

TQUK Level 3 Diploma in Design, Engineer, Construct: The Digital Built Environment (RQF) (603/1993/8)

Paper ID: KNIL - 10 Diploma

Assessment date: PASTPAPER1

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 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 in the Reading papers; therefore, errors are **not** penalised
- Unless indicated, quotations and candidates' own words are acceptable.

Key

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

Marking Term	Definition
(CAO)	Mark awarded for a correct answer only
(FT)	Follow-through marks are applied when there are earlier mistakes in the method. The candidate should not be penalised.
(M)	Method mark awarded for application of a correct method.

Grade boundaries:

E	37
D	48
C	59
B	72
A	83
A*	94

Q	Answer	Marks	SC
1a	<p><i>Identify two elements that should be included in a mission statement.</i></p> <p>Award 1 mark for each response up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> ● Purpose (1) / vision (1) <ul style="list-style-type: none"> ○ purpose statement (1) ○ vision statement (1) ● core values (1) <ul style="list-style-type: none"> ○ sustainability (1) ○ quality (1) ○ safety (1) ○ integrity and ethics (1) ● commitment to clients (1) <ul style="list-style-type: none"> ○ customer satisfaction (1) ○ innovation (1) ○ timeliness and budget (1) ● community and social responsibility (1) <ul style="list-style-type: none"> ○ community engagement (1) ○ social responsibility (1) ● employee focus (1) <ul style="list-style-type: none"> ○ employee development (1) ○ teamwork (1) ● innovation and continuous improvement (1) <ul style="list-style-type: none"> ○ continuous learning (1) ○ innovation. (1) <p>Accept any other suitable response.</p>	2	1.1.5

Q	Answer	Marks	SC
1b	<p><i>What does 'ethical sourcing' mean?</i></p> <p>Award 1 mark for a correct definition. For example:</p> <ul style="list-style-type: none"> ● ensuring products / materials are obtained in a responsible manner (1) considering the environmental / social / economic impacts of the sourcing process (1) ● a process that uses fair trader practices (1) ● a process that uses fair trade practices (1) ● a process that minimises environmental harm. (1) <p>Accept any other suitable response.</p>	1	1.2.4

Q	Answer	Marks	SC
1c (i)	<p><i>What does 'sustainability monitoring and reporting procedures' for the lifecycle of the project mean?</i></p> <p>Award 1 mark for a correct definition. For example:</p> <ul style="list-style-type: none"> continuous tracking / assessment / reporting of a project's environmental, social, and economic impacts, from its inception through to its completion and beyond / BREEAM rating / reputation (1) <p>Accept any other suitable response.</p>	1	1.2.5

Q	Answer	Marks	SC
1c (ii)	<p><i>State a benefit of 'sustainability monitoring and reporting procedures' on the lifecycle of a construction project.</i></p> <p>Award 1 mark for a correct benefit. For example:</p> <ul style="list-style-type: none"> ensures the project aligns with sustainability goals (1) ensures a project adapts to challenges (as they arise). (1) <p>Accept any other suitable response.</p>	1	1.2.5

Q	Answer	Marks	SC
1d	<p>Identify four ways an eco-building project team could commit to minimising construction waste.</p> <p>Award 1 mark for each response, up to a maximum of 4 marks. Answers must be specific. For example:</p> <ul style="list-style-type: none"> ● design for deconstruction (1) / reuse (1) <ul style="list-style-type: none"> ○ modular construction (1) ○ material selection (1) ● efficient material management (1)t <ul style="list-style-type: none"> ○ accurate material estimation (1) ○ just-in-time delivery (1) ○ material segregation (1) ● on-site waste reduction practices <ul style="list-style-type: none"> ○ waste audits (1) ○ on-site recycling facilities (1) ○ waste reduction targets (1) ● off-site construction) <ul style="list-style-type: none"> ○ prefabrication (1) ○ lean construction techniques (1) ● sustainable procurement practices <ul style="list-style-type: none"> ○ local sourcing (1) ○ eco-friendly materials (1) ● education and training <ul style="list-style-type: none"> ○ worker training (1) ○ awareness programmes (1) ● implementing circular economy principles <ul style="list-style-type: none"> ○ material reuse (1) ○ cradle-to-cradle design. (1) <p>Accept any other suitable response.</p>	4	1.2.3

Q	Answer	Marks	SC
2a (i)	<p>Identify one positive and one negative of using larch for an eco-house construction.</p> <p>Award 1 mark for a positive of using larch for an eco-house construction. Answers must be specific. For example:</p> <ul style="list-style-type: none"> • durability (1) <ul style="list-style-type: none"> ○ natural resistance (1) (larch wood is naturally resistant to decay and insect attacks, making it a durable choice for both structural and external applications) ○ longevity (1) (its resistance to weathering and rot means that larch can have a long lifespan, especially when used in outdoor settings like decking, cladding, and fencing) • strength (1) <ul style="list-style-type: none"> ○ load-bearing capacity (1) (larch has a good strength-to-weight ratio, making it suitable for structural elements such as beams, posts, and supports) ○ stability (1) (it performs well in varying conditions and is less likely to warp or twist compared to some other softwoods) • aesthetic appeal (1) <ul style="list-style-type: none"> ○ appearance (1) (larch has a warm, rich colour with a distinctive grain pattern that can enhance the visual appeal of a building. It often develops a silvery patina over time if left untreated) ○ workability (1) (it is relatively easy to work with, including sawing, sanding, and finishing, allowing for a variety of design options) • environmental considerations (1) <ul style="list-style-type: none"> ○ sustainability (1) (larch is often sourced from sustainably-managed forests, especially in European and North American regions. Look for certification to ensure responsible sourcing.) <p>Award 1 mark for a negative of using larch for an eco-house construction. For example:</p> <ul style="list-style-type: none"> • cost (1) <ul style="list-style-type: none"> ○ price (1) (larch can be more expensive than some other softwoods like pine or spruce. Its higher cost may be due to its durability and aesthetic qualities) • moisture sensitivity (1) <ul style="list-style-type: none"> ○ shrinkage and swelling (1) (whilst larch is resistant to decay, it can still experience some movement with changes in moisture content, leading to potential shrinkage or swelling if not properly treated or managed) • maintenance (1) <ul style="list-style-type: none"> ○ weathering (1) (although larch is resistant to decay, it can weather over time if exposed to the elements. This natural weathering process can lead to colour changes and surface degradation, which may require maintenance or treatment to preserve its appearance) • availability (1) 	2	3.1.2

	<ul style="list-style-type: none">○ supply (1) (depending on your location, larch might not be as readily available as other softwoods. This could affect procurement and lead times for construction projects)● knots (1)<ul style="list-style-type: none">○ appearance (1) (larch can contain knots, which may be a concern in applications where a smooth, knot-free surface is desired. Knots can also affect the wood's strength and workability.) <p>Accept any other suitable response.</p>		
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Past paper

Q	Answer	Marks	SC
2a (ii)	<p>Identify one positive and one negative of using oak for an eco-house construction.</p> <p>Award 1 mark for a positive of using oak for an eco-house construction. Answers must be specific. For example:</p> <ul style="list-style-type: none"> ● strength and durability (1) <ul style="list-style-type: none"> ○ high strength (1) (oak is renowned for its strength and robustness, making it an excellent choice for structural elements such as beams, joists, and posts)) ○ longevity (1) (oak is naturally durable and resistant to wear and tear, which contributes to a long lifespan in construction applications) ● aesthetic appeal (1) <ul style="list-style-type: none"> ○ rich appearance (1) (oak has a distinctive grain pattern and rich colour that can add elegance and warmth to both interior and exterior elements) ○ finishing (1) (it responds well to various finishing treatments, including staining and varnishing, which can enhance its natural beauty) ● versatility (1): <ul style="list-style-type: none"> ○ applications (1) (oak is suitable for various applications, including flooring, cabinetry, furniture, and structural elements. Its versatility makes it a popular choice in multiple construction and design contexts (1) ● workability (1) <ul style="list-style-type: none"> ○ ease of use (1) (whilst oak is a hardwood, it is relatively easy to work with compared to some other hardwoods, allowing for detailed carving and precision in joinery) ○ historical significance (1) ○ tradition (1) (oak has been used in construction for centuries, providing a sense of historical continuity and traditional craftsmanship) ● fire resistance (1) <ul style="list-style-type: none"> ○ natural resistance (1) (oak has better fire resistance compared to some other timbers, which can enhance the fire safety of buildings.) <p>Award 1 mark for a negative of using oak for an eco-house construction. For example:</p> <ul style="list-style-type: none"> ● cost (1) <ul style="list-style-type: none"> ○ expense (1) (oak is generally more expensive than other types of timber, such as softwoods or less durable hardwoods. This higher cost can impact the overall budget of a construction project) ● weight (1) <ul style="list-style-type: none"> ○ heaviness (1) (oak is a heavy timber, which can make it more challenging to handle and transport. This can also impact the structural load and require more robust supporting elements) ● moisture sensitivity (1) 	2	3.1.2

	<ul style="list-style-type: none"> ○ movement (1) (oak can expand and contract with changes in moisture content, which may lead to warping or splitting if not effectively managed. Ensuring adequate treatment and sealing is essential) ● environmental impact (1) <ul style="list-style-type: none"> ○ sourcing concerns (1) (oak is a slow-growing species and can be subject to overharvesting. It is important to source oak from sustainably managed forests to mitigate environmental impact) ● maintenance (1) <ul style="list-style-type: none"> ○ ongoing care (1) (oak can require ongoing maintenance, such as periodic sealing or refinishing, to maintain its appearance and durability, especially in exterior applications) ● knots and imperfections (1) <ul style="list-style-type: none"> ○ aesthetic issues (1) (oak can contain knots and imperfections, which might be undesirable in applications where a perfectly smooth surface is needed. These features can also affect the strength and workability of the wood) ○ acidic, requires specific fixing materials, not ferrous 1000 (1). <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
2a (iii)	<p>Identify one positive and one negative of using bamboo for an eco-house construction.</p> <p>Award 1 mark for a positive of using bamboo for an eco-house construction. Answers must be specific. For example:</p> <ul style="list-style-type: none"> ● sustainability (1) <ul style="list-style-type: none"> ○ rapid growth (1) (bamboo grows incredibly fast, with some species reaching maturity in 3-5 years, making it a highly renewable resource compared to traditional timber) ○ low carbon footprint (1) (bamboo absorbs substantial amounts of carbon dioxide during its growth, contributing to a lower carbon footprint) ● strength and durability (1) <ul style="list-style-type: none"> ○ high strength (1) (bamboo has a high strength-to-weight ratio, making it suitable for structural applications. It is often stronger than many hardwoods and softwoods in terms of tensile strength) ○ flexibility (1) (its natural flexibility makes it resistant to impact and seismic forces, beneficial for regions prone to earthquakes) ● versatility (1) <ul style="list-style-type: none"> ○ applications (1) (bamboo can be used in a wide range of construction applications, including flooring, scaffolding, structural supports, and even as a replacement for traditional timber in some cases) ○ design flexibility (1) (its unique appearance allows for innovative and aesthetically-pleasing design options) ● environmental benefits (1) <ul style="list-style-type: none"> ○ soil erosion control (1) (bamboo's extensive root system helps prevent soil erosion and can improve soil health) ○ biodiversity (1) (bamboo forests support diverse ecosystems and provide habitat for various species) ● low processing energy (1) <ul style="list-style-type: none"> ○ minimal processing (1) (bamboo often requires less energy to process compared to traditional timber, making it an eco-friendlier in terms of production.) <p>Award 1 mark for a negative of using bamboo for an eco-house construction. For example:</p> <ul style="list-style-type: none"> ● moisture sensitivity (1) <ul style="list-style-type: none"> ○ water absorption (1) (bamboo can be sensitive to moisture and prone to swelling or shrinking with changes in humidity. This can lead to issues like warping or cracking if not properly treated) ● durability concerns (1) <ul style="list-style-type: none"> ○ pest and decay (1) (untreated bamboo can be susceptible to insect infestation and decay. It typically requires treatment to enhance its durability and resistance to pests) ● quality variation (1) 	2	3.1.2

	<ul style="list-style-type: none"> ○ inconsistency (1) (the quality of bamboo can vary widely depending on the species and processing methods. This can impact its strength and suitability for different construction applications) ● limited availability (1) <ul style="list-style-type: none"> ○ regional constraints (1) (while bamboo is widely available in some regions (like Asia), it may be less accessible in others, potentially affecting supply and cost) ● building codes and standards (1) <ul style="list-style-type: none"> ○ regulatory challenges (1) (bamboo construction might face challenges with building codes and standards in some regions. Its use may be limited by local regulations or require additional testing and certification) ● maintenance (1) <ul style="list-style-type: none"> ○ ongoing care (1) (bamboo structures often require regular maintenance to ensure longevity and to address potential issues with pests or environmental exposure.) <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
2b	<p>Choose one material from either bamboo, larch, or oak to clad the exterior of an eco-build house. Explain two reasons why you have chosen the material.</p> <p>Award for 2 marks for each explanation, up to a maximum of 4 marks. Answers must be specific. For example:</p> <ul style="list-style-type: none"> larch is a strong, durable, and visually appealing choice for construction, particularly in applications exposed to the elements. (2) Its cost, potential moisture sensitivity, and availability should be considered. (2) When sourcing larch, ensure it comes from a sustainably managed forest to support environmental responsibility. (2) oak's structural elements are ideal for beams, trusses, and joists due to its strength and durability. (2) It can be used for exterior elements like cladding and decking if properly treated to withstand weather conditions. (2) Oak offers strength, durability, and aesthetic appeal, making it suitable for a variety of construction and design applications. (2) Its higher cost, weight, and sensitivity to moisture are important factors. To ensure sustainability and reduce environmental impact, choose oak sourced from responsibly managed forests, and consider the long-term maintenance requirements. (2) bamboo can be used for beams, columns, and trusses in both residential and commercial buildings. (2) It can be used for roofing materials and exterior cladding, especially in tropical and subtropical climates. (2) Bamboo is a construction material known for its sustainability, strength, and versatility. (2) Its performance can be affected by moisture sensitivity and durability issues if not properly treated. Its availability and regulatory acceptance may also influence its use in different regions. (2) Bamboo is ethically-sourced (2) and must be used in accordance with local building codes and standards. (2) <p>Accept any other suitable response.</p>	4	3.1.2

Q	Answer	Marks	SC
3a	<p><i>Explain three purposes of a hydrology study.</i></p> <p>Award 1 mark for each correct answer, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • use of flood risk management which determines flood patterns and risks to help design flood defences and manage floodplain development (1) • water supply planning, which estimates the availability of water resources to ensure sustainable supply for domestic, agricultural, and industrial use (1) • the use of environmental protection, which assesses how human activities and / or construction projects might impact local water systems, including aquatic ecosystems and water quality (1) • infrastructure development supports the design of dams, bridges, roads, and other infrastructure by understanding how these might be affected by or affect local water systems (1) • climate change impact evaluates how changing climate patterns are likely to alter water availability, quality, and flood risks over time. (1) <p>Accept any other suitable response.</p>	3	1.3.5

Q	Answer	Marks	SC
3b(i)	<p><i>Identify two objectives of a geotechnical survey during the initial planning stages of a project.</i></p> <p>Award 1 mark for each objective, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • soil and rock characterisation (1) (to identify the types of soil and rock present, their distribution, and their physical properties, such as density, moisture content, and grain size) • bearing capacity (1) (to determine the soil's ability to support the weight of a structure without excessive settlement or failure) • foundation design (1) (to provide data that informs the design of foundations) • slope stability (1) (to assess the risk of landslides or slope failure, particularly in hilly or mountainous areas) • seismic analysis (1) (to evaluate how the ground will respond to seismic activity) • groundwater conditions (1) (to understand the groundwater table's location and movement) <p>Accept any other suitable response.</p>	2	1.3.3

Q	Answer	Marks	SC
3b (ii)	<p>Identify two methods of study in a geotechnical survey.</p> <p>Award 1 mark for each method of study, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • site investigation (1) (includes drilling boreholes, digging test pits, and collecting soil and rock samples for laboratory analysis) • laboratory testing (1) (analysing soil and rock samples to determine properties like shear strength, compressibility, and permeability) • field testing (1) (conducting tests like standard penetration tests (SPTs) or cone penetration tests (CPTs) directly on-site to assess soil conditions) • geotechnical reporting (1) (compiling all data and analyses into a report that includes recommendations for foundation design, ground improvement, and any necessary mitigation measures). <p>Accept any other suitable response.</p>	2	1.3.3

Q	Answer	Marks	SC
3b (iii)	<p>Explain the importance of a geotechnical survey in construction.</p> <p>Award 2 marks for an explanation of the importance of a geotechnical survey. For example:</p> <ul style="list-style-type: none"> • it helps mitigate risks by identifying potential geotechnical hazards such as subsidence, landslides, or soil liquefaction, and recommending measures (2) • it ensures design efficiency and provides engineers with critical data that ensures foundations and other structures are designed efficiently and cost-effectively (2) • it ensures regulatory compliance (1) and that construction projects meet local building codes and regulations regarding soil and foundation conditions. (2) <p>Accept any other suitable response.</p>	2	1.3.3

Q	Answer	Marks	SC
3c(i)	<p>Identify two objectives of a topographical survey in the initial planning stages of a construction project.</p> <p>Award 1 mark for each objective, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • elevation data (1) (captures the height of land features relative to a fixed datum, often sea level, showing how the land rises and falls) • contours and terrain (1) (represent the shape and slope of the land, typically shown through contour lines that connect points of equal elevation) • natural features (1) (maps out the locations of trees, rivers, lakes, and other natural landmarks) • man-made structures (1) (includes details of buildings, roads, bridges and other infrastructure) • boundaries (1) (identifies property lines and other legal boundaries important for land ownership and development) <p>Accept any other suitable response.</p>	2	1.3.2

Q	Answer	Marks	SC
3c(ii)	<p>Identify two methods of study in a topographical survey in construction.</p> <p>Award 1 mark for each method of study, up to a maximum of 2 marks. For example:</p> <ul style="list-style-type: none"> • field surveying (1) (surveyors use tools like GPS, total stations, and levels to measure distances, angles, and elevations directly on-site) • aerial surveying (1) (drones or aircraft equipped with LiDAR (Light Detection and Ranging) or photogrammetry technology capture detailed images and elevation data from above) • geospatial technology (1) (Geographic Information Systems (GIS) is often used to analyse and visualise the data collected, producing detailed topographic maps) <p>Accept any other suitable response.</p>	2	1.3.2

Q	Answer	Marks	SC
3c (iii)	<p><i>Explain the importance of a topographical survey in construction.</i></p> <p>Award 2 marks for a correct explanation of importance. For example:</p> <ul style="list-style-type: none"> • site planning provides crucial information for architects and engineers to design buildings and infrastructure that fit well with the natural landscape (2) • drainage design helps in planning effective drainage systems by showing how water will flow across the land (2) • earthwork calculations assist in calculating the amount of material to be cut or filled during construction, ensuring accurate budgeting and resource management (2) • regulatory compliance: ensures that development projects adhere to local zoning laws and environmental regulations. (2) <p>Accept any other suitable response.</p>	2	1.3.2

Q	Answer	Marks	SC
4a	<p><i>Identify four different aspects of occupancy comfort.</i></p> <p>Award 1 mark for each aspect, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • thermal comfort (1): <ul style="list-style-type: none"> ○ temperature (1) ○ humidity (1) ○ airflow (1) • acoustic comfort (1): <ul style="list-style-type: none"> ○ noise levels (1) ○ sound insulation (1) • visual comfort (1): <ul style="list-style-type: none"> ○ lighting (1) ○ views (1) • indoor air quality (1): <ul style="list-style-type: none"> ○ ventilation (1) ○ pollutants (1) • ergonomics and functionality (1): <ul style="list-style-type: none"> ○ layout (1) ○ accessibility (1) • aesthetic and psychological comfort (1): <ul style="list-style-type: none"> ○ design and ambience (1) ○ personalisation (1) • safety and security (1): <ul style="list-style-type: none"> ○ safe design (1) ○ emergency preparedness. (1) <p>Accept any other suitable response.</p>	4	3.3.1

Q	Answer	Marks	SC
4b	<p>Look at the Resource Document. Calculate the average total lumens required for the footprint of Plot 3. You must show your workings.</p> <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> total lumens = $250 \text{ lux} \times 98 \text{ m}^2$ (1) (M) = 24,500 lumens (1) (CAO) 	2	3.3.3

Q	Answer	Marks	SC
4c	<p>Look at the Resource Document. The average room height for a private home is 2,400mm. Using the equation: air change per hour = airflow rate (m^3/h) \div room volume (m^3) Calculate the air change per hour for the footprint of Plot 3. Give your answer to one decimal place. You must show your workings.</p> <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> (volume of room = length \times width \times height) volume of room = $98 \text{ m}^3 \times 2.4 \text{ m}$ (1) (M) = 235.2 m^3 (1) (CAO) <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> (air change per hour = airflow rate (m^3/h) \div room volume (m^3)) air change per hour = $400 \div 235.2 \text{ m}^3$ (1) (M) = 1.7 ACH (1) (CAO) 	4	3.3.3

Q	Answer	Marks	SC
4d	<p>Identify the meaning of each of the symbols in the formula.</p> $U = Q \div (A \times \Delta T)$ <p>You must write your answers in the table below.</p> <p>Where:</p> <ul style="list-style-type: none"> • $U =$ • $Q =$ • $A =$ • $\Delta T =$ <p>Award 1 mark for each correct answer, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • $U = U\text{-value } (W/m^2 \cdot K) (1)$ • $Q = \text{Heat transfer rate } (W) (1)$ • $A = \text{Area of the building component } (m^2) (1)$ • $\Delta T = \text{Temperature difference across the component } (K \text{ or } ^\circ C) (1)$ <p>Do not accept any other answers.</p>	4	3.3.4

Q	Answer	Marks	SC
5a	<p>Look at the Resource Document. The allocation of a building budget covers the house shell and internal walls for each of the four houses plus additional costs. Calculate the total maximum budget for the shells and internal walls for all four houses combined. You must show your workings.</p> <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> • (total build cost = cost m^2 x area of combined footprint) • total build cost = $\pounds 1,950 \times (110 + 100 + 98 + 110) (1) (M) = \pounds 815,100 (1) (CAO)$ <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> • (budget for the shells and internal walls = total build cost + Additional costs @23%) • budget for the shells and internal walls = $\pounds 815,100 \times 1.23 (1) (M) = \pounds 1,002,573 (CAO)$ 	4	5.2.3

Q	Answer	Marks	SC
5b	<p><i>Explain three roles of building information modelling (BIM) in the financial control of a building project.</i></p> <p>Award 2 marks for each response up to a maximum of 6 marks. For example:</p> <ul style="list-style-type: none"> ● detailed quantity take-offs <ul style="list-style-type: none"> ○ BIM allows for automatic extraction of quantities directly from the 3D model. This provides precise data on materials, labour and other resources required for the project. As a result, cost estimators can generate more accurate and detailed cost estimates early in the design process (2) ● real-time cost updates <ul style="list-style-type: none"> ○ as the design evolves, the BIM model can be updated to reflect changes. This allows for real-time tracking of costs and adjustments to the budget, reducing the risk of cost overruns (2) ● phased budgeting <ul style="list-style-type: none"> ○ BIM enables the visualisation and planning of distinct phases of construction. This helps in aligning the budget with the project timeline, ensuring that funds are allocated appropriately across the various stages of the project (2) ● cash flow forecasting <ul style="list-style-type: none"> ○ by linking the BIM model to project scheduling (4D BIM), financial managers can forecast cash flow needs more accurately. This helps in ensuring that the necessary funds are available when needed, avoiding delays due to financial constraints (2) ● early detection of issues <ul style="list-style-type: none"> ○ BIM facilitates clash detection and other analyses early in the design phase. Identifying and resolving issues before construction begins can significantly reduce the risk of costly change orders and delays, leading to better cost control (2) ● scenario analysis <ul style="list-style-type: none"> ○ BIM allows for the simulation of different scenarios, including cost variations due to changes in design, materials, or external factors. This helps financial managers prepare for potential risks and develop strategies to mitigate them (2) ● optimised procurement <ul style="list-style-type: none"> ○ BIM provides detailed information on materials, quantities and timelines. This information can be used to optimise procurement processes, ensuring that materials are purchased in the right quantities, at the right time and at the best prices (2) ● maintenance and operation costs <ul style="list-style-type: none"> ○ BIM models can include information on building systems, materials and components, allowing for better forecasting and management of maintenance and operation costs after construction is completed. (2) <p>Accept any other suitable response.</p>	6	5.2.1

Q	Answer	Marks	SC
5c	<p><i>Identify who is responsible for ensuring the project stays within its budget.</i></p> <p>Award 1 mark for a correct answer. For example:</p> <ul style="list-style-type: none"> • the project manager • a quantity surveyor • a financial analyst • the project accountant • a program manager (in relation to multiple related projects) • CFO (Chief Financial Officer) <p>Accept any other suitable responses,</p>	1	5.2.3

Q	Answer	Marks	SC
5d (i)	<p><i>State how a procurement manager is accountable for keeping a project within budget.</i></p> <p>Award 1 mark for a correct answer. For example:</p> <ul style="list-style-type: none"> • (the procurement manager) ensures that procurement processes are cost-effective (1) / aligned with the project budget. (1) <p>Accept any other suitable response.</p>	1	5.2.3

Q	Answer	Marks	SC
5d (ii)	<p><i>Provide one example of how a procurement manager can keep a project within budget.</i></p> <p>Award 1 mark for a correct answer. For example:</p> <ul style="list-style-type: none"> • negotiating contracts (1) • managing supplier relationships (1) • avoiding unnecessary expenditures • track expenditure. (1) <p>Accept any other suitable responses</p>	1	5.2.3

Q	Answer	Marks	SC
6a	<p><i>Explain four advantages of an organogram in a construction project.</i></p> <p>Award 1 mark for each explanation, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • clear definition of roles and responsibilities <ul style="list-style-type: none"> ◦ clearly outlines who is responsible for what tasks and who reports to whom (1), reduces confusion and ensures that every team member understands their role in the project (1) • improved communication and coordination <ul style="list-style-type: none"> ◦ shows the lines of communication within the project team, making it easier to understand who to contact for specific issues or decisions (1) • enhanced project management <ul style="list-style-type: none"> ◦ project managers can use the organogram to oversee the entire team (1), ensuring that all roles are filled and that the structure supports the project's goals (1) • facilitates accountability <ul style="list-style-type: none"> ◦ it assigns specific tasks and responsibilities to individuals, which makes it clear who is accountable for various aspects of the project (1) • streamlined decision-making <ul style="list-style-type: none"> ◦ by clearly showing the hierarchy and reporting structure, it helps streamline decision-making processes (1) (as it identifies who has the authority to make specific decisions) • facilitates onboarding / training <ul style="list-style-type: none"> ◦ (an organogram) serves as a useful tool for onboarding new team members (1), helping them quickly understand the project structure and their place within it (1) • transparency and clarity for stakeholders (1) <ul style="list-style-type: none"> ◦ provides a transparent view of the project's organisational structure for external stakeholders (such as clients, investors, or regulatory bodies) (1) • supports risk management (1) <ul style="list-style-type: none"> ◦ helps in identifying potential risks related to personnel (such as key positions that lack backup or areas with unclear responsibilities) by clearly defining roles (1) • adaptability to project changes <ul style="list-style-type: none"> ◦ as construction projects evolve, the organogram can be updated to reflect changes in personnel / roles / responsibilities (1) • efficiency in resource allocation <ul style="list-style-type: none"> ◦ helps in visualising the distribution of roles across the full project (1), making it easier to identify where additional resources or adjustments might be needed. (1) <p>Accept any other suitable response.</p>	4	2.1.5

Q	Answer	Marks	SC
6b	<p>Identify four fundamentals of a construction design brief</p> <p>Award 1 mark for each comparative up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • project objectives and goals (1) • client's needs and expectations (1) • aesthetic considerations and design style (1) • functional requirements (for example, number of rooms, types of spaces) (1) • target audience or end-users (1) • site analysis and context (1) • budget constraints and timeline (1) • environmental and sustainability goals (1) • broad design principles or inspirations (1) <p>Accept any other suitable response.</p>	4	2.1.1

Q	Answer	Marks	SC
6c	<p>State four ways building information modelling (BIM) is used by an integrated project team.</p> <p>Award 1 mark for each response up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> • facilitate early collaboration (1) • define roles / responsibilities (1) • enhance communication / information sharing (1) • coordinate workflows / integrate teams (1) • support collaborative decision-making (1) • ensure accountability / performance monitoring (1) • facilitate contractual arrangements (1) • enable efficient resource allocation (1) • support ongoing training / development (1) • facilitate continuous improvement / feedback loops (1) • visualise in 3d. (1) <p>Accept any other suitable response.</p>	4	2.1.4

Q	Answer	Marks	SC
7a	<p><i>Explain six possible impacts of user post-occupancy behaviours.</i></p> <p>Award 1 mark for each impact, up to a maximum of 6 marks. Also accept effects on user acoustic temperature lighting. For example:</p> <ul style="list-style-type: none"> • energy consumption and efficiency <ul style="list-style-type: none"> ○ inefficient use of heating or cooling systems / leaving lights on / using high-energy appliances affects energy consumption that can lead to increased energy use / reduced efficiency (1) ○ higher energy consumption can lead to increased operational costs / greater environmental impact / potential wear and tear on systems due to overuse, which can shorten their lifespan (1) • maintenance and wear <ul style="list-style-type: none"> ○ the way occupants interact with and maintain their living environment such as cleaning habits / usage patterns / adherence to maintenance schedules - affects the wear and tear on the building's materials and systems (1) ○ poor maintenance practices can accelerate deterioration, lead to higher repair costs / potentially involve more frequent renovations or replacements of building components (1) • indoor environmental quality <ul style="list-style-type: none"> ○ occupant activities such as cooking / smoking / keeping pets can impact indoor air quality and comfort. Inadequate ventilation during high moisture activities can lead to mould growth and poor indoor air quality (1) ○ compromised indoor environmental quality can result in health issues for occupants / increased demand for repairs / potential modifications to improve ventilation or air quality systems, impacting the building's life cycle (1) • space utilisation and adaptation <ul style="list-style-type: none"> ○ the use and modification of spaces by occupants can include converting rooms / altering layouts that affect the functionality / design of the building (1) ○ changes in space utilisation may require adjustments to building systems / renovations to accommodate new uses, impacting long-term maintenance and adaptation needs (1) • impact on building systems <ul style="list-style-type: none"> ○ regular use and maintenance (or lack thereof) of systems such as plumbing / electrical / HVAC can influence their performance and lifespan. Occupants' practices in managing these systems, like adjusting thermostats / cleaning filters, may alter the lifespan of the systems (1) 	6	5.1.4

	<ul style="list-style-type: none"> ○ efficient management can extend the life of building systems / reduce repair costs, whereas neglect can lead to system failures / higher long-term expenses (1) • resource usage <ul style="list-style-type: none"> ○ the consumption of water / energy / other resources by occupants affects the overall sustainability and performance of the building. Excessive water use / high energy demand impacts resource management (1) ○ higher resource consumption can lead to increased utility costs and a greater environmental footprint, which might involve upgrades to building systems / practices to improve sustainability (1) • occupant satisfaction and building performance <ul style="list-style-type: none"> ○ occupant satisfaction influences how well they take care of the property. Happy / engaged occupants are more likely to adhere to maintenance guidelines / report issues promptly (1) ○ high satisfaction levels can lead to better upkeep / fewer issues, whereas dissatisfaction may result in neglect / more frequent problems, affecting the building's overall performance and longevity (1) • resilience and adaptability <ul style="list-style-type: none"> ○ the ability of occupants to adapt to changes such as adjustments in use / environmental conditions, can influence how well the building performs over time (1) ○ buildings that are more adaptable to changing needs / behaviours can experience a longer / more effective life cycle, while those that cannot accommodate changes may require more frequent renovations or upgrades. (1) <p>Accept any other suitable response.</p>		
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Q	Answer	Marks	SC
7b	<p>State four benefits of involving the facilities manager early in the design process of a building project.</p> <p>Award 1 mark for each example, up to a maximum of 4 marks. For example:</p> <ul style="list-style-type: none"> operational efficiency (1) life cycle cost considerations (1) improves sustainability practices (1) enhanced flexibility and adaptability (1) risk mitigation (1) optimised maintenance and accessibility (1) users experience enhancement (1) communication and collaboration (1) meeting regulatory and compliance requirements (1) time and cost saving. (1) <p>Accept any other suitable responses.</p>	4	5.1.5

Q	Answer	Marks	SC
7c	<p>State one role of building information modelling (BIM) in the operation management phase of a sustainable building project.</p> <p>Award 1 mark for a correct answer. For example:</p> <ul style="list-style-type: none"> facility management integration (1) energy performance monitoring (1) space utilisation optimisation (1) predictive maintenance (1) indoor environmental quality (IEQ) monitoring. (1) <p>Accept any other suitable response.</p>	1	5.1.5

Q	Answer	Marks	SC
8a (i)	<p>Look at the Resource Document. Calculate the total cladding costs of one property using larch at £49.60 per sqm. You must show your workings.</p> <p>Award 1 mark for the correct calculation and 1 mark for the correct answer:</p> <ul style="list-style-type: none"> (cost = $108\text{m}^2 \times £49.60\text{sqm}$) cost = $108\text{m}^2 \times £49.60\text{sqm}$ (1) (M) = £5356.80 (1) (CAO) 	2	6.1.2

Q	Answer	Marks	SC
8a (ii)	<p>Look at the Resource Document. Calculate the total cladding costs of one property using oak at £55.40 per sqm. You must show your workings.</p> <p>Award 1 mark for a correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> • (cost = external cladding per property x oak per sqm) • cost = $108\text{m}^2 \times £55.40\text{sqm (1) (M)} = £5983.20 \text{ (1) (CAO)}$ 	2	6.1.2

Q	Answer	Marks	SC
8a (iii)	<p>Look at the Resource Document. Calculate the total cladding costs of one property using bamboo at £23.80 per sqm. You must show your workings.</p> <p>Award 1 mark for a correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> • (cost = external cladding per property x bamboo per sqm) • cost = $108\text{m}^2 \times £23.80\text{sqm (1) (M)} = £2,570.40 \text{ (1) (CAO)}$ 	2	6.1.2

Q	Answer	Marks	SC
8b	<p><i>Look at the Resource Document and use your calculations from answer 5a. Calculate the total profit from the development, if all the properties achieve their individual value on completion of contracts. You must show your workings.</i></p> <p>Answer 5a</p> <ul style="list-style-type: none"> total build cost £815,100 <p>Award 1 mark for a correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> (total costs = land purchase + (building costs x % additional costs) total costs = £650,000 + (£815,100 x 1.23) (1) (M) (FT) = £1,652,573 (1) (CAO) <p>Award 1 mark for the correct calculation and 1 mark for the correct answer.</p> <ul style="list-style-type: none"> total sale price = £590,000 + £585,000 + £590,000 + £595,000 (1) (M) = £2,360,000 (1) (CAO) <p>Award 1 mark for the correct answer</p> <ul style="list-style-type: none"> (total profit = total sale price - total costs) total profit = £2,360,000 - £1,652,573 (M) = £707,427 (1) (CAO) 	5	6.1.2

Q	Answer	Marks	SC
9a	<p><i>Name the legislation used to decide if planning permission is required for a new development.</i></p> <p>Award 1 mark for a correct answer. For example:</p> <ul style="list-style-type: none"> Town and Country Planning Act 1990. (ENGLAND) Town and Country Planning Act 1997 (SCOTLAND) Planning and Development Act 2000 (IRELAND) Planning and Building Law 2002 (JERSEY) <p>Accept any other response relevant to the country where the exam is being undertaken.</p>	1	2.3.2

Q	Answer	Marks	SC												
9b	<p><i>Planning permission is a six-stage process Identify the three missing stages in order in the table below.</i></p> <table><tr><td>Stage 1</td><td>Pre-application advice.</td></tr><tr><td>Stage 2</td><td>Application submission.</td></tr><tr><td>Stage 3</td><td></td></tr><tr><td>Stage 4</td><td></td></tr><tr><td>Stage 5</td><td></td></tr><tr><td>Stage 6</td><td>Implementation.</td></tr></table> <p>Award 1 mark for each correct answer in order, up to a maximum of 3 mark.</p> <p>Stage 3 = Consultation (1) Stage 4 = Decision (1) Stage 5 = Appeals. (1)</p> <p>Do not accept any other responses. Marks are awarded for the correct stage, order not necessary.</p>	Stage 1	Pre-application advice.	Stage 2	Application submission.	Stage 3		Stage 4		Stage 5		Stage 6	Implementation.	3	2.3.1
Stage 1	Pre-application advice.														
Stage 2	Application submission.														
Stage 3															
Stage 4															
Stage 5															
Stage 6	Implementation.														

Q	Answer	Marks	SC
9c(i)	<p><i>Identify three purposes of Building Regulations</i></p> <p>Award 1 mark for each purpose identified, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • safety (1) (building regulations ensure that buildings are constructed in a way that protects the safety of occupants, including measures to prevent accidents, structural failure and fire hazards) • health (1) (they address issues like ventilation, dampness and hygiene to ensure that buildings provide a healthy living environment) • accessibility (1) (regulations ensure that buildings are accessible to all people, including those with disabilities, by including features like ramps, wide doorways and accessible bathrooms) • energy efficiency (1) (they promote energy efficiency to reduce the carbon footprint of buildings, including standards for insulation, heating and lighting) • environmental protection (1) (building regulations aim to minimise the environmental impact of buildings through sustainable design and construction practices) <p>Accept any other suitable response.</p>	3	2.3.2

Q	Answer	Marks	SC
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9c (ii)	<p><i>Identify three reasons why you should apply for Building Regulations.</i></p> <p>Award 1 mark for each example identified up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • new buildings (1) regulations apply to the construction of new buildings, ensuring they meet the required standards) • extensions / alterations (1) (when extending or altering existing buildings, the work must comply with building regulations to ensure safety) • material changes of use (1) (if a building's use is changed for example, converting a house into a block of flats, it must meet the regulations applicable to its new use) • renovations (1) (major renovations must comply with relevant building regulations, especially if structural changes or energy efficiency improvements are involved) <p>Accept any other suitable response. Award responses that explain why you must apply for building regulations.</p>	3	2.3.2
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Q	Answer	Marks	SC
9c (iii)	<p><i>Discuss one impact of non-compliance with Building Regulations.</i></p> <p>Award 2 marks for discussing an impact of non-compliance. For example:</p> <ul style="list-style-type: none"> • legal action: failure to comply with building regulations can result in legal action, fines, and enforcement notices requiring alterations or demolitions (2) • sale issues: non-compliance can also create difficulties when selling the property, as potential buyers may demand evidence that the building meets all regulations (2) • safety risks: non-compliance can lead to unsafe conditions, posing risks to the occupants and potentially resulting in accidents or building failures. (2) <p>Accept any other suitable response. Award responses that discuss how a project will have to stop.</p>	2	2.3.2

Q	Answer	Marks	SC
10a	<p><i>The Resource Document states that the houses will be ‘timber-frame structures’ with ‘virtually no steel or concrete.’ Compare and contrast a timber-frame construction with a traditional concrete construction and a modern steel-frame construction. You must consider their:</i></p> <ul style="list-style-type: none"> • <i>aesthetic appeal</i> • <i>appropriateness</i> • <i>reliability</i> • <i>sustainability.</i> <p>Award 1 mark for each comparison of aesthetic appeal, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • timber-frame construction: <ul style="list-style-type: none"> ○ timber-frame construction is known for its natural beauty and warmth. Exposed timber beams can create a visually appealing, rustic, and inviting atmosphere. The material’s natural grain and texture are often appreciated in both traditional and contemporary designs. (1) Timber can be used in a variety of architectural styles, from modern to traditional, providing a versatile aesthetic. (1) • traditional concrete construction: <ul style="list-style-type: none"> ○ concrete offers a more industrial and minimalist appearance. It can be finished in numerous ways (for example polished, textured, or painted) to enhance its look. However, it is often perceived as less warm and inviting compared to timber. (1) Concrete’s aesthetics can be quite versatile with the use of formwork and surface treatments, but it generally provides a more rigid and monolithic appearance (1) • modern steel-frame construction: <ul style="list-style-type: none"> ○ steel frames are known for their sleek, modern look and ability to create open, unobstructed spaces due to their high strength-to-weight ratio. The industrial aesthetic of exposed steel beams can be a feature in contemporary designs. (1) Steel structures offer design flexibility with large spans and high ceilings, contributing to modern architectural aesthetics (1) <p>Award 1 mark for each comparison of appropriateness, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> • timber-frame construction: <ul style="list-style-type: none"> ○ timber is well-suited for residential buildings and low-rise structures. It is also favoured for projects aiming for a natural or traditional look. It can be less appropriate for very tall or large-span structures due to its lower load-bearing capacity compared to steel or concrete (1) • traditional concrete construction: 	12	6.1.1 6.1.2 6.1.3 6.1.4

	<ul style="list-style-type: none"> ○ concrete is ideal for high-rise buildings, large commercial structures, and infrastructures such as bridges and dams. Its strength and durability make it suitable for a wide range of building types, including those requiring substantial load-bearing capacity (1) ● modern steel-frame construction: <ul style="list-style-type: none"> ○ steel frames are highly suitable for large-scale commercial buildings, high-rise structures and industrial applications. They are preferred where large open spaces, long spans and high strength are required (1) <p>Award 1 mark for each comparison of reliability, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> ● timber-frame construction: <ul style="list-style-type: none"> ○ timber is durable but can be susceptible to issues like rot, termites and fire if not properly treated or maintained. Modern treatments and building practices can enhance its longevity and resilience (1) ● traditional concrete construction: <ul style="list-style-type: none"> ○ concrete is highly durable and can withstand harsh weather conditions and heavy loads. It has a long lifespan with minimal maintenance requirements. (1) Concrete structures require less maintenance but can suffer from issues such as cracking and spalling over time (1) ● modern steel-frame construction: <ul style="list-style-type: none"> ○ endurance and reliability: steel is very strong and durable, with high resistance to factors such as weather and termites. However, it is susceptible to rust if not properly protected. (1) Steel structures generally require regular maintenance to address corrosion and ensure the integrity of protective coatings. (1) <p>Award 1 mark for each comparison of sustainability, up to a maximum of 3 marks. For example:</p> <ul style="list-style-type: none"> ● timber-frame construction: <ul style="list-style-type: none"> ○ timber is a renewable resource and can have a lower environmental impact if sourced sustainably. It also stores carbon, contributing to lower overall carbon emissions. (1) The sustainability of timber depends on responsible sourcing and forest management practices (1) ● traditional concrete construction: <ul style="list-style-type: none"> ○ concrete production is energy-intensive and involves high CO2 emissions. However, the longevity of concrete structures can mitigate some environmental impacts over their lifecycle. (1) Innovations such as the use of recycled aggregates and improved production techniques can enhance concrete's sustainability (1) ● modern steel-frame construction: 		
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	<ul style="list-style-type: none"> steel is recyclable and can be reused, reducing waste. However, the production of steel is energy-intensive and has a significant carbon footprint. (1) The sustainability of steel can be improved through the use of recycled materials and energy-efficient production processes. (1) <p>Accept any other suitable responses.</p>		
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Q	Answer	Marks	SC
10b	<p><i>Justify why a timber-frame structure is a more cost-effective choice than a traditional concrete or modern steel frame.</i></p> <p>Award 1 mark for a justified selection of material versus cost. For example:</p> <ul style="list-style-type: none"> timber-frame construction <ul style="list-style-type: none"> timber is generally less expensive than steel and concrete on a per-unit basis. (1) The cost can vary based on timber type, quality, and sourcing (1) traditional concrete construction <ul style="list-style-type: none"> concrete is often more expensive than timber but can be less expensive than steel. (1) The cost of concrete includes not just the material itself but also the formwork and reinforcement required (1) modern steel-frame construction <ul style="list-style-type: none"> steel is typically more expensive than timber and concrete. (1) The cost includes not only the steel itself but also the fabrication and treatment of steel components. (1) <p>Accept any other suitable response.</p>	1	6.1.2

End of Mark Scheme