)	B1- Structural analysis	6
5(c)	C1- Exposure to local climate	12
	Total	**75**

Pearson BTEC Level 3 Nationals

Construction and the Built Environment

Information Booklet for Unit 1: Construction Principles

Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Sample Assessment Materials for first teaching September 2017 onwards.

Instructions

You will need the information in this booklet to answer some questions.

Read the information carefully.

You must **not** write your answers in this booklet. Only answers given in your question paper booklet will be marked.

Climatic information for use with Question 5

Figure 3: Mean temperature for January 1981–2010

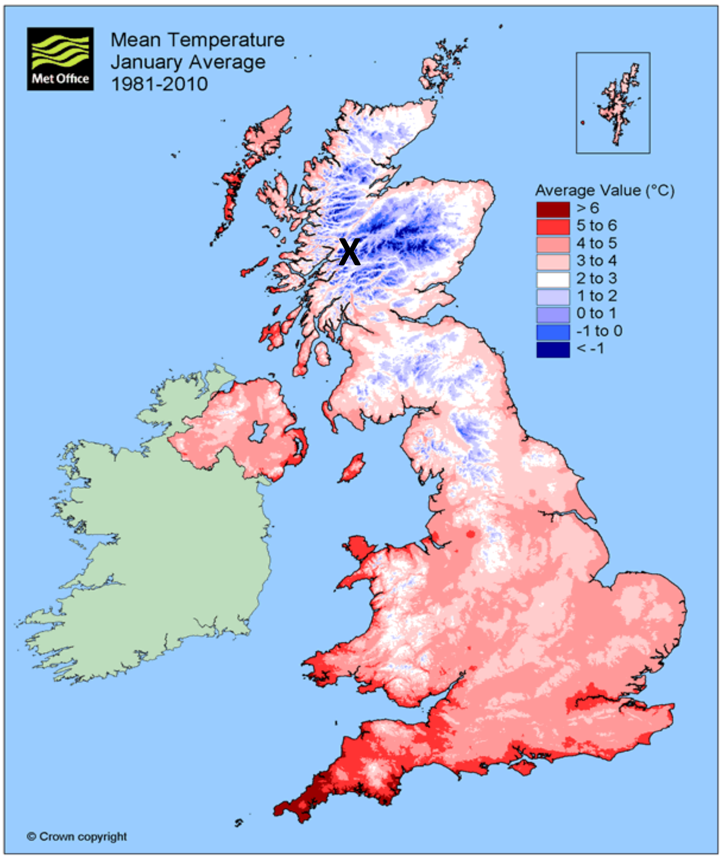
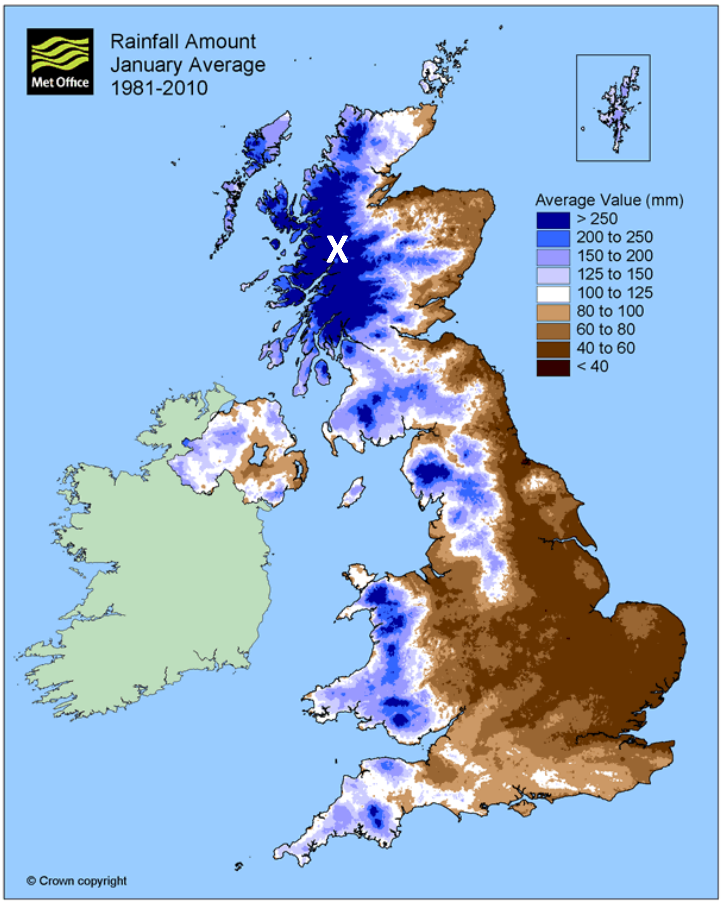
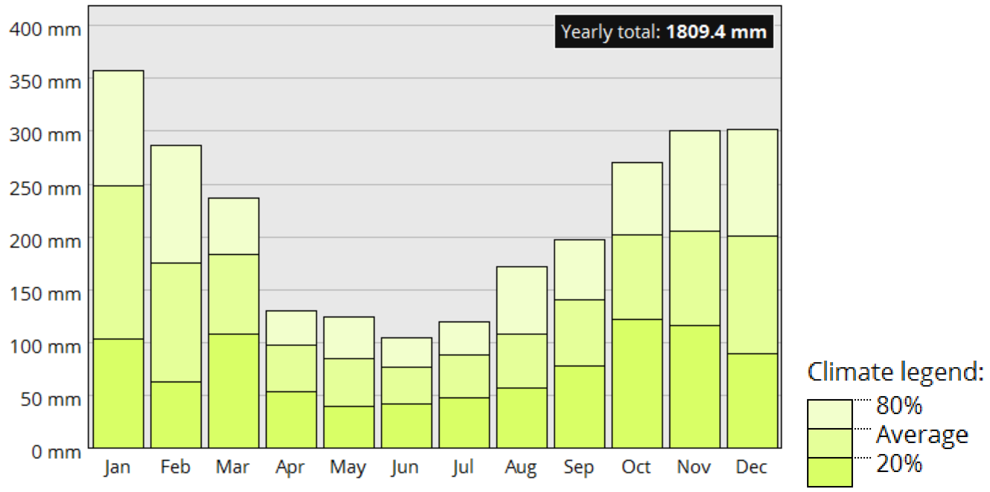


Figure 4: Mean rainfall for January 1981–2010





Met Office © Crown copyright

Climate legend: On average, once every five years rainfall is lower than the 20% value and once every five years higher than the 80% value.

Figure 5: Chart showing total yearly rainfall for the location

Month	Days of air frost (days)	Days of rainfall ≥ 1 mm (days)	Monthly mean wind speed at 10 m (knots)	Maximum wind gust speed at 10 m (knots)
January	14.3	19.5	8.5	57.2
February	14	15.9	7.8	44.2
March	11.5	19.7	7.8	39.8
April	7.6	14.7	6.5	26.1
May	3.7	14.6	6	26.9
June	0.4	13.6	5.9	24
July	0	15.6	5.5	22.4
August	0.1	15.4	5.3	22.7
September	1.2	16.5	5.8	26.8
October	3.9	20	6.6	35.7
November	9	19.3	6.4	36.8
December	14.8	16.8	6.6	26.3

Figure 6: Days of air frost, days of rainfall and monthly wind speed

Section 2: Formulae and constants

Formulae

Surface areas of regular shapes

Total surface area of a cylinder, $TSA = 2\pi rh + 2\pi r^2$

Curved surface area of cone, $CSA = \pi rl$

Surface area of a sphere, $SA = 4\pi r^2$

Area of a sector of a circle, $A = \frac{1}{2} r^2\theta$

Volumes of regular shapes

Volume of a cylinder, $V = \pi r^2 h$

Volume of sphere, $V = \frac{4}{3}\pi r^3$

Volume of a cone, $V = \frac{1}{3}\pi r^2 h$

Geometric techniques

Pythagoras' theorem $a^2 = b^2 + c^2$, where angle A is a right angle

Radians, arc lengths and areas of sectors

Length of an arc of a circle, $s = r\theta$

Graphical techniques

Equation of a straight line, $y = mx + c$

Forces, stress, strain and modulus of elasticity

Relationship between force (load), mass and acceleration due to gravity, $F = mg$

Direct stress, $\sigma = \frac{F}{A}$

Direct strain, $\varepsilon = \frac{\Delta L}{L}$

Shear stress, $\tau = \frac{F}{A}$

Shear strain, $\gamma = \frac{a}{b}$

Modulus of elasticity, $E = \frac{\sigma}{\varepsilon}$

Hooke's law, $F = -Kx$

Resolution of forces in perpendicular directions, $F_x = F\cos\theta$, $F_y = F\sin\theta$

Equilibrium conditions to ensure stability of a beam $\Sigma F_x = 0$, $\Sigma F_y = 0$ and $\Sigma M = 0$

Moment of a force: moment = force × distance

Human comfort effect of temperature on construction materials while in situ

Thermal resistance (R_C) = $\dfrac{\text{thickness of material}}{\text{thermal conductivity}}$

Calculation of U-values: $U = \dfrac{1}{R_C}$, $U = \dfrac{\text{thermal conductivity}}{\text{thickness of material}}$

Application of mathematical methods to determine lighting requirements

Inverse square law of illumination, $E = \dfrac{I}{r^2}$

Cosine law of illumination, $E = \dfrac{I}{d^2}\cos\theta$

Constants

Acceleration due to gravity, G = 9.81 m/s^2

π = 3.142