

6720-550 June 2018

6720-36 Advanced Technical Extended Diploma in Constructing the Built Environment (Construction) (720)

1	Describe what is meant by the term 'levelling' as used in land surveying.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following up to a maximum of two marks.</p> <p>Levelling is the measurement of height (1) using an optical levelling instrument and a level staff or rod having a numbered scale (1). Levelling is used to find the height of a given point with respect to the given or assumed datum (1). It is also used to set out a point at a given elevation with respect to the given or assumed datum (1).</p>	n/a	2

2	Name two instruments which can be used on construction sites for levelling purposes.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following at one mark each.</p> <ul style="list-style-type: none"> • Dumpy level. • Tilting level. • Builder's Level. • Laser level. • Total station. • Digital theodolite. • Water level. 	n/a	2

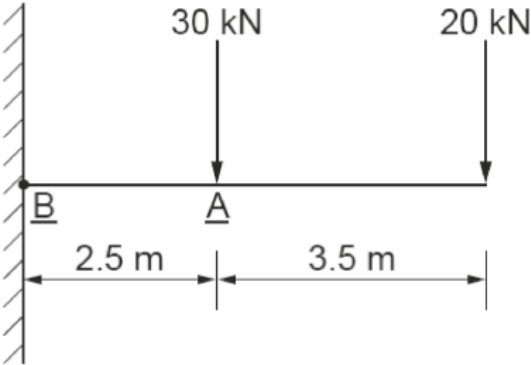
3	Describe the term 'intersection' as used in land surveying.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following up to a maximum of two marks.</p> <p>Intersecting lines of position are used to fix the position (1) of an unmapped feature or point by fixing its position relative to two (or more) mapped or known points (1).</p>	n/a	2

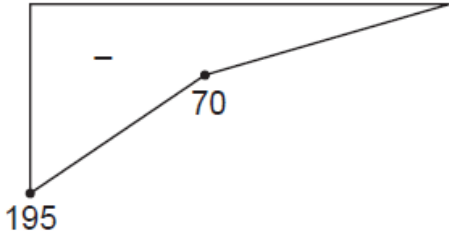
4	Explain one reason why a land surveyor might choose a Global Positioning System (GPS) to survey a large greenfield area of undulating terrain.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any one of the following. One mark for a reason and one mark for a linked response.</p> <ul style="list-style-type: none"> • Greater accuracy of positioning physical features over large areas (1) so manual errors involved in reading and recording are reduced (1). • Surveying can be completed quicker (1) as the instrument is relatively easy to use once training has been completed (1). • Less labour intensive (1) therefore a more cost effective way of capturing data than traditional techniques (1). • Automated process with direct links to IT systems (1) reduces human error / ensuring greater accuracy (1). 	n/a	2

5	<p>A horizontal curve of radius 400 m connects two straight sections of road with a deflection angle of 40°, as shown in Figure 1.</p> <p>The chainage of the intersection point I is 2000 m.</p> <div data-bbox="443 1048 1206 1693" data-label="Diagram"> </div> <p style="text-align: center;">Figure 1</p> <p>Calculate</p>		
5a)	the length of curve		
	Acceptable answer(s)	Guidance	Max marks

	<p>One mark for the correct formula and one mark for the correct answer.</p> <p>$L = 40 \times 2 \times \pi \times 400/360$ (1) = 279.253 (1) m</p>	n/a	2
5b)	the length of the tangent straight IT_1 .		
	Acceptable answer(s)	Guidance	Max marks
	<p>One mark for the correct formula and one mark for the correct answer.</p> <p>$IT_1 = \text{Tangent length} = 400 \times \tan 20^\circ$ (1) = 145.588 (1) m</p>	n/a	2

6	Identify two of the laws of static equilibrium used to determine beam reactions.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following at one mark each.</p> <ul style="list-style-type: none"> The algebraic sum of the vertical forces must equal zero (1). Accept $\Sigma V = 0$ The algebraic sum of the horizontal forces must equal zero (1). Accept $\Sigma H = 0$ The algebraic sum of the moments of forces must equal zero (1). Accept $\Sigma M = 0$ 	n/a	2

7	For the cantilever beam shown in Figure 2.		
	 <p style="text-align: center;">Figure 2</p>		
7a)	Determine the bending moment values at points A and B.		
	Acceptable answer(s)	Guidance	Max marks

	A= 70 kNm (1) B= 195 kNm (1)	n/a	2
7b)	Produce a bending moment diagram to represent the loading.		
	Acceptable answer(s)	Guidance	Max marks
	 <p style="text-align: center;">BM Diagram (kNm)</p>	Marks allocated as follows: <ul style="list-style-type: none"> • Correct shape (1) • Correct values (1) 	2

8	Describe one effect that eccentric loading has on columns.		
	Acceptable answer(s)	Guidance	Max marks
	Up to two marks for a coherent description of one of the following effects. <ul style="list-style-type: none"> • Direct stress • Bending stress • Total stress 	n/a	2

9	Determine the safe axial-load for a timber post that is 75 mm square and which has an effective length of 2.5 m, using the table below. You must show all calculations. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Slenderness ratio (L/b)</th> <th>Permissible stress (N/mm²)</th> </tr> </thead> <tbody> <tr> <td>30</td> <td>8.7</td> </tr> <tr> <td>40</td> <td>11.5</td> </tr> </tbody> </table>			Slenderness ratio (L/b)	Permissible stress (N/mm ²)	30	8.7	40	11.5
Slenderness ratio (L/b)	Permissible stress (N/mm ²)								
30	8.7								
40	11.5								
	Acceptable answer(s)	Guidance	Max marks						
	Four marks as allocated below. $L/b = 2500/75 = 33.33$ (1) Permissible stress by interpolation = 9.6 N/mm ² (1) Safe Load = 9.6 x 75 x 75 (1) = 54 000N or 54 kN (1)	n/a	4						

10	State the following modes of failure for a retaining wall.		
10a	Overturning.		
	Acceptable answer(s)	Guidance	Max marks
	Overturning failure is a result of soil pressure causing the wall to rotate.	n/a	1
10b	Sliding.		
	Acceptable answer(s)	Guidance	Max marks
	Sliding failure is a result of soil pressure to move away laterally.	n/a	1

11	A retaining wall retains water of density 10 kN/m ³ . The height of the wall is 4.5 m.		
11a	Determine the pressure per linear metre at the base of the wall.		
	Acceptable answer(s)	Guidance	Max marks
	$P = 4.5 \times 10 = 45$ (1) kN/m ²	Mark only for correct answer.	1
11b	Calculate the magnitude of the total force per metre run (F_h) acting on the wall.		
	Acceptable answer(s)	Guidance	Max marks
	One mark for the formula and one mark for the correct answer. $F_h = 45 \times 4.5/2$ (1) = 101.25 (1) kN/m	n/a	2

12	Name one method used to determine forces in statically determinate frameworks.		
	Acceptable answer(s)	Guidance	Max marks

	<p>One mark for any one of the following:</p> <ul style="list-style-type: none"> Graphical method. Method of resolution. Method of sections. 	n/a	1
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13	Name two temporary methods of groundwater control that can be used on construction sites.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following at one mark each.</p> <ul style="list-style-type: none"> Dewatering Pumps Sumps Well points Electro-osmosis Freezing Grouting Compressed air Cut-off trenches. 	n/a	2

14	Name two items of earthworks plant used on construction sites.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two of the following at one mark each:</p> <ul style="list-style-type: none"> Excavators Bulldozers Backacters Scraper Grader Loader Dumper Draglines 	n/a	2

15	Describe the purpose of a contraction joint used in rigid pavements.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two from the following up to a maximum of two marks:</p> <p>A contraction joint is a sawed, formed, or tooled groove in a concrete slab that creates a weakened vertical plane (1). It regulates the location of the cracking caused by dimensional changes in the slab (1).</p>	n/a	2

16	State two duties under the Health & Safety at Work Act (HASWA) that employees must follow.		
	Acceptable answer(s)	Guidance	Max marks
	<p>Any two from the following up to a maximum of two marks:</p> <ul style="list-style-type: none"> To act with due care and for themselves and others (1). To cooperate with the employer e.g. taking part in toolbox talks (1). To correctly use anything provided for health and safety in accordance with any instruction or training (1). Not to misuse or damage equipment provided for health and safety purposes (1). 	n/a	2

17	Explain the advantages of using a caisson as a method of deep excavation for bridge piers.		
	Acceptable answer(s)	Guidance	Max marks
	<p>A coherent explanation of the following. Marks as shown to a maximum of three marks in total.</p> <p>A caisson is a box or shell-like structure which is sunk into water (1). It allows dry working (1), it can become part of the structure so does not need removing (1), can be internally pressurised to prevent water ingress (1).</p>	n/a	3

18	A retail company is planning to build a large new distribution warehouse.		
	Explain why a steel portal frame may be considered the best design option for the building.		
	Acceptable answer(s)	Guidance	Max marks
<p>A coherent explanation of the following. Marks as shown to a maximum of three marks in total.</p> <p>The frame can be prefabricated, quick and easy to construct (1). There are lower installation costs to the retail company as the speed of erection is quicker (1) and generally less skilled workers and their number are required to be part of the construction phase (1). The frame is designed so that there is more space inside the structure, hence why it is so popular in the use of industrial factories or storage facilities (1). Portal frame does not require bracing so the location of windows or doors is not affected (1). The construction and erection of the framework is not affected by the weather so</p>	n/a	3	

	there should not be delays due to in-climate weather conditions (1). There are reduced wastage on site as components are made off-site and made to measure (1). Steel is preferred to concrete or timber as its stronger and stiffer (1).		
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19	A developer is keen to incorporate a sustainable urban drainage system (SUDS) into a new eco-village development and is seeking local public opinion on the design of the SUDS.		
	Evaluate the design considerations the local public may require the developer to consider.		
	Acceptable answer(s)	Guidance	Max marks
	A coherent evaluation of the following. Marks as shown to a maximum of four marks in total. Ponds should be made as 'natural' in appearance as possible (1). Vegetation and planting adjacent to SUDS is important and should include native species (1). Shore slopes should be gentle (1) Natural barriers (e.g. planting) should be introduced to help manage perceived safety risks (1). Deep water warning signs should be used were applicable (1). Benches should be introduced (1). Picnic tables, walkways and children's play areas should be considered (1). Land based wildlife and aquatic species, including fish, should be encouraged to colonise the system and its marginal areas (1).	n/a	4

20	A property developer has planning permission to build a large two-storey steel frame sports complex on an undeveloped area of wasteland that has been targeted by the local authority for regeneration. The new building will be rectangular and have plan dimensions of 80 m x 20 m. The site varies in its topographical make-up and includes soil mounding from its previous use as a landfill tip.		
20a	Explain the process of how to use standard formulae to calculate cut and fill quantities to level the site in preparation for construction activities.		
	Acceptable answer(s)	Guidance	Max marks
	Explanation of the need to produce grids of levels or section details in order to complete cut and fill calculations (1). Use Simpson's rule and Trapezoidal Rule to calculate cut and fill quantities (1). Simpson's Rule is considered the most accurate method to calculate cut and fill requirements but can only be used with an odd number of ordinates (1).	n/a	3
20b	Discuss the structural and design issues that will need to be considered for the steel frame.		

Acceptable answer(s)	Guidance	Max marks
<p>Intention: <i>The aim of the question is for learners to apply a range of understanding of surveying techniques to calculate cut and fill requirements and factors affecting the design of the steel frame structure in a synoptic contextualised scenario setting.</i></p> <p>Mark Band 1 (1-3 marks) The learner identifies a limited number of structural considerations to specify how the steel frame will affect the design of the structure but there is little in the way of description. The learner’s response lacks detail and is not clearly linked to the scenario.</p> <p>Mark Band 2 (4-6 marks) The learner identifies a wide range of structural considerations of how the steel frame will affect the design of the structure used and supports this with brief descriptions. The learner’s response is detailed but incomplete, makes some allowance for, and has clear links to the scenario in most cases.</p> <p>Mark Band 3 (7-9 marks) The learner identifies a comprehensive range of the structural considerations to specify how the steel frame will affect the design of the structure and supports this with in-depth descriptions. Their response is detailed and complete, and has clear and accurate links to the scenario.</p>	<p>Indicative content: Recognition and use of the theory of bending to design components, use of permissible stress design tables to size sections, understand the importance of terms in the design of axially-loaded columns: effective length, moment of inertia, cross-sectional area, radius of gyration and slenderness ratio, consider column sectional shape.</p> <p><i>For no awardable content, award 0 marks.</i></p>	9