

Mark Scheme (Results)

January 2020

Pearson BTEC Level 3 Construction

Unit 1: Construction Principles
(20075K)

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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

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

Construction Level 3 Unit 1 January 2020

| Question Number | Answer | Mark |
|-----------------|---------------------|------------|
| 1(a) | B - Hardness | (1) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 1(b) | <p>Award one mark for identification and one additional mark for appropriate expansion.</p> <ul style="list-style-type: none">• The minimum amount of light/level of lux (1) falling on a plane surface (1)• The required quality of light (1) that allows activities to be carried out safely/for people to see clearly (1)• Lowest possible level of lighting (1) to minimise energy costs / carbon emissions / distractions to train drivers (1) | (2) |

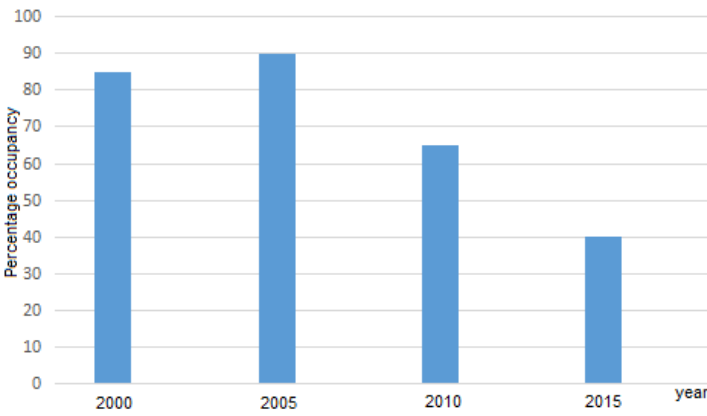
| Question number | Working | Answer | Notes | Mark |
|-----------------|---|----------------------------------|---|--|
| 1(c) | <p>Method 1</p> <p>Area of rectangular section $A_r = b \times w$ $A_r = 3 \times 7$ $A_r = 21 \text{ m}^2$</p> <p>Area of trapezium section $A_t = (\text{top} + \text{bottom})/2 \times \text{height}$ $A_t = (6 + 3)/2 \times 3$ $A_t = 4.5 \times 3$ $A_t = 13.5 \text{ m}^2$</p> <p>Total area = $A_r + A_t$ Area = $21 + 13.5$ Area = 34.5 m^2</p> <p>Method 2</p> <p>Area of overall rectangle</p> $A_r = 6 \times (3+7)$ $A_r = 6 \times 10$ $A_r = 60 \text{ m}^2$ <p>Area of rectangular cut outs $A_c = 2 \times (0.5 \times 3 \times 7)$ $A_c = 2 \times 10.5$ $A_c = 21 \text{ m}^2$</p> <p>Area of triangular cut outs</p> $A_t = 2 \times (0.5 \times (0.5 \times 3) \times 3)$ $A_t = 2 \times 2.25$ $A_t = 4.5 \text{ m}^2$ <p>Area = $A_r - A_c - A_t$ Area = $60 - 21 - 4.5$ Area = 34.5 m^2</p> | <u>Area = 34.5 m²</u> | <p>A1 for correct answer for (A_r)</p> <p>M1 for correct population of formula (A_t) A1 for correct answer for (A_t)</p> <p>A1 for correct total area (ft)</p> <p>A1 for correct answer for (A_r)</p> <p>M1 for area of rectangular cut outs (A_c)</p> <p>A1 for triangular cut outs (A_t)</p> <p>A1 for correct total area (ft)</p> | <p style="text-align: right;">(4)</p> |

| | | | | |
|--|---|--|--|--|
| | <p>Method 3</p> <p>Area of central rectangle</p> <p>$A_r = 3 \times 10$ $A_r = 30 \text{ m}^2$</p> <p>Area of triangles</p> <p>$A_t = 2 \times (0.5 \times (0.5 \times 3) \times 3)$ $A_t = 2 \times 2.25$ $A_t = 4.5 \text{ m}^2$</p> <p>Area = $A_r + A_t$ Area = $30 + 4.5$ Area = 34.5 m^2</p> | | <p>A1 for correct answer for (A_r)</p> <p>M1 for correct population of formula (A_t) A1 for correct answer for (A_t)</p> <p>A1 for correct total area (ft)</p> | |
|--|---|--|--|--|

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 1(d) | <p>Award one mark for identification and one additional mark for appropriate expansion.</p> <ul style="list-style-type: none"> • Airborne sound can pass through gaps/holes in the building structure (1) which could result in excessive noise inside the houses (1) • Noise of trains travelling will cause airborne sound (1) which will have the greatest effect on windows/doors/walls facing the railway line (1) • Vibrations from sound could cause building/structure damage (1) potentially leading to higher maintenance requirements (1) • Requirement for houses to be fitted with double glazing/sound insulation (1) to reduce impact of airborne sound as more sound waves are reflected/absorbed (1) • Noise issues in local gardens (1) which would have a negative effect on the quality of life for residents /decrease value of housing (1) • Trains will generate a lot of noise (1) which could cause difficulty sleeping / wake residents / affects well-being (1) | (2) |

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 1(e) | <p>Award one mark for identification and one additional mark for appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Use a concrete mix that has low permeability / apply surface coating (1) to increase the time taken for moisture to reach the reinforcement bars (1) • Reduce the water content of the concrete (1) provides more strength to the concrete to reduce cracking (1) • Use of high-quality aggregates (1) which can then reduce the chances of shrinkage (1) • Reinforced concrete sections can be prestressed (1) to reduce chances of shear failure (1) • Ensure reinforcement the correct type/quantity/ amount of reinforcement is used (1) to prevent tensile/compression failure (1) • Ensure there is sufficient concrete cover over the steel reinforcement (1) to give sufficient protection from weathering/ corrosion of steel reinforcement (1) • Use a sulphate resistant concrete mix (1) to protect foundations from chemical /sulphate attack (1) • To resist freeze-thaw deterioration use air-entrained concrete (1) which would relieve internal pressure on the concrete by providing tiny chambers for water to expand into when it freezes (1) • Use stainless steel/galvanised/coated steel reinforcement (1) to which will prevent the reinforcement bars from corroding (1) • Have a planned maintenance schedule (1) ensuring any damage is repaired as soon as possible (1) • Allow the fresh concrete to cure for a sufficient time to gain strength (1) before applying loadings (1) • Include movement joints (1) to stop thermal expansion of the reinforced concrete (1) • Design the reinforced concrete with an appropriate factor of safety (1) to reduce the possibility of damage due to excess loading (1) • Reduce/minimise dynamic loads in the bridge is exposed to (1) so it is not exposed to loads beyond what it was designed for (1) | (4) |

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 2(a) | <p>Award one mark for any of the following:</p> <ul style="list-style-type: none"> • Sunlight (1) • Ageing (1) • Ultraviolet (UV) radiation (1) • Wet rot (1) • Dry rot (1) • Fungal attack / decay (1) • Lichens/mosses (1) • Weathering / erosion (1) • Freeze/thaw (1) • Acid rain (1) • Rusting/oxidisation (1) • Capillary attraction (1) <p>Do not accept: weather / rain / wind / rotting on their own</p> | (1) |

| Question number | Working Answer | Notes | Mark |
|-----------------|---|---|------------|
| 2(b) |  <p>(horizontal bar chart acceptable)</p> | <p>B1-1 mark for the axes drawn correctly and labelled with values</p> <p>B1-1 mark for any one bar drawn to the correct height</p> <p>B2-2 marks for any two bars drawn to the correct height</p> <p>B3-3 mark for all four bars drawn to the correct height.</p> | (4) |

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 2(c) | <p>Award one mark for identification and one additional mark for appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Allows different temperatures to be set for each room (1) depending on the activities that are carried out in them (1) • Control systems can react to a wide range of conditions (1) including humidity / light levels / movement / sensors (1) • Allows for temperatures/heating system to be controlled remotely (1) using voice recognition / mobile phone apps (1) • Heating system can be programmed to reach a given temperature at a set time (1) meaning the heating is turned on earlier in colder weather (1) • The system allows a choice of comfort conditions to be set (1) which can set an exact temperature / allows complex programming (1) <p>Do not accept: easy/easier on its own as electronic systems can be complex and difficult to operate.</p> | (4) |

| Question Number | Answer | Mark |
|-----------------|---|------|
| 2(d) | <p>Award one mark for a disadvantage and one additional mark for appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Could lead to damp due to condensation (1) if no ventilation is provided to allow the house to breathe (1) • External insulation is expensive (1) when compared to internal insulation (1) • External window sills will need to be extended (1) due to the increased thickness of the wall (1) • External fixtures (satellite dishes, pipework) will need to be removed and refitted (1) increasing the cost of the installation (1) • External insulation is susceptible to weather degradation (1) therefore will need an applied finish/cladding/outer skin to protect it (1) • Access maybe restricted (1) as the neighbouring property owner's permission will be required (1) • External access scaffolding will be required (1) for health and safety/allow efficient installation (1) | |

| | | |
|--|---|------------|
| | <ul style="list-style-type: none"> • Not all external insulation is fire resistant (1) which could result in fire spreading more quickly (1) • External insulation will affect the external appearance of the building (1) which may result in a building that is not aesthetically pleasing/not in keeping with other buildings in the local area (1) • External cladding will restrict the ability to maintain the external walls of the building (1) which could result in structural damage not being identified (1) | (4) |
|--|---|------------|

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 3(a) | <p>Award one mark for an advantage and one additional mark for appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Plasterboard is lightweight (1) making it safer to handle / reducing the risks of injury on site / faster to install (1) • It allows for a clean / simple installation process (1) due to the straight edges of the boards / easy to cut to alter shape to fit / coverage of large size of the board (1) • Plasterboard can slow down the spread of fires (1) since it is an incombustible material (1) • Easy to repair if damaged (1) as repairs can be completed without the use of specialist tools (1) • Plasterboard reduces noise from classrooms (1) as it reduces transmission of airborne noise / has some sound insulation properties (1) • It is readily available at most builders' merchants and DIY stores (1) therefore few supply issues to complete the work (1) • Plasterboard has a smooth surface (1) which would allow a range of finishes to be directly applied (1) | (4) |

| Question number | Working | Answer | Notes | Mark |
|-----------------|--|---|--|------|
| 3(b) | Strain = dL/L Strain = $0.04/200$ Strain = 0.0002 Or 2×10^{-4} or $1/5000$ | 2×10^{11} (oe) (N/m ²) Or -2×10^{11} (oe) (N/m ²) | M1 for correct substitution of values for strain A1 for correct answer for strain | |

| | | | | |
|--|---|--|---|------------|
| | Modulus of Elasticity = stress/strain Modulus of Elasticity = 40 000 000 / 0.0002 Modulus of Elasticity = 2×10^{11} N/m ² Or 20×10^{10} N/m ² | | M1 for correct substitution for modulus of elasticity (ft) A1 for correct value for modulus of elasticity (oe) | (4) |
|--|---|--|---|------------|

| Question number | Indicative content |
|-----------------|--|
| 3(c) | <p>Answers will be credited according to the learner's demonstration of knowledge and understanding the use steel structures, 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 a steel structured building is suitable for the teaching block.</p> <ul style="list-style-type: none"> • Consideration of the use of steel as a material <ul style="list-style-type: none"> ○ Steel is durable ○ Steel is recyclable ○ Steel sections are structurally stable ○ Steel is relatively lightweight compared to alternatives ○ Steel is versatile ○ Steel can be used for most of the required structural members ○ Steel does not buckle ○ Steel is not affected by natural agents ○ Steel is not affected by insect attack ○ Steel is a relatively cheap / cost-effective material • Analysis of the benefits of a steel frame <ul style="list-style-type: none"> ○ Frames can be prefabricated ○ Prefabricated frames allow construction in a short time ○ Allows structures to be adaptable and flexible ○ Long span steel construction creates column-free space ○ Allows rooms to be configured on the floor plan to meet the current and future educational needs. ○ Light steel internal walls are able to be relocated ○ Safer construction methods can be used ○ Off-site fabrication reduces risks and hazards to pupils/staff ○ Smaller foundations are required ○ Reduced disruption on the site • Impact on the structure of the building <ul style="list-style-type: none"> ○ Allows the teaching block to meet acoustic, thermal or ventilation requirements ○ Provides flexible teaching spaces ○ Building is able to withstand wind loadings well ○ Structure can allow services to be incorporated through beams ○ Allows for future extension of the building ○ Steel allows for taller structures/more storeys than alternatives |

| | <ul style="list-style-type: none"> ○ A range of different types of exterior cladding can be used |
|----------------|---|
| Level | Descriptor |
| 0 0 marks | No rewardable material |
| 1 1-3 marks | <p>A few key points identified, or one point described in some detail. The answer is likely to be in the form of a list. Only one viewpoint considered. Points made will be superficial/generic and not applied/directly linked to the situation in the question.</p> <p>The candidate demonstrates a basic understanding of the use of steel framed construction.</p> |
| 2 4-6 marks | <p>Some points identified, or a few key points described. Consideration of more than one viewpoint but there will be more emphasis on one of them. The answer is unbalanced. Most points made will be relevant to the situation in the question, but the link will not always be clear.</p> <p>The candidate demonstrates a good understanding of the use of steel framed construction.</p> |
| 3 7-9 marks | <p>Range of points described, or a few key points explained in depth. All sides of the case are considered, and the answer is well-balanced, giving weight to all viewpoints. The majority of points made will be relevant and there will be a clear link to the situation in the question.</p> <p>The candidate demonstrates a developed understanding of the use of steel framed construction.</p> |

| Question number | Working | Answer | Notes | Mark |
|-----------------|---|---|--|------------|
| 4(a) | <p>The total sound absorption in the loading bay</p> $A = 40 \times 0.2 + 32 \times 0.4 + 40 \times 0.7$ $A = 8 + 12.8 + 28$ $A = 48.8$ <p>Mean sound absorption coefficient</p> $= 48.8 / (40 + 40 + 32)$ $= 48.8 / 112$ $= 0.4357...$ <p><u>Do not accept 0.43</u></p> | <p>Mean sound absorption coefficient = 0.4357...</p> <p>Accept answers that round to 0.44</p> | <p>M1 for correct substitution of values</p> <p>A1 for total sound absorption</p> <p>M1 for correct substitution (ft)(dep)</p> <p>A1 for correct value of mean sound absorption coefficient (ft)</p> | (4) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 4(b) | <p>Award one mark for identification and one additional mark for appropriate expansion.</p> <ul style="list-style-type: none"> • Condensation occurs within the construction material (1) leading to mould / corrosion / rotting /swelling/ expansion / lose strength / internal degradation of the material. (1) • There is a temperature gradient across the construction material (1) and the dew point temperature falls within the construction material/condensation occurs internally (1) <p>Accept any other relevant phrasing/wording.</p> | (2) |

| Question Number | Answer | Mark |
|-----------------|--|------------|
| 4(c) | <p>Award one mark for identification and one additional mark for appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Natural lighting can provide good levels of illumination (1) during daylight hours/during periods of good weather (1) • Natural light can make employees more alert / improve productivity (1) as the body has a positive reaction to daylight (1) • Natural light can provide useful illumination (1) for tasks that require specific colour rendition (1) • Reduces the need for artificial light (1) which in turn reduces energy use/use of finite resources / CO₂ emissions / energy costs (1) • Natural light is more visually appealing (1) which can reduce the possibility of eye strain / seasonal affected disorder (1) <p>Accept any other relevant phrasing/wording.</p> | (4) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 5(a) | <p>Award one mark for the identification and one additional mark for the appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • Pantile performs well in most wind conditions (1) making it suitable for both locations as average wind speeds are generally low (1) • Pantile offers good resistance to rain (1) suitable for the level of rainfall in both locations (1) • Pantiles are durable (1) meaning they will not need to be frequently replaced (1) • Pantiles have good frost resistance (1) which is appropriate for the number of days with air frost in winter for both locations (1) • Pantiles do not degrade when exposed to salty air (1) making them suitable for use in coastal locations (1) • Pantiles are not affected by insects / lichens / moss (1) making them suitable for installation in locations close to trees/vegetation (1) • They do not become damaged by sunlight (1) making them suitable for locations with high amounts of sunshine (1) <p>Accept any other valid response.</p> | (4) |

| Question Number | Answer | Mark |
|-----------------|---|------------|
| 5(b) | <p>Award one mark for the identification and one additional mark for the appropriate expansion, up to a maximum of six marks.</p> <ul style="list-style-type: none"> • Low emissivity glass reflects heat back to its source (1) so it helps the homes stay cooler in the summer / warmer in the winter / maintain desired temperature (1) • Reduces energy use in the homes (1) which in turn reduces energy bills / carbon emissions (1) • Reduces heat losses from the homes (1) which allows the temperature to be controlled more easily (1) • Reduced levels of condensation (1) as the glass does not become as cold (1) • It helps protect fading of any nearby furniture / decoration (1) by blocking UV light (1) <p>Accept any other valid response.</p> | (6) |

| Question number | Indicative content |
|-----------------|---|
| 5(c) | <p>Answers will be credited according to the learner’s 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"> • Consideration of the climate at the two locations, including temperature, hours of sunshine, rainfall, wind speed, and days of air frost • The appropriateness of the materials with regards to the type of construction proposed and how they meet legislative requirements • Consideration of materials to be used: <ul style="list-style-type: none"> ○ Resistance to exposure to weather ○ Aesthetics ○ Property values ○ Combustibility/fire resistance ○ Thermal insulation ○ Sustainability/recyclability ○ Maintenance ○ Finishes ○ Resistance to insects/rot/rusting ○ Durability ○ Sound insulation ○ Thermal Insulation ○ Standard sizes ○ Ease of drilling / cutting ○ Ability to take mechanical fixings ○ Speed of installation ○ Traditional construction methods • Consideration of location and climate: <ul style="list-style-type: none"> ○ The locations are relatively damp and moderately warm meaning materials need to withstand a range of exposure conditions ○ Wind speeds in the locations are relatively low on average ○ The locations both have quite high annual rainfall ○ Both locations have quite frequent days of air frost in the winter ○ The locations both have relatively high levels of sunshine in the summer ○ Both locations have limited levels of sunshine in the winter • Consideration of design/construction methods: <ul style="list-style-type: none"> ○ The design could be appropriate for homes in both locations as brick/block is a traditional building method ○ Cavity wall construction is likely to be familiar to local workforces ○ Gives the homes a traditional look ○ Provides the external walls with very high levels of thermal insulation |

| Level | Descriptor |
|-----------------|--|
| 0 0 marks | No rewardable material |
| 1 1-4 marks | <p>Basic arguments on both sides identified, or 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 candidate demonstrates a basic understanding of the combined use of the materials in the scenario.</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 present, 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 candidate demonstrates a good understanding of the combined use of the materials in the scenario.</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 candidate demonstrates a developed understanding of the combined use of the materials in the scenario.</p> |

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Welsh Assembly Government

