

TQUK Level 3 Diploma in Design, Engineer, Construct. The Digital Built Environment (RQF)

Paper ID: KNIL – 11 Diploma

Assessment date: PASTPAPER2

Mark Scheme

Mark scheme information

This mark scheme is intended to support the valid and consistent marking of the examination paper identified above. This mark scheme includes:

- the total mark available for each question
- the individual subject content coverage of each question
- further considerations which could or should be followed.

Information for the marker

- All marking must be completed consistently, and the mark scheme must be applied fairly
- Markers should award full marks if the candidate deserves full marks
- Markers should be prepared to award zero marks if the candidate's response is not worthy of credit according to the guidance for that activity
- Crossed-out work should be marked unless the candidate has replaced it with an alternative response
- There are no marks for spelling, punctuation and grammar, therefore errors are not penalised
- Unless indicated, quotations and candidates' own words are acceptable

Mathematics

- **(M)** = Method mark awarded for application of a correct method.
- **(CAO)** = Mark awarded for a correct answer only.
- **(FT)** = Follow-through – where an answer requires a number of calculations if the answer to the first calculation is incorrect, and this is carried into another calculation, the candidate should **not** be penalised in the second calculation.
- **(OE)** = or equivalent. Where an answer could be rounded up or down, for example, or where an alternative method could be used.

Key

SC	Subject Content Coverage (as identified in the Qualification Specification)
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Text in brackets	May be included but is not essential to be awarded the mark
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Grade boundaries:

E	36
D	48
C	60
B	72
A	83
A*	95

Q	Answer	Marks	SC
1a.	<p>Identify one type of hydrological data collected when producing a hydrology study.</p> <p>Award 1 mark for a correct type of hydrological data, for example:</p> <ul style="list-style-type: none"> • rainfall (data) / precipitation (data) (1) • streamflow (data) (1) • soil characteristics (1) • water lost through evaporation / evapotranspiration rates (1) • flood records (1). <p>Accept any other suitable response.</p>	1	1.3.5

Q	Answer	Marks	SC
1b.	<p>Hydrological data is used as part of a site survey. Identify three other types of data that should be used during a site survey.</p> <p>Award 1 mark for each correct answer, up to a maximum of 3 marks. This must not be hydrological data as in the stem of the question. For example:</p> <ul style="list-style-type: none"> • topographical (1) • geotechnical (1) • ecological (1). <p>Accept any other suitable response.</p>	3	1.3.5

Q	Answer	Marks	SC
1c.	<p>State four tools or pieces of equipment used during a site survey.</p> <p>Award 1 mark for each correct tool or piece of equipment used during a site survey, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • total station (1) • Global Positioning System (GPS) (1) • Global Navigation Satellite System (GNSS) (1) • theodolite (1) • measuring tapes (1) • plumb bob (1) • steel stakes / rebar (1) • surveyor's compass (1) • surveying rods (1) • range poles (1) • boundary markers (1) • laser rangefinder (1) • (surveyor's) chain (1) • Ground Penetrating Radar (GPR) (1) • Electronic Distance Measurement (EDM) (1) • drill for bore hole (1) • spade or shovel for trial pit (1) • drones / UAV (1). <p>Accept any other suitable response.</p>	4	1.3.1

Q	Answer	Marks	SC
2a.	<p>Identify two features of a shell structure.</p> <p>Award 1 mark for each correct feature, linked to a shell structure, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • a (usually) curved surface (1) • gives evenly-distributed stress (1) • curvature-resist bending (1) • thin in comparison to their overall size (1) • lightweight (while still maintaining strength) (1) • transfer forces efficiently across its surface (1) • minimal need for internal bracing / heavy materials (1) • balance of material in compression on the outer surface and in tension on the inner surface (1) • structural strength-resisting bending / compression (1) • material efficiency / uses less material compared to other types of structures (1) • environmentally efficient (1). <p>Accept any other suitable response.</p>	2	3.2.1

Q	Answer	Marks	SC
2b.	<p>Identify three features of steel.</p> <p>Award 1 mark for each correct feature of steel, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • high strength-to-weight ratio (1) • flexibility / behaves elastically (1) • ease of fabrication and assembly (1) • durability (1) • recyclability (1) • toughness / strong in tension / strong in compression (1) • ductile / ductility (1) • susceptible to corrosion (1) • can distort / buckle in fire (1) • conductive (thermal bridge) (1). <p>Accept any other suitable response.</p>	3	3.2.5

Q	Answer	Marks	SC
2c.	<p>Identify two advantages and two disadvantages of a mass structure.</p> <p>Award 1 mark for each correct advantage of a mass structure, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • compressive strength (1) • fire-resistance (1) • cost-effectiveness (1) • versatility (1) • durability (1) • ability to be poured into form (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for each correct disadvantage of a mass structure, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • heavy material use / require more materials (1) • long curing / setting time (1) • labour-intensive (1) • inherently rigid / inflexible (1) • higher dead load (1) • lack of aesthetic variety (1) • high transportation costs (1) • issues with thermal insulation (1) • energy-efficiency issues (1) • (traditional mass structures made of stone, brick, or concrete) may not provide the best insulation (1). <p>Accept any other suitable response.</p>	4	3.2.5

Q	Answer	Marks	SC
3a (i).	<p>What is responsible procurement?</p> <p>Award 1 mark for a correct answer, for example:</p> <ul style="list-style-type: none"> • (procurement that considers) social / environmental / economic impacts to support sustainable development (1) • (procurement that takes into account) compliance with environmental legislation and / or regulation / consider environmental impact in procurement (1). <p>Accept any other suitable response.</p>	1	1.2.4

Q	Answer	Marks	SC
3a (ii).	<p>Identify three environmental reasons to use ethical sourcing practices.</p> <p>Award 1 mark for each correct environmental reason to use ethical sourcing practices, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • sustainability / sustainable resources / packaging (1) • effective management of resources (1) • energy-efficiency (1) • waste reduction (1) • carbon footprint reduction (1) • animal welfare (1). <p>Accept any other suitable response.</p>	3	1.2.4

Q	Answer	Marks	SC
3b.	<p>Explain three reasons a construction company would want to minimise waste.</p> <p>Award 1 mark for each correct reason given linked to minimising waste, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • material savings (1) • reduced disposal costs (1) • better use of materials (1) • recycling / reusing materials (1) • higher profitability (1) • competitive advantage (1) • avoiding fines (1) • reducing liability (1) • faster completion times (1) • reduced labour costs (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for each linked explanation, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • construction materials can be expensive so waste reduction helps the company avoid purchasing unnecessary materials (1) • improper disposal of waste or the need to remove excess material can incur additional costs (1) • optimised material usage ensures that fewer materials go unused or get wasted (1) • waste reduction can lead to a culture of recycling and reusing (1) • by reducing waste, construction companies can lower overhead costs / improve operational efficiency / increase profitability (1) • clients may prefer working with firms that are committed to sustainability (1) • fines or penalties are imposed on companies that fail to comply with waste management regulations (1) • construction waste can be hazardous so improperly managing it can result in costly accidents / injuries / health risks (1) • involves better project planning leading to smoother operations and fewer delays (1) • by reducing waste, construction companies can optimise workforce productivity (1). <p>Accept any other suitable response.</p>	6	1.2.3

Q	Answer	Marks	SC
3c.	<p><i>Look at the Resource Document. Identify three positive and three negative impacts a large-scale construction project could have on a local community.</i></p> <p>Award 1 mark for each positive impact on a local community, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • job creation (1) • local business opportunities (1) • infrastructure improvement (1) • increased property values (1) • community facilities (1) • tax revenue (1) • skills development (1) • community engagement (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for each negative impact on a local community, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • noise pollution (1) • air pollution (1) • traffic disruptions (1) • dust / debris (1) • displacement / gentrification (1) • environmental impact (1) • visual impact (1) • strain on local services (1) • community disruption (1). <p>Accept any other suitable response.</p>	6	1.2.1

Q	Answer	Marks	SC
4a (i).	<p><i>What is occupant comfort?</i></p> <p>Award 1 mark for a correct answer, for example:</p> <ul style="list-style-type: none"> • the overall satisfaction / well-being / contentment of individuals within a built environment (such as homes, offices or other indoor spaces) (1). <p>Accept any other suitable response.</p>	1	3.3.1

Q	Answer	Marks	SC
4a (ii).	<p>Identify three factors that contribute to occupant comfort.</p> <p>Award 1 mark for each contributing factor to occupant comfort, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • thermal (comfort) (1) • indoor air quality (IAQ) / air quality (1) • lighting (1) • acoustics (1) • visual (factors) (1) • ergonomics (1). <p>Accept any other suitable response.</p>	3	3.3.1

Q	Answer	Marks	SC
4b.	<p>Look at Table 1 in the Resource Document. Both toilet spaces in the building require a lux of 200 and use 6-watt LED bulbs. Calculate the total number of light bulbs required for the toilet spaces.</p> <p>Use: $\text{lumens} = \text{lux} \times \text{area}$ and Use: $\text{bulbs required} = \text{lumens required} / \text{lumens of 6-watt LED bulbs}$. You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the area of the toilet spaces, for example:</p> <p>(area of both toilet spaces =) $24.75 \text{ (m}^2\text{)} + 21.25 \text{ (m}^2\text{)} \text{ (1)}$</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>46 (m²) (1)</p> <p>Award 1 mark for the method (M) given correctly to calculate the lumens required, for example:</p> <p>(lumens =) $200 \times 46 \text{ (m}^2\text{)} \text{ (1)}$</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>9200 (lumens) (1)</p> <p>Award 1 mark for the method (M) given correctly to calculate the number of 6-watt LED bulbs required, for example:</p> <p>(bulbs required =) $9200 / 400 \text{ (1)}$</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>23 (bulbs) (1)</p> <p>Please note: Accept 24 bulbs will be required. (If areas calculated independently as two separate spaces.)</p> <p>There are up to 6 marks available.</p>	6	3.3.3

Q	Answer	Marks	SC
4c.	<p>Look at Table 2 in the Resource Document. Calculate the lumens required for cleaning the auditorium.</p> <p>Use: lumens required = lux x area. You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the lumens required for cleaning the auditorium, for example:</p> <p>(lumens =) 350 x 468 m² (1)</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>163800 (lumens) (1)</p> <p>There are up to 2 marks available.</p>	2	3.3.3

Q	Answer	Marks	SC
4d.	<p>Look at the Resource Document. The auditorium has a wall height of 5.6m. Calculate the volume in metres cubed (m³) of the auditorium.</p> <p>Use: room volume = area x height.</p> <p>You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the volume of the auditorium, for example:</p> <p>(room volume =) 468 (m²) x 5.6 (m) (1)</p> <p>Award 1 mark for the correct answer (OE):</p> <p>2620.80 (m³) (1) or 2621 (m³) (1)</p> <p>There are up to 2 marks available.</p>	2	3.3.3

Q	Answer	Marks	SC
4e.	<p>Look at the Resource Document. The air purification system in the building will filter the air at 256 cubic feet per minute (CFM). Calculate the air exchange per hour for the auditorium.</p> $\frac{\text{CFM} \times 60}{\text{Use: Volume of room}}$ <p>Give your answer to one decimal place. You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the air exchange per hour for the auditorium, for example:</p> <p>(air exchange per hour =) $256 \text{ (CFM)} \times 60 = 15360 / 2620.80 \text{ or } 2621 \text{ (1)}$</p> <p>Award 1 mark for the correct answer (CAO) (FT):</p> <p>5.9 (1)</p> <p>There are up to 2 marks available.</p>	2	3.3.3

Q	Answer	Marks	SC
5a.	<p>Identify one way Building Information Modelling (BIM) supports the operation, management or maintenance of a sustainable building project during its lifecycle.</p> <p>Award 1 mark for a correct answer linked to the way BIM can support the operation, management or maintenance of a sustainable building project. For example:</p> <ul style="list-style-type: none"> • centralised data repository (1) • energy efficiency monitoring (1) • predictive maintenance (1) • lifecycle cost analysis (1) • improved collaboration (1). <p>Accept any other suitable response.</p>	1	5.1.1

Q	Answer	Marks	SC
5b.	<p>Identify four benefits of involving the Facilities Manager early in the design process.</p> <p>Award 1 mark for each benefit given linked to early involvement of the Facilities Manager, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • improved functionality (1) • enhanced user satisfaction (1) • reduced design changes (1) • better adaptation to user behaviour (1) • increased buy-in / ownership (1) • better alignment with operational needs (1) • more support for inclusivity and accessibility (1). <p>Accept any other suitable response.</p>	4	5.1.5

Q	Answer	Marks	SC
5c.	<p><i>Explain two reasons why a handover from the construction team to the end user is important.</i></p> <p>Award 1 mark for each correct reason given linked to handing over to an end user, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • effective knowledge transfer (1) • smooth transition to operation (1) • optimised building performance (1) • early issue identification (1) • improved end user confidence (1) • compliance and documentation (1) • support for long-term maintenance (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for each linked explanation, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • the construction team provides the end user with information about the building to ensure the end user understands how to operate / maintain the building effectively (1) • smooth transition minimises disruptions as it ensures that all building systems (such as heating, ventilation and air-conditioning / HVAC / electrical / plumbing) are fully tested (1) / functional (1) / ready for use (1). It allows the end user to begin operations without unexpected issues or delays (1) • end users are trained on how to use systems efficiently during the handover, supporting optimal energy performance / proper use of technology / adherence to sustainability goals (1) • the handover process includes commissioning and defect checks which allows for the identification / rectification of any outstanding issues (before the building is fully occupied) (1) • a well-executed handover builds confidence in the building's quality and functionality / provides reassurance that the project has been delivered as promised and is ready to meet the user's needs (1) • handover ensures that the end user receives all necessary compliance documentation (including certificates for fire safety, energy performance, and structural integrity) for legal and operational purposes (1) • (by providing detailed information and guidance) the handover process equips the end user or facilities manager with the tools needed for effective long-term maintenance (1), reducing lifecycle costs / extending the building's lifespan (1). <p>Accept any other suitable response.</p>	4	5.1.2

Q	Answer	Marks	SC
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5d.	<p><i>Explain two benefits of setting targets for energy and / or water consumption.</i></p> <p>Award 1 mark for each benefit given linked to setting targets for energy and / or water consumption, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • promotes sustainability (1) • enhances operational efficiency (1) • encourages innovation / best practice (1) • supports compliance with regulations (1) • increases building value (1) • minimises environmental impact (1). <p>Accept any other suitable response.</p> <p>Award 2 marks for each linked explanation, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • targets for energy performance or water use align with global sustainability goals such as reducing carbon emissions / conserving resources (1) which can minimise environmental impact (1) • setting clear goals for energy or water consumption allows building systems to be designed / optimised to operate more efficiently (1) which reduces resource wastage / enhances performance (throughout the lifecycle of the building) (1) • establishing targets challenges project teams to adopt innovative solutions such as energy-efficient systems or water-saving technologies (1) which fosters continuous improvement (1) • many authorities have strict requirements for energy efficiency or water use so setting targets ensures that the project meets / exceeds these standards (1). This means avoiding penalties (and enhancing reputation) (1). • buildings designed with clear sustainability / performance targets often have higher market value (1) meaning they appeal to tenants / owners / investors who prioritise 'green' / cost-effective properties (1). • setting and achieving targets reduces the building's carbon footprint / lowers water consumption (1) which contributes to a healthier environment (1). <p>Accept any other suitable response.</p>	6	5.1.3
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Q	Answer	Marks	SC
6a.	<p>Look at the Resource Document. The construction team would like to add an extension to the existing structure. The team want the maximum amount of glazing to be 40% of the floor area, plus the total area of any windows and doors which no longer exist or are no longer exposed. Calculate the total glazing allowance for the extension. You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the floor area, for example:</p> <p>(area =) $7 \times 3 \text{ (m}^2\text{)}$ (1)</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>21 (m²) (1)</p> <p>Award 1 mark for the method (M) given correctly to calculate the percentage of the floor area, for example:</p> <p>(percentage of the floor area =) $0.40 \times 21 \text{ (m}^2\text{)}$ (1)</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>8.4 (1)</p> <p>Award 1 mark for the method (M) given correctly to add the percentage of floor area and the total area of any windows and doors which no longer exist or are no longer exposed, for example:</p> <p>(total glazing allowance =) $(0.40 \times 21) + 2 + 1.5$ (1)</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>11.9 (m²) (1)</p> <p>There are up to 6 marks available.</p>	6	2.2.4

Q	Answer	Marks	SC								
6b.	<p>A wall in the building has three layers:</p> <table><tr><th>Layer</th><th>Thermal resistance</th></tr><tr><td>Outer brick layer</td><td>$R1 = 0.15 \text{ m}^2 \text{ K/WR}$</td></tr><tr><td>Insulation layer</td><td>$R2 = 2.5 \text{ m}^2 \text{ K/WR}$</td></tr><tr><td>Inner plaster layer</td><td>$R3 = 0.12 \text{ m}^2 \text{ K/WR}$</td></tr></table> <p>The wall has a combined internal and external surface resistance of: $R_s = 0.04 \text{ m}^2 \text{ K/WR}$ Use the combined thermal resistance and internal and external surface resistance to calculate the U-value of the wall. Use: $U = 1 / R_{\text{Total}}$ You must show your workings.</p> <p>Award 1 mark for the method (M) given correctly to calculate the combined thermal resistance and internal and external surface resistance, for example:</p> <p>(combined thermal and internal and external surface resistance =) $0.15 + 2.5 + 0.12 + 0.04 \text{ (K/WR) (1)}$</p> <p>Award 1 mark for the correct answer (CAO):</p> <p>2.77 (K/WR) (1)</p> <p>Award 1 mark for the method (M) given correctly to calculate the U-value of the wall, for example:</p> <p>(U-value =) $1 / 2.77 \text{ (1)}$</p> <p>Award 1 mark for the correct answer (OE): $0.36101... / 0.36 \text{ (1)}$</p> <p>There are up to 4 marks available.</p>	Layer	Thermal resistance	Outer brick layer	$R1 = 0.15 \text{ m}^2 \text{ K/WR}$	Insulation layer	$R2 = 2.5 \text{ m}^2 \text{ K/WR}$	Inner plaster layer	$R3 = 0.12 \text{ m}^2 \text{ K/WR}$	4	2.2.4
Layer	Thermal resistance										
Outer brick layer	$R1 = 0.15 \text{ m}^2 \text{ K/WR}$										
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Inner plaster layer	$R3 = 0.12 \text{ m}^2 \text{ K/WR}$										

Q	Answer	Marks	SC
6c.	<p>Identify one way the orientation of a building affects solar gain and one way it affects natural ventilation.</p> <p>Award 1 mark for a correct answer linked to solar gain, for example:</p> <ul style="list-style-type: none"> • (the building's orientation) determines how much direct sunlight it receives (1) / can reduce the need for heating in colder months (1) • (orienting a building) with solar exposure can lead to overheating in summer (1) / solar exposure can increase the need for cooling (unless proper shading is incorporated) (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for a correct answer linked to natural ventilation, for example:</p> <ul style="list-style-type: none"> • (the orientation of the building) can influence its ability to utilise natural ventilation (1) • buildings oriented to align with prevailing winds can use passive airflow to cool the interior (1) • aligning to prevailing winds can reduce reliance on mechanical air conditioning systems (1). <p>Accept any other suitable response.</p>	2	2.2.4

Q	Answer	Marks	SC
7a.	<p>Identify three recurrent fixed costs in a construction project.</p> <p>Award 1 mark for each correct recurrent fixed cost, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • salaries / wages (1) • insurance premiums (1) • lease / rental payments (1) • permits / licensing fees (1) • utilities (1) • security / surveillance (1) • maintenance / repairs (1) • project management software / project management tools (1) • office / administrative expenses (1) • taxes / fees (1). <p>Accept any other suitable response.</p>	3	5.3.2

Q	Answer	Marks	SC
7b.	<p>Identify three recurrent variable costs in a construction project.</p> <p>Award 1 mark for each correct recurrent variable cost, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • temporary labour (costs) (1) • unanticipated material (costs) (1) • extra equipment rental (1) • additional fuel / energy (1) • unexpected transportation (costs) (1) • subcontractor (costs) (1) • extra waste disposal (1) • temporary utilities (1) • unexpected safety / compliance costs (1) • additional testing / inspection costs (1) • extra permit fees (1) • temporary site facilities (1). <p>Accept any other suitable response.</p>	3	5.3.3

Q	Answer	Marks	SC
7c.	<p>Identify three capital costs in a construction project.</p> <p>Award 1 mark for each correct capital cost, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • land / property acquisition (1) • consultant / architectural / engineering fees (directly linked to the development) (1) • statutory permit / statutory regulatory (costs) (1) • materials / plant / equipment / machinery (1) • furniture / fixtures / fittings (1) • utility infrastructure (1) • landscaping / site improvements (1) • technology / information systems (1) • contingency funds (1) • commissions (1). <p>Accept any other suitable response.</p>	3	5.3.1

Q	Answer	Marks	SC
8a.	<p>Look at the Resource Document. Discuss two methods of sustainable construction which could impact the energy performance of the completed construction project. For each method, you should:</p> <ul style="list-style-type: none"> • identify what the method is • identify what impact the method would typically have on energy performance • discuss the impact of the method on the energy performance of the Grade II listed building. <p>Award 1 mark for each method of sustainable construction identified, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • insulation improvements / adding insulation (to roof / walls / floors) / internal (or external) wall insulation / loft insulation / underfloor heating (systems) (1) • energy-efficient windows / replacing single-glazed windows with secondary glazing / energy-efficient double-glazing (1) • sustainable heating systems / (installing) low-carbon heating systems / (installing) underfloor heating / (putting in) air-source heat pumps / (installing) biomass boilers (1) • solar energy integration / (installing) solar panels (on roofs) / (integrating) solar thermal systems (to heat water) (1) • rainwater harvesting systems / collecting (and storing) rainwater for non-potable uses (1) • (installing) green roofs / green (living) walls (1) • using sustainable materials / using locally-sourced (or renewable or reclaimed) materials / using timber from sustainable sources / using reclaimed stone (or bricks or tiles) / retaining (or reusing) existing structural elements (such as beams, floors and walls) (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for the typical impact on energy performance of each method identified, up to a maximum of 2 marks. For example:</p> <p>(insulation improvements can...)</p> <ul style="list-style-type: none"> • reduce heat loss which helps to maintain stable indoor temperatures (1) • reduce heat loss which helps to lower heating demands (1). <p>(energy-efficient windows can...)</p> <ul style="list-style-type: none"> • improve thermal performance (without compromising a building's aesthetics) (1) • minimise heat loss, therefore reducing the need for artificial heating (1). <p>(sustainable heating systems can...)</p>	8	6.1.3

	<ul style="list-style-type: none"> • reduce reliance on fossil fuels (for example, by extracting renewable heat from the air / ground) (1) • improve overall energy efficiency (1) • offer a sustainable / cost-effective solution by using renewable heat from the air / ground (1). <p>(solar energy integration can...)</p> <ul style="list-style-type: none"> • generate renewable energy on-site (1) • provide a significant reduction in energy bills by harnessing natural sunlight (1) • reduce dependency on grid power (1). <p>(rainwater harvesting systems can...)</p> <ul style="list-style-type: none"> • reduce water consumption by collecting / storing rainwater for non-potable uses, such as irrigation / flushing toilets (1) • reduce the demand for mains water, therefore reducing the energy required to pump, treat and distribute water (1). <p>(green roofs / walls can ...)</p> <ul style="list-style-type: none"> • enhance thermal insulation (1) • reduce stormwater runoff (1) • improve air quality (1) • reduce the heat island effect, (improving a building's energy efficiency in both summer and winter) (1). <p>(use of sustainable materials can...)</p> <ul style="list-style-type: none"> • reduce the environmental impact associated with demolition and / or new construction (1) • improve the building's carbon footprint • offer better insulation properties (1) • contribute to a building's resilience / longevity (1) • minimise construction waste (1). <p>Accept any other suitable response.</p> <p>Award 2 marks for discussing the impact of each method identified to this Grade 2 listed building, up to a maximum of 4 marks. <i>1 mark is for applying this to the scenario and the other mark is for the discussion.</i> For example:</p> <p>(insulation improvements)</p> <ul style="list-style-type: none"> • Improving internal insulation can help avoid altering the external appearance of this listed building (1). The council requires improved comfort for users but do not want heritage value to be compromised, therefore the insulation's performance may be limited by the building's construction and the materials used (1). <p>(energy-efficient windows)</p>		
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	<ul style="list-style-type: none"> Careful selection of glazing is needed to ensure the historic character is preserved while improving thermal performance for users (1). While secondary glazing is less disruptive to the building's original appearance, it may not be as effective as full double-glazing (1). <p>(sustainable heating systems)</p> <ul style="list-style-type: none"> The integration of a sustainable heating system may be complex due to the structure of this Grade II listed building (1). It would, however, meet the Council's requirement to reduce long-term energy consumption as part of its commitment to be carbon neutral by 2030 (1). <p>(solar energy integration)</p> <ul style="list-style-type: none"> Installation of solar panels would meet the Council's requirements for energy efficiency, but the construction team may be restricted by planning regulations for listed buildings (1). It is important given this building's historical significance to use discreet installation methods to preserve the building's value given its historical significance (1). <p>(rainwater harvesting systems)</p> <ul style="list-style-type: none"> The planned use for this building means that there will be significant amounts of energy required to pump, treat and distribute water for example in flushing toilets (1). With many users for events, training, conferences for example collecting rainwater will help to lower the building's overall environmental impact, linking to the Council's priorities (1). <p>(green roofs and walls)</p> <ul style="list-style-type: none"> Installing a green roof or living walls can be challenging for a Grade II listed building, given the need to preserve its existing façade, but it may be feasible where structural modifications can be made (1). Installing these would improve the building's energy efficiency all year round, but structural concerns and historical preservation issues may limit this (1). <p>(use of sustainable materials)</p> <ul style="list-style-type: none"> Using the existing red brick of the building alongside locally-sourced, renewable or reclaimed materials will help ensure a lower environmental impact, fulfilling the Council's requirement (1). Given the historical significance of the building this will help contribute to its resilience and longevity (1). It will also minimise construction waste which will limit the impact on residents in the area (1). <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
8b. (i)	<p>Look at the Resource Document. Describe a suitable structural method to use for the auditorium of the Grade II listed building.</p> <p>Award 1 mark for an appropriate selection of structural method for the auditorium area, for example:</p> <ul style="list-style-type: none"> • steel frame (construction) (1) • timber frame (1) • reinforced concrete (1) • hybrid construction (1) • reversible / non-invasive methods (1) • using pre-fabricated elements (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for a description linked to why this is useful for the auditorium, for example:</p> <p>(Steel frames...)</p> <ul style="list-style-type: none"> • allow for large, column-free areas, ideal for the wide-open nature of the auditorium (1) • have slim structural profiles meaning less interference with the historic element of the auditorium (1) • reduce load on existing foundations, which is crucial in preserving this heritage structure (1). <p>(Timber frames...)</p> <ul style="list-style-type: none"> • can complement the historic character of this listed building (1) • are an environmentally-friendly choice with a warm, natural finish which is in keeping with the aims of the building (1) • can span long distances (for example if engineered timber like glulam or CLT is used) which is useful for a larger space like the auditorium (1). <p>(Reinforced concrete...)</p> <ul style="list-style-type: none"> • is useful in areas requiring strong load-bearing capacity like in the auditorium for rigging / (audio-visual) equipment) (1) • provides excellent sound insulation which would be beneficial in the auditorium (1) • can be used discretely (for example for foundations or slabs) where it won't affect the auditorium's heritage appearance (1). <p>(Hybrid construction...)</p> <ul style="list-style-type: none"> • gives the 'best of both worlds' as it combines steel or timber for span efficiency with masonry or concrete for support (1) • allows a tailored solution for this specific space (whereas timber could be used in Reception or concrete in technical areas) (1) • is preservation-friendly, enabling minimal intervention where the original fabric of the auditorium must be retained (1). <p>(Reversible / non-invasive methods...)</p>	2	6.1.1

	<ul style="list-style-type: none"> • can be demanded where a building is Grade II listed (1) • methods like lightweight steel mezzanines / bolted timber structures / modular partitions respect the original fabric of the auditorium but can be removed later (1). <p>(Use of pre-fabricated elements...)</p> <ul style="list-style-type: none"> • can mean less disruption to the existing structure of the auditorium during installation (1) • accelerates construction and ensures a higher-quality fit, crucial in this delicate historic setting (1) • limits vibrations / dust / moisture which protects original materials in the auditorium (1). <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
8b (ii).	<p><i>Look at the Resource Document. Use your answer to Question 8b(i). Give one suitable structural material you would use in the auditorium. Give one reason why this material is appropriate for the method you chose in your answer to 8b(i).</i></p> <p>Award 1 mark for an appropriate selection of structural material for the method chosen, for example:</p> <p>(Steel frame)</p> <ul style="list-style-type: none"> • structural steel (1) (for example, S275 or S355 for beams / columns / trusses) • steel decking (1) (for floors and roof support, can be combined with concrete slabs) • fire-resistant coatings (1) (for example, intumescent paints to comply with fire regulations). <p>(Timber frame)</p> <ul style="list-style-type: none"> • Glulam / glued laminated timber (1) • CLT / cross-laminated timber (1) (for walls, floors, and roofs where solid timber panels are required) • softwood studs (1) (such as C24 for internal partitions and lightweight framing). <p>(Reinforced concrete)</p> <ul style="list-style-type: none"> • reinforced concrete (1) (for example RC30 / RC40 for slabs, stairs, or structural walls) • precast concrete panels (1) • acoustic-insulating concrete (1). <p>(Hybrid construction)</p> <ul style="list-style-type: none"> • combination of steel and timber (1) (such as steel primary frames with timber joists or wall linings) • steel with concrete composite slabs (1) • masonry and frame (1) (brick or stone retained façades with internal steel / timber frames). <p>(Reversible / non-invasive methods)</p> <ul style="list-style-type: none"> • bolted steel connections (1) • modular timber panels (1) • lightweight, factory-made components (1) • glass / acrylic partitions (1) • rubber / neoprene pads (1). <p>(Pre-fabricated elements)</p> <ul style="list-style-type: none"> • precast concrete units (1) (for stairs, floor slabs, or technical rooms) • pre-assembled steel trusses or frames (1) • modular timber panels (1) (such as SIPs / Structural Insulated Panels for pre-fabricated wall or ceiling elements). <p>Accept any other suitable response.</p>	2	6.1.1

Award **1 mark** for a reason **linked to why it is appropriate for the method chosen**, for example:

(Steel frame materials...)

- give long-span support in the auditorium (1)
- have a structural framework for rigging and equipment areas (1).

(Timber frame materials...)

- can give visually-pleasing exposed beams (1)
- offer sustainable span solutions for the auditorium roof (1).

(Reinforced concrete materials...)

- will provide strength for the auditorium floor, tiered seating, or platforms (1)
- are strong for sub-structures / foundations (1).
- are useful for quick installation (1) (with minimal on-site disruption)
- improve sound dampening where special mixes are used (1).

(Hybrid construction...)

- can create strong, lightweight floor systems (1)
- can help to retain original historic walls with modern structural infill as required by the plans (1)
- gives flexible integration in the auditorium space (1).

(Reversible / non-invasive methods...)

- avoid welding and therefore structures can be dismantled (1)
- can create temporary features / modular walls / non-permanent lighting rigs in the auditorium (1)
- create transparent, reversible divisions (1)
- helps avoid vibration isolation from new structures (1).

(Pre-fabricated elements...)

- useful for acoustic panels in the auditorium (1)
- can be delivered and installed with minimal on-site work (1).

Accept any other suitable response.

Q	Answer	Marks	SC
8b (iii).	<p><i>Look at the Resource Document. Identify one way materials used for this construction project can be sustainably sourced.</i></p> <p>Award 1 mark for a suitable response linked to sustainably sourcing materials for this construction project. For example:</p> <ul style="list-style-type: none"> • (creating Glulam-engineered joists by) re-using timber (1) • (creating steel-engineered joists by) re-using steel (1) • re-using / recycling concrete (1) <p>Accept any other suitable response.</p>	1	6.1.4

Q	Answer	Marks	SC
8c.	<p><i>Off-site factory production of the component parts of buildings is a common characteristic of modern methods of construction. State one positive impact and one negative impact of modern methods of construction on operating costs.</i></p> <p>Award 1 mark for a positive impact of modern methods of construction on operating costs, for example:</p> <ul style="list-style-type: none"> • reduced labour costs (1) • faster construction time (1) • reduced material waste (1) • improved quality control (1) • low energy costs (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for a negative impact of modern methods of construction on operating costs, for example:</p> <ul style="list-style-type: none"> • higher initial capital costs (1) • higher transport costs (1) • limited flexibility on site (1) • dependence on external suppliers (1) • higher storage and handling costs (1). <p>Accept any other suitable response.</p>	2	6.1.2

Q	Answer	Marks	SC
9a.	<p>Identify three things a feasibility study could include.</p> <p>Award 1 mark for each correct thing that could be included in a feasibility study, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> financial analysis (to determine the project's financial viability) / estimated costs (of implementation) / capital expenditures / operating expenses / cost comparisons (to the expected revenue and cash flow projections) / potential return on investment (1) economic impact (of the project), job creation / tax benefits / contributions to local economy / economic benefit to the organisation or community (1) technical aspects (of the project) / availability of technology / availability of equipment / availability of materials / expertise required (for implementation) / technical challenges (or constraints that may affect the project's success) (1) discussion of how the project meets planning policies / legislation (1) equality considerations / inclusive design principles and accessibility (such as meeting equality legislation, for example Equality Act 2010) (1) meeting environmental legislation (such as any Tree Preservation Orders (TPOs), the Wildlife and Countryside Act 1981) (1). <p>Accept any other suitable response.</p>	3	2.3.3

Q	Answer	Marks	SC
9b.	<p>State three benefits of creating a schedule of accommodation.</p> <p>Award 1 mark for each benefit stated, linked to creating a schedule of accommodation, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> clear space requirements (1) improved planning and design (1) will help with cost estimation (1) efficient project coordination (1) will show evidence of compliance (with regulations) (1) improved time management (1) improved client communication (1) allows for effective change management (1). <p>Accept any other suitable response.</p>	3	3.1.4

Q	Answer	Marks	SC
9c.	<p>Explain two responsibilities of the client in a construction project.</p> <p>Award 1 mark for each responsibility identified, linked to the client, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • defining project objectives / requirements (1) • appointing a project team (1) • securing funding / financial management (1) • obtaining planning permission / approvals (1) • selecting contractors / suppliers (1) • ensuring compliance with legal / regulatory requirements (1) • risk management (1) • monitoring project progress (1) • monitoring project quality (1) • managing health / safety / environmental standards (1) • facilitating communication / coordination (1) • handling changes / variations (1) • approving / certifying payments (1) • handover and occupancy (1) • post-completion evaluation / maintenance (1) • ensuring sustainability / energy efficiency (1). <p>Accept any other suitable response.</p> <p>Award 2 marks for each suitable explanation, linked to the relevant responsibility of the client, up to a maximum of 4 marks. For example:</p> <p>(defining project objectives / requirements)</p> <ul style="list-style-type: none"> • (The client is responsible for) clearly defining the project's scope, budget, timeline, and performance expectations (1). This includes setting out the desired outcome, the functionality of the building and any specific design or technical requirements (1). <p>(appointing a project team)</p> <ul style="list-style-type: none"> • (The client) must appoint key professionals to manage the project (1), such as an architect, project manager, quantity surveyor and engineers (1). <p>(securing funding / financial management).</p> <ul style="list-style-type: none"> • (The client is responsible for) securing the necessary funding for the project (1), which includes budgeting, financing and ensuring sufficient cash flow throughout the project (1). <p>(obtaining planning permission / approvals).</p> <ul style="list-style-type: none"> • (The client must) ensure that all necessary permits and / or planning approvals are obtained before the project starts (1). The client must make sure that all relevant environmental assessments are completed before the project starts (1). <p>(selecting contractors / suppliers)</p>	6	2.1.2

	<ul style="list-style-type: none"> The client plays a key role in selecting the contractors, subcontractors and suppliers who will deliver the project (1). The client must ensure that the team they appoint are competent / suitable / high quality (1). <p>(ensuring compliance with legal / regulatory requirements)</p> <ul style="list-style-type: none"> (The client is responsible for) ensuring the construction project complies with all relevant laws, regulations and building codes (1). The client is also responsible for checking that the project complies with health and safety standards (1). <p>(risk management)</p> <ul style="list-style-type: none"> (The client must) identify potential risks to the project (1) and establish a risk management plan to mitigate these risks (1). <p>(monitoring project progress / monitoring project quality)</p> <ul style="list-style-type: none"> (The client must) ensure that the project is progressing on schedule, within budget and to the specified quality standards (1). (The client takes responsibility for) having regular site visits / meetings with the project manager (1). <p>(managing health / safety / environmental standards)</p> <ul style="list-style-type: none"> (The client is responsible for) ensuring that proper health and safety protocols are followed on site (1) and that environmental sustainability practices are incorporated where applicable (1). <p>(facilitating communication / coordination)</p> <ul style="list-style-type: none"> (The client must) ensure effective communication between all project stakeholders (1), including the project manager, contractors, designers, and regulatory authorities (1). <p>(handling changes / variations)</p> <ul style="list-style-type: none"> (The client is responsible for) approving any changes or variations to the project scope, design or schedule (1). (The client also needs to) manage these changes during the construction process (1). <p>(approving / certifying payments)</p> <ul style="list-style-type: none"> (The client is responsible for) authorising payments to contractors and suppliers (1) based on agreed milestones or completion stages (1). <p>handover and occupancy)</p> <ul style="list-style-type: none"> Upon completion of the project (the client is responsible for) accepting the building and ensuring the handover process is carried out properly (1), including any necessary training on building systems / maintenance (1). <p>(post-completion evaluation / maintenance)</p>		
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	<ul style="list-style-type: none"> • (The client is responsible for) maintaining the building after construction is complete (1). This includes addressing any warranty claims / maintenance issues that arise (1). <p>(ensuring sustainability / energy efficiency)</p> <ul style="list-style-type: none"> • (The client has a responsibility to) ensure that sustainable construction practices are incorporated into the project (1). This could include energy-efficient designs / low-carbon materials / environmental impact considerations (1). <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
10.	<p><i>Look at the Resource Document. The construction project could use a combination of glass, concrete, aluminium and steel materials. Compare one advantage and one disadvantage of each material to the aesthetic appeal of the completed project.</i></p> <p>Award 1 mark for an advantage to the aesthetic appeal of the completed project given for each material, up to a maximum of 4 marks. For example:</p> <p>glass:</p> <ul style="list-style-type: none"> • its transparency creates lightness (1) • non-intrusive integration (1) • minimalistic modernity (1) • visual contrast to heavy (red brick and Portland stone) materials (1). <p>concrete:</p> <ul style="list-style-type: none"> • creates textural contrast (1) • sculptural quality (1) • versatility in form (1) • minimalist (1) • has modern appeal (1). <p>aluminium:</p> <ul style="list-style-type: none"> • modern appeal (1) • lightweight look (1) • durable appeal (1). <p>steel:</p> <ul style="list-style-type: none"> • structural honesty (1) • modern appeal (1) • lightweight / slim profile (1) • dynamic / contemporary lines (1). <p>Accept any other suitable response.</p> <p>Award 1 mark for a disadvantage to the aesthetic appeal of the completed project given for each material, up to a maximum of 4 marks. For example:</p> <p>glass:</p> <ul style="list-style-type: none"> • potential disruption of historic character (1) • reflection (1) • glare (1). <p>concrete:</p> <ul style="list-style-type: none"> • cold / harsh appearance (1) • heavy visual mass (1) • overpowers the original structure (1). <p>aluminium:</p>	8	6.1.1

	<ul style="list-style-type: none"> • cold / industrial appearance (1) • lack of warmth (1). <p>steel:</p> <ul style="list-style-type: none"> • industrial / cold feel (1) • potential over modernisation (1). <p>Accept any other suitable response.</p>		
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End of Mark Scheme

Past paper