



Mark Scheme (Final)

January 2019

NQF BTEC Level 3

Construction

Unit 1: Construction Principles

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than 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 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 also be prepared to award zero marks if a candidate's response is not worthy of credit according to the mark scheme.
- Where some judgment is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt about applying the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Phonetic spelling should be accepted.

## **Specific marking guidance**

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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:

- ft – follow through
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC - special case
- oe – or equivalent (and appropriate)
- dp - decimal places
- sf - significant figures
- dep - mark is awarded dependent on the previous mark
- indep - mark is awarded independent of the previous mark

## BTEC Next Generation Mark Scheme Template

<<Construction>> <<Unit 1>> <<Series 1901>> <<Draft 1>>

Question Number	Answer	Mark
1(a)	<b>D</b> - Workability	1

Question Number	Answer	Mark
1(b)	<p>Award <b>one</b> mark for each of the following up to a maximum of <b>two</b> marks.</p> <ul style="list-style-type: none"> <li>• Allows for off-site fabrication (1)</li> <li>• Large open span (1)</li> <li>• Speed of erection onsite (1)</li> <li>• Low site wastage (1)</li> <li>• Flexibility of design (1)</li> <li>• Steel has compressive/tensile/shear strength (1)</li> <li>• Steel has a long life span (1)</li> </ul> <p><b>Accept any other appropriate answer.</b></p>	2

Question Number	Working	Answer	Notes	Mark
1(c)	<p><u>Area of rectangular wall:</u>  <math>40 \times 12 = 480 \text{ m}^2</math>            or <math>15 \times 40 = 600 \text{ m}^2</math></p> <p><u>Area of triangular wall:</u>  <math>0.5 \times 40 \times 3 = 60 \text{ m}^2</math>            or  <math>(3 \times 18)/2 + (3 \times 22)/2</math>  <math>= 27 + 33 = 60 \text{ (M1)}</math></p> <p><u>Area of wall:</u>  <math>480 + 60 = 540 \text{ m}^2</math>            or <math>600 - 60 = 540 \text{ m}^2</math></p>	<u><math>A = 540 \text{ m}^2</math></u>	<p>M1 for area of the rectangular section</p> <p>M1 for area of triangular section</p> <p>M1 for process of adding/subtracting areas (ft)(dep)</p> <p>A1 for total area</p> <p>B1 1 mark for <math>\text{m}^2</math></p>	5

Question Number	Working	Answer	Notes	Mark
1(d)	$a^2 = b^2 + c^2$  $BC^2 = 18^2 + 3^2$ $BC^2 = 333$ $BC = \sqrt{333}$ $BC = 18.2 (483...) \text{ m}$	18.2 (483...) Accept answers in the range of 18.2-18.25	M1 for populating formula  M1 for manipulating formula  A1 for correct answer for BC  Do not penalise if no units are shown	3

Question Number	Answer	Mark
2(a)	Award <b>one</b> mark for any of the following: <ul style="list-style-type: none"> <li>• Fast start-up times (1)</li> <li>• Long lifespan (1)</li> <li>• Provides warm light (1)</li> <li>• Enables coverage of large areas (1)</li> <li>• Provides good colour representation (1)</li> <li>• Flexible light levels (1)</li> <li>• Reduced energy consumption (1)</li> <li>• Relatively high lumen output per watt (1)</li> <li>• Can be dimmed (1)</li> </ul> <p><b>Do not accept references to cost, ease of use, easy/quick to install etc.</b></p> <p><b>Accept any other appropriate response.</b></p>	1

Question Number	Answer	Mark
2(b)	<p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Float glass is transparent (1) allows goods to be easily viewed (1)</li> <li>• Float glass is very flat (1) so does not distort the view through the window (1)</li> <li>• Float glass has uniform thickness (1) with rollers being used to determine the thickness (1)</li> <li>• Large panes of glass are possible (1) allowing for single windows to span a full shop width (1)</li> <li>• Has a very smooth surface (1) meaning little or no polishing is required/easy to maintain (1)</li> <li>• Can be formed into curved shapes (1) meaning there is more flexibility with shop front designs (1)</li> <li>• High degree of light transmission (1) reduces need for additional lighting/increase levels of natural light (1)</li> <li>• Ability to be produced in a range of colours/tints (1) allowing the building to be pleasing aesthetically/protects window displays from sunlight (1).</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	4

Question Number	Answer	Mark
2(c)	<p>Explain <b>two</b> reasons why the architect will have considered dead and live loads.</p> <p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• To design the building safely (1) to ensure the building does not collapse (1)</li> <li>• To comply with building regulation requirements (1) to ensure building permission is approved (1)</li> <li>• The design of suitable materials (1) incorporating economic section sizes (1)</li> <li>• Different factors of safety/weightings are applied to each type of load (1) meaning the structure could be overdesigned if only one type of load was considered (1)</li> <li>• Consider the loading placed on the foundation of the building (1) may require underpinning or more extensive foundations (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	4

Question Number	Working	Answer	Notes	Mark
2(d)	<p>Direct stress <math>\sigma = F/A</math></p> <p><math>A = 0.5 \times 0.5 = 0.25</math></p> <p><math>\sigma = 8.5/0.25</math></p> <p><math>\sigma = 34 \text{ kN/m}^2</math></p>	<u><math>\sigma = 34 \text{ kN/m}^2</math></u>	<p>M1 for calculating area</p> <p>M1 for Populating formula</p> <p>A1 for correct answer for direct stress</p>	3



Question Number	Answer	Mark
3(a)	<p>Award <b>one</b> mark for any of the following:</p> <ul style="list-style-type: none"> <li>• Concrete tiles (1)</li> <li>• Slate (1)</li> <li>• Clay tiles (1)</li> <li>• 'Green' roof / turf (1)</li> <li>• Felt (1)</li> <li>• Timber shingles (1)</li> <li>• Profiled metal sheeting (1)</li> <li>• Glass (1)</li> <li>• Aluminium sheeting (1)</li> <li>• Copper (1)</li> <li>• Lead (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	1

Question Number	Answer	Mark
3(b)	<p>Award <b>one</b> mark for identification.</p> <ul style="list-style-type: none"> <li>• Use a (sound) pressure level meter (1)</li> <li>• Mobile phone applications (1)</li> <li>• Decibel meter (1)</li> <li>• Decibel reader (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p> <p><b>Do not accept sound meter.</b></p>	1

Question Number	Answer	Mark
3(c)	<p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Higher mass materials could be used (1) as materials with higher density are more effective at absorbing sound (1)</li> <li>• Avoiding mechanical connections between wall surfaces (1) to break the vibration path of sound (1)</li> <li>• Interrupting the sound path (1) by using double framed walls (1).</li> <li>• Sound absorbing materials could be used (1) to reduce sound transferring to/within the buildings (1)</li> <li>• Making sure apertures into the building are correctly sealed (1) to reduce flanking sound/unwanted noise (1)</li> </ul>	4

	<ul style="list-style-type: none"> <li>• Use of glazing systems (1) through a variety of cavities reduces sound transmission (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	
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Question number	Indicative content
3(d)	<p>Answers will be credited according to learners' demonstration of knowledge and understanding of lighting and illumination, 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.</p> <p>An analysis of the reasons why light levels differ depending on the use of the buildings.</p> <ul style="list-style-type: none"> <li>• Consideration of the types of lighting available: <ul style="list-style-type: none"> <li>○ Natural light</li> <li>○ Artificial light</li> <li>○ Reflected light</li> <li>○ Types of artificial light</li> </ul> </li> <li>• Analysis of types of activity carried out in different buildings: <ul style="list-style-type: none"> <li>○ Eating and drinking</li> <li>○ Walking</li> <li>○ Shopping</li> <li>○ Driving</li> <li>○ Loading/unloading vehicles</li> <li>○ Resting</li> </ul> </li> <li>• Reasons for different lighting levels: <ul style="list-style-type: none"> <li>○ Eating and communal areas need to have enough illuminance to reduce the potential for accidents</li> <li>○ Lighting levels in dining areas should be limited to comfortable levels</li> <li>○ Lighting in dining areas should be able to be controlled depending on the time of day/outside conditions</li> <li>○ Light levels in the petrol filling station should allow for the safe movement of people and vehicles</li> <li>○ Provide security</li> </ul> </li> </ul>

Level	Mark	Descriptor
Level 0	0	No rewardable material
Level 1	1 - 3	<ul style="list-style-type: none"> <li>● Demonstrates isolated knowledge and understanding of relevant information; there may be major gaps or omissions.</li> <li>● Provides little evidence of weighing up competing arguments/pros and cons in context; discussion likely to consist of basic description of information.</li> <li>● Meaning may be conveyed but in a non-specialist way; response lacks clarity and provides a basic answer to the question.</li> <li>● The learner demonstrates a basic understanding of how lighting levels may need to differ depending on the use of each area within the building.</li> </ul>
Level 2	4 - 6	<ul style="list-style-type: none"> <li>● Demonstrates accurate knowledge and understanding of relevant information with a few gaps or omissions.</li> <li>● Discussion is partially developed, but will be imbalanced; evidences the weighing up of competing arguments/pros and cons in context.</li> <li>● Demonstrates the use of logical reasoning, clarity, and appropriate specialist technical language.</li> <li>● The learner demonstrates a good understanding of how lighting levels may need to differ depending on the use of each area within the building.</li> </ul>
Level 3	7-9	<ul style="list-style-type: none"> <li>● Demonstrates accurate and thorough knowledge and understanding of relevant information; any gaps or omissions are minor.</li> <li>● Displays a well-developed and balanced discussion, demonstrating a thorough grasp of competing arguments/pros and cons in context.</li> <li>● Logical reasoning evidenced throughout response that is clear and uses specialist technical language.</li> <li>● The learner demonstrates a developed understanding of how lighting levels may need to differ depending on the use of each area within the building.</li> </ul>

Question Number	Answer	Mark
4(a)	Award <b>one</b> mark for the following: <ul style="list-style-type: none"> <li>• Steel (1)</li> </ul>	1

Question Number	Answer	Mark
4(b)	Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks. <ul style="list-style-type: none"> <li>• Effects of natural elements/sunlight/UV/acid rain (1) causes the surface of materials to break down over time/discolour (1)</li> <li>• Freeze-thaw cycles in winter (1) results in materials fracturing as ice expands (1)</li> <li>• Thermal ageing (1) can cause materials to become brittle and fracture (1)</li> <li>• Timber can decay over time (1) as a result of wet rot (1)</li> <li>• Moisture movement in materials/capillary action (1) can lead to shrinkage/expansion (1)</li> <li>• Corrosion of metals (1) results in oxidation (1)</li> <li>• Extremes of temperature (1) causing surface cracking due to expansion/contraction (1)</li> </ul> <p><b>Accept any other appropriate response.</b></p>	4

Question Number	Answer	Mark
4(c)	<p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Moisture resistant (1) therefore stable in areas of high moisture content (1)</li> <li>• Concrete blocks allow privacy within the changing rooms (1) because they have good sound reduction properties/provide a visual barrier for occupants (1)</li> <li>• Can be fair faced (1) to accept direct decoration/natural finish (1)</li> <li>• They have good compressive strength (1) making them suitable for load bearing walls (1)</li> <li>• They have high levels of thermal mass (1) allowing the internal temperature to remain stable (1)</li> <li>• They are durable (1) allowing the building structure to have a long service life (1).</li> <li>• They are tough (1) meaning they will not fracture if they receive impact (1)</li> <li>• The blocks are versatile (1) allowing them to be used for all parts of the building (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	4

Question Number	Answer	Mark
4(d)	<p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion.</p> <ul style="list-style-type: none"> <li>• Underfloor heating provides radiant heat (1) ensuring the changing areas do not have any cold areas (1)</li> <li>• Heat from the floor will rise due to convection (1) allowing cooler air to fall and be reheated (1)</li> <li>• No exposed radiators/pipes/heaters (1) increase usable space/ that could prevent injury/burns (1)</li> <li>• Water will quickly/easily evaporate from the floor surface (1) as water will get transferred to the floor from shower areas/as people dry themselves (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	2

Question Number	Answer	Mark
4(e)	<p>Award <b>one</b> mark for each valid statement up to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Ventilation (1) to remove moist air/allow for air changes (1)</li> <li>• Air conditioning (1) to control quality of the air in the building (1)</li> <li>• Dehumidification (1) to control moisture content (1)</li> <li>• Maintain high temperatures (1) to prevent condensation (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	4

Question Number	Answer	Mark
5(a)	<p>Award <b>one</b> mark for the identification and <b>one</b> additional mark for the appropriate expansion to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Prevent moisture from passing through the raft foundation into the building (1) as polythene is an impermeable barrier (1)</li> <li>• Must not be affected by changes in temperature (1) as temperature variations each month are quite wide (1)</li> <li>• DPM can be relatively tough (1) to allow it to be laid directly under the concrete raft (1)</li> <li>• DPM is waterproof (1) which prevents moisture from passing into insulation materials (1)</li> <li>• Different gauges of polythene are available (1) to suit different circumstances, e.g. to prevent damage (1)</li> <li>• DPM allows ease of dealing with /waterproofing/detailing (1) allowing for seams and laps (1)</li> <li>• Can be linked to vertical DPM to raft edge (1) links the DPC/cavity gutters at foot of external wall (1)</li> </ul> <p><b>Accept any other relevant phrasing/wording.</b></p>	4

**QUESTION 5b**

<b>Layer</b>	<b>Thickness (m)</b>	<b>Conductivity (W/mK)</b>	<b>Resistance (m<sup>2</sup>K/W)</b>
Surface resistance			0.12
Plasterboard	0.025	0.14	<b>0.18 (1)</b>
Mineral wool	0.100	0.04	<b>2.5 (1)</b>
Insulation board	0.020	0.03	<b>0.67 (1)</b>
Cavity			0.18
Facing brick	0.113	0.84	<b>0.13 (1)</b>
Surface resistance			0.06
Total thermal resistance			<b>3.84 (1)(ft)</b>

(Accept correct rounding to one decimal place)

$$\mathbf{U = 1/Rt = 1/3.84 = 0.26}$$

Calculation of resistance values:

B1- 2 correct values of resistance shown

B2- 3 correct values

B3- 4 correct values

A1 (ft)- Total resistance values

M1 (ft) - 1/3.84 (or their value)

A1 - 0.26

Question number	Indicative content
5(c)	<p>Answers will be credited according to learners' demonstration of knowledge and understanding of the context, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive.</p> <p>Answers may cover some or all of the indicative content but should be rewarded for other relevant answers.</p> <p>An analysis of the use of the same designs, materials and construction methods, the appropriateness for the locations, or not, supported by relevant points, which may include:</p> <ul style="list-style-type: none"> <li>• Consideration of the climate at the given location, including rainfall, wind speed, days of air frost and temperatures.</li> <li>• The appropriateness of the materials with regards to the type of construction proposed and how they meet legislative requirements.</li> <li>• Consideration of materials to be used: <ul style="list-style-type: none"> <li>○ facing bricks are able to withstand the effects of rain, wind and frost in the location</li> <li>○ facing bricks have sufficient compressive strength for use in non-load bearing walls</li> <li>○ facing bricks are durable and can have a long lifespan</li> <li>○ can be used to provide protection for the steel framework and insulation from frost/rain</li> <li>○ Use of steel studs allows for apartments to be erected quickly.</li> <li>○ steel stud sections are lighter in weight than comparable timber sections</li> <li>○ steel studs will not twist/warp as they do not absorb moisture</li> <li>○ mineral wool insulation will need to be protected from damp/moisture</li> <li>○ mineral wool can be an irritant when being installed</li> <li>○ mineral wool provides very good thermal and acoustic insulation</li> <li>○ plasterboard has good thermal insulation properties when combined with insulators.</li> </ul> </li> <li>• Consideration of location and climate: <ul style="list-style-type: none"> <li>○ the location is relatively warm, meaning materials do not need to withstand extremes</li> <li>○ windspeeds in the location are relatively high therefore wind loadings need to be considered</li> <li>○ the location has a high proportion of days with rain throughout the year</li> <li>○ overall rainfall levels are similar throughout the year, except for winter months</li> <li>○ the location encounters air frost in the winter and spring, therefore the effects of frost need to be considered</li> <li>○ the location is sunny in the summer although extreme temperatures are not generally encountered.</li> </ul> </li> <li>• Consideration of design/construction methods:</li> </ul>



	<ul style="list-style-type: none"> <li>○ the design could be appropriate for apartment blocks as an alternative to a concrete frame design</li> <li>○ construction methods, such as traditional brick exterior construction, would be familiar to local workforces</li> <li>○ gives the appearance of a traditional brick built building.</li> </ul>
Level	Descriptor
0 0 marks	No rewardable material
1 1-4 marks	<p>Basic arguments on both sides identified, <b>or</b> only one side considered. The answer is likely to be in the form of a list.</p> <p>Points made will be superficial/generic and not applied/directly linked to the situation in the question. No conclusion produced or the conclusion a consequence of only one side of the argument being considered.</p> <p>The learner demonstrates a basic understanding of the construction principles involved.</p>
2 5-8 marks	<p>Arguments for and against are described, but there will be more emphasis on one side than the other. The answer will be unbalanced. A conclusion is likely to be present or embedded, but this is either implicit or as a result of unbalanced consideration of the arguments. There is little or unfocused justification of the conclusion. Most points made will be relevant to the situation in the question, but the link will not always be clear.</p> <p>The learner demonstrates a good understanding of the construction principles involved.</p>
3 9-12 marks	<p>Balanced explanation of both sides for and against. A conclusion is produced which is justified clearly linked to the consideration of arguments for and against, and their relative importance to the situation. The majority of points made will be relevant and there will be a clear link to the situation in the question.</p> <p>The learner demonstrates an advanced understanding of the construction principles involved.</p>

**Ofqual**  
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Llywodraeth Cynulliad Cymru  
Welsh Assembly Government

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