



Mark Scheme

ADDITIONAL SAM

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 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

BTEC Mark Scheme

Construction and the Built Environment, Unit 1 – Additional SAM

Question Number	Answer	Mark
1a	C – fatigue	(1)

Question Number	Answer	Mark
1b	<p>Award one mark for the identification and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none"> • Ensure there are no holes left in walls/floors/ceilings (1) by sealing gaps around pipes/ducts (1). • Add sealing to electrical sockets (1) to prevent sound passing through cover plates (1). • Increase thickness of insulation materials (1) to provide more sound absorption between wall surfaces (1). • Design of passive or mechanical systems (1) to reduce transmission of sound through the ventilation system (1). • Use of triple glazing/positioning of windows (1) to minimise sound re-entering the building (1). <p>Accept any other appropriate responses.</p>	(2)

Question number	Working	Answer	Notes	Mark
1(c)	<p>Length of AB</p> <p>$\tan \theta = \text{opp/adj}$</p> <p>$AB = \text{opposite}$</p> <p>$\tan 35 = AB/6$</p> <p>$AB = 6 \tan 35$</p> <p>$AB = 6 \times 0.700$</p> <p>$AB = 4.2\text{m}$</p> <p>Accept 4.201m (this is to an appropriate degree of accuracy)</p>	<u>$AB = 4.2\text{m}$</u>	<p>M1 for $\tan 35 = AB/6$</p> <p>M1 for $AB = 6 \tan 35$ or $AB = 6 \times 0.700$</p> <p>A1 for correct value of AB</p>	(3)

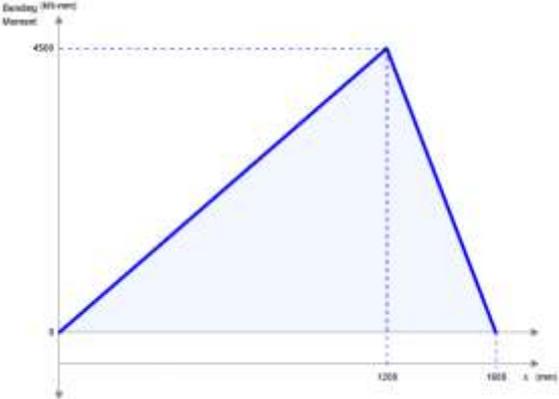
Question number	Working	Answer	Notes	Mark
1(d)	<p>Method 1:</p> <p>Conversion to radians</p> $2\pi\theta/360$ $= 2 \times 35 \times \pi/360$ $= 0.61 \text{ rad}$ $\text{Area} = (6^2 \times 0.61)/2$ <p>Area = accept 10.99 to 10.996</p> <p><u>Area = 11m²</u></p> <p>Method 2 alternative approach:</p> $\text{Area} = \pi \times \theta \times r^2/360$ $\text{Area} = \pi \times 35 \times 6^2/360$ <p><u>Area = 11m²</u></p>	<p><u>Area = 11m²</u></p> <p>Allow (ft)</p>	<p>M1 for conversion to radians</p> <p>A1 for correct radian measurement</p> <p>M1 for calculation of area</p> <p>A1 for correct value of area</p> <p>M1</p> <p>M2</p> <p>A1</p>	(4)

Question Number	Answer	Mark
2a	<p>Award one mark for any of the following:</p> <ul style="list-style-type: none"> • age (1) • previous exposure to noise (1) • state of health (1) • activity (1) 	(1)

Question Number	Answer	Mark
2b	<p>Award one mark for the identification and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none"> • LED lighting has a long lifetime (1) reducing the need to change bulbs frequently (1). • LED lighting is energy efficient (1) reducing the cost of illuminating the flats (1). • LED lights do not burn out (1) reducing the chances of having no lighting (1). • LED lighting does not need a warm up period (1) meaning the full luminance is available instantly (1). • LED lighting is not affected by being turned on/off (1) making it suitable for rooms where lights are often used for short periods of time (1). • Rugged - LEDs are also called "Solid State Lighting (SSL)(1) as they are made of solid material with no filament or tube or bulb to break. • Not affected by cold temperatures (1) LEDs "like" low temperatures and will start-up even in sub-zero weather. • Directional - With LED's you can direct the light where you want it (1) thus no light is wasted. • Excellent Colour Rendering (1) LEDs do not wash out colours like other light sources such as fluorescents/ making them perfect for displays and retail applications (1). • Environmentally friendly (1) LEDs contain no mercury or other hazardous substances (1). 	(2)

Question Number	Answer	Mark
2c	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of four marks.</p> <ul style="list-style-type: none"> • Moist air created by cooking (1) coming into contact with cold surfaces (1). • Differences in temperature between the outside and inside of the building/lack of insulation (1) reducing the temperature of walls/windows (1). • Lack of circulation of warm moist air (1) caused by windows being closed (1). • High levels of humidity (1) caused by showers/drying clothes (1). • Extractor fans/tumble driers are inadequate for purpose (1) creates build-up of moisture (1). <p>Accept any other appropriate response.</p>	(4)

Question Number	Answer	Mark
3a	<p>Award one mark for a failure mode and one further mark for a description of the failure mode, to a maximum of four marks.</p> <ul style="list-style-type: none"> • The column could buckle (1) meaning it will deflect from the vertical near the midpoint (1). • The column could yield (1) causing the column to bend close to the midpoint (1). • Fatigue could cause failure (1) causing fracture of the steelwork (1). • The column could have torsional buckling (1) which will cause it to twist and fail (1). • A short column will fail internally by yielding (1) in the case of ductile materials such as mild steel (1). • The member does not collapse immediately but remains in bent equilibrium (1) unless the yield strength of the material has been exceeded (1). • In the case of slender structural columns the critical buckling load and the critical length depend upon a number of factors (1), such as the shape and size of the cross-section/the relationship between the length of the column and its lateral dimensions/the degree of fixity at both ends (1). <p>Accept any other appropriate response.</p>	(4)

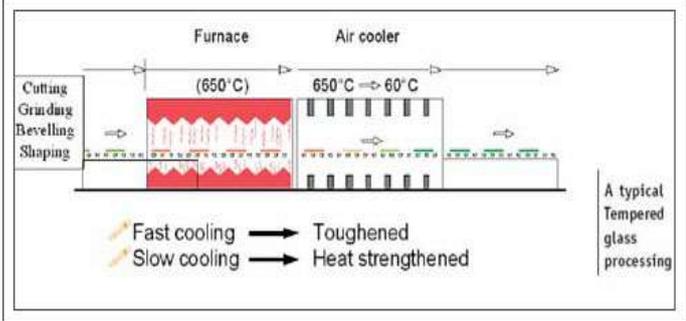
Question number	Working	Notes	Mark
3b	<p>Take moments about point A</p> $BM_A = -5 \times 1.6 - 15 \times 1.2 + 16.25 \times 1.6$ $BM_A = -8 - 18 + 26$ $BM_A = 0 \text{ kNm}$ <p>Take moments about point B</p> $BM_B = 16.25 \times 0.4 - 5 \times 0.4 = 3.75 \times 1.2$ $BM_B = 6.5 - 2 = 4.5$ $BM_B = 4.5 \text{ kNm}$ <p>Take moments about point C</p> $BM_C = -15 \times 0.4 + 3.75 \times 1.6$ $BM_C = -6 + 6$ $BM_C = 0 \text{ kNm}$ <p>Bending moment diagram</p> 	<p>M1 for taking moments about A</p> <p>A1 for BM at A</p> <p>M1 for taking moments about B</p> <p>A1 for BM at B</p> <p>M1 for taking moments about C</p> <p>A1 for BM at C</p> <p>M1 for plotting BM diagram</p>	(7)

Question number	Indicative content
3c	<p>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.</p> <p>An analysis of the suitability of glulam beams for applications with large roof spans.</p> <ul style="list-style-type: none"> • Consideration of the ability to produce beams that cannot be easily sourced from solid sawn timber. • Analysis of building applications for supermarkets. <ul style="list-style-type: none"> ○ large span roofs ○ need for uninterrupted floor space, reduced number of columns ○ need to have more sustainable construction methods • Benefits of glulam beams: <ul style="list-style-type: none"> ○ made from natural, renewable resources (timber) ○ low levels of embedded energy compared to alternatives ○ no need to mine/process raw materials unlike steel or concrete ○ beams have a natural appearance making them attractive to look at ○ size / shape of beams is flexible ○ long lengths of beams are possible – up to 30 m ○ improved strength to weight ratio compared to alternatives ○ durable material that can be designed to suit specific performance requirements ○ improved performance in fires compared to steel as it does not deform.

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	<ul style="list-style-type: none"> • No rewardable material.
Level 1	1–3	<ul style="list-style-type: none"> • 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 provides a basic answer to the question.
Level 2	4–6	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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
4a	<p>Award one mark for the identification and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none"> • Tempered glass breaks into small particles (1) reducing the risk of cuts/injury (1). • Tempered glass is significantly stronger than alternatives (1) reducing the potential for breakage (1). • Tempered glass has good hardness characteristics (1) reducing the risk of damage from vandalism (1). • Safety is the main advantage of tempered glass (1) Using tempered glass reduces the risk of injury caused by jagged glass shards (1). • Broken panels of tempered glass is easier to clean up (1) since it crumbles into small pieces, there are fewer sharp shards (1). • Tempered glass is also more heat resistant than normal glass (1) which makes it ideal for laboratory uses and buildings that must be built to strict fire codes (1). 	(2)

Question Number	Answer	Mark
4b	<p>Award one mark for each valid point Maximum three marks if only an annotated drawing or written description.</p>  <ul style="list-style-type: none"> • Glass is cut to the required size (1). • Sharp edges are removed (1). • Glass is checked for imperfections (1). • Pass float glass through a horizontal furnace (1). • Heat the glass beyond its softening point (over 600°C) (1). • Cool the glass down rapidly/quenched (1). 	(4)

Question number	Working	Answer	Notes	Mark
4(c)	<p>CSA of cone $CSA = \pi r l$ $l = \sqrt{(r^2 + h^2)} = \sqrt{(1^2 + 2^2)}$ $l = \sqrt{(1+4)} = 2.24 \text{ m}$ $CSA = 1 \times 2.24 \times \pi$ <u>$CSA = 7.02 \text{ m}^2$</u></p>	<u>$CSA = 7.02 \text{ m}^2$</u>	<p>M1 for correct substitution of values A1 for correct value of l M1 for calculating the CSA (ft) A1 for correct value of CSA (ft)</p>	(4)

Question Number	Answer	Mark
4d	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of six marks.</p> <ul style="list-style-type: none"> • Area/shape/location of windows (1) which will impact on the light at various parts of the classroom (1). • The structure of the building (1) because single storey buildings can allow for roof lights to be incorporated (1). • Whiteboards/televisions/screens/interior decoration (1) as these will create internal reflective surfaces in the rooms (1). • Provision and use of shading devices on windows (1) to prevent glare/control lighting levels (1). <p>Accept any other appropriate response.</p>	(6)

Question Number	Answer	Mark
5a	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of four marks.</p> <ul style="list-style-type: none"> • Thatch is thermally stable (1) as there are a large number of frost days in the winter and summer temperatures over 20C (1). • Thatch is not adversely affected by extensive periods of sunlight (1) as the location has long sunny days in the summer (1). • Not be damaged by frequent rainfall (1) as there is rainfall approximately 1 in 3 days (1). • Not be damaged/affected by sustained higher temperatures (1) as summer temperatures are around 20C or higher (1). <p>Accept any other appropriate response.</p>	(4)

Question Number	Answer	Mark
5b	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of six marks.</p> <ul style="list-style-type: none"> • Temperature can be controlled through an app (1) allowing a comfortable temperature to be set for when the resident arrives home (1). • Energy use can be monitored (1) allowing the resident to save money/be more environmentally aware (1). • Can identify faults in the system (1) reporting these automatically to a service engineer (1). • Allows more control over temperatures in individual rooms (1) as heating/ventilation is controlled in zones (1). • Allows for external sensors to be used (1) to monitor the outside climate/weather/temperature (1). <p>Accept any other appropriate response.</p>	(6)

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"> • Consideration of the relative climates of the two locations, including rainfall and temperatures. • The appropriateness of using the same construction techniques for the two sites, linking this with materials and locations. • Consideration of materials: <ul style="list-style-type: none"> ○ Timber cladding will need to be specified that it is capable of exposure to higher levels of rainfall. ○ Timber would need to be designed so as not to fail with both high temperatures and high levels of rainfall. ○ Materials would need to be specified or treated that can resist moisture penetration for higher rainfall levels. ○ Roofing materials suitable for location A, such as thatch, would not be appropriate in location B. ○ Insulation requirements will be different in each location, with location B requiring more insulation potentially. • Consideration of location and climate: <ul style="list-style-type: none"> ○ Location A is relatively dry and warm compared to location B, resulting in different approaches to ensure human comfort. ○ Location B has significantly higher levels of rainfall, therefore roof trusses and roof coverings specified for that location may be unnecessarily expensive for location A. ○ Location A has a warmer/drier climate therefore there will be less need for insulation compared to location B. ○ Location A is warmer, therefore there could be a need for air conditioning. ○ Location B is further north, therefore likely to need more artificial lighting than location A. • Consideration of design/construction methods: <ul style="list-style-type: none"> ○ The same design could be appropriate for low rise buildings for housing as needs are similar in all locations. ○ The same design/method of construction prevents use of local materials/building styles. ○ Using the same design assumes the similar ground conditions and site availability at both locations.

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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

Ofqual



Llywodraeth Cynulliad Cymru
Welsh Assembly Government



Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE