**6720-550 March 2018**

# 6720-36 Advanced Technical Extended Diploma in Constructing the Built Environment (Construction) (720)
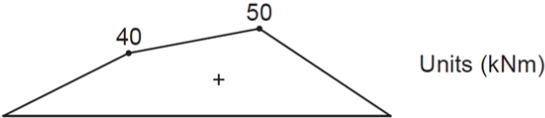
| 1a) | Define the term triangulation as used in surveying. | | |
|---|---|---|---|
| | **Acceptable answer(s)** | **Guidance** | **Max marks** |
| | Any **two** from the following, maximum **two** marks.<br><br>It is a surveying method that measures the angles in a triangle (1) formed by three survey control points (1). Using trigonometry and the measured length of just one side, the other distances in the triangle are calculated (1). | n/a | 2 |
| 1b) | Define GIS as used in surveying. | | |
| | **Acceptable answer(s)** | **Guidance** | **Max marks** |
| | Any **two** from the following, maximum **two** marks.<br><br>A Geographic Information System (1).<br>It is a collection of computer software and information which is used for viewing, analysing, managing and displaying geographical data (1).<br>In general, GIS allows users to search for information about specific geographical areas, analyse spatial information, edit the data and create maps, charts and reports that show users the results in visual forms (1). | n/a | 2 |

| 2 | Describe the purpose of a TBM in surveying. | | |
|---|---|---|---|
| | **Acceptable answer(s)** | **Guidance** | **Max marks** |
| | Marks as shown to a max of **two** marks.<br>Temporary Bench Mark (1) is used for levels on site/an agreed reference point (1).<br>Height datum is established to an arbitrary fixed point established on site (1) used on smaller construction projects/sites (1). | n/a | 2 |

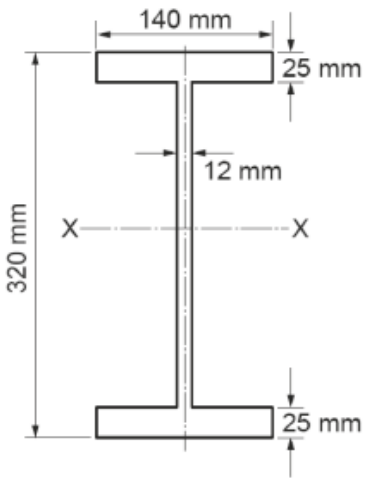| 3 | Explain **one** reason why a site surveyor might choose to use a total station to perform a land survey. | | |
|---|---|---|---|
| | **Acceptable answer(s)** | **Guidance** | **Max marks** |
| | Any **one** of the following. **One** mark for a reason and **one** mark for a linked response. Maximum **two** marks.<br><br>• Field work is carried out very fast (1) the instrument is relatively easy to use once training has been completed and reduces the need to record data manually (1).<br>• Accuracy of measurement is high (1) manual errors involved in reading and recording are eliminated (1).<br>• Calculation of coordinates is very fast and accurate (1) corrections for temperature and pressure are automatically made (1).<br>• Computers can be employed for map making and plotting contour and cross-sections (1) contour intervals and scales can be changed in no time (1). | n/a | 2 |

| 4 | A new sewer is to be excavated between two manholes. The trench width for the new sewer is to be 600 mm. The depths of excavation from the existing ground levels to the proposed formation levels of the sewer are shown below in Table 1. | | |
|---|---|---|---|
| | | |

| Chainage (m) | Depth of excavation to formation level. (m) |
|---|---|
| MH 1- Chainage 0 | 1.3 |
| 10 | 1.45 |
| 20 | 1.6 |
| 30 | 1.65 |
| 40 | 1.7 |
| 50 | 1.8 |
| 60 | 1.6 |
| 70 | 1.65 |
| MH 2- Chainage 80 | 1.2 |

Table 1

Determine, using Simpson's Rule shown below, the volume of spoil to be removed.

Simpson's Rule: Area = $w/3 [(y_1+y_n) + 4(y_2+y_4....) + 2 (y_3+y_5+..... )]$

| **Acceptable answer(s)** | **Guidance** | **Max marks** |
|---|---|---|
| Area = 10/3 [(1.3 + 1.2) + 4(1.45 + 1.65+ 1.8+1.65) + 2 (1.6+1.7+1.6)] (1)<br>Area = 10/3 [(2.5) + (26.2) + (9.8 )]<br>Area = 10/3 x 38.5 (1)<br>Area = 128.3 $m^2$ (1)<br>Volume = 128.3 x 0.6 = 26.1 $m^3$ (1) | Accept alternative method using volumes input direct into Simpson's Rule. | 4 |

| 5 | State the technical term used for loads that are | | |
|---|---|---|---|
| 5a) | concentrated at one place | | |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Point load. | | 1 |

| 5b) | spread out over an area. | | |
|---|---|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Uniformly distributed load (UDL). | n/a | 1 |

| 6 | Determine the bending moment (BM) values at points A and B. | | |
|---|---|---|---|
| 6a) | | | |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| A = 20 x 2 = 40 kNm(1)<br>B = 2 x 25 = 50 kNm(1) | n/a | 2 |

| 6b) | Produce a BM diagram for the beam. | | |
|---|---|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
|  | Marks awarded as follows:<br>• Correct shape (1)<br>• Labelling values (1) | 2 |

| 7 | State the meaning of **three** of the terms of the bending theory equation shown below. | | |
|---|---|---|---|

$$\frac{M}{f} = \frac{I}{y}$$

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| **One** mark for each up to a maximum of **three** marks.<br><br>M = Maximum bending moment<br>f = permissible stress<br>I = moment of inertia or second moment of area | n/a | 3 |

| 8 | State the units for: | | |
|---|---|---|---|
| 8a) | first moment of area | | |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| $mm^3$ **or** length to the power of 3 (1) | n/a | 1 |

| 8b) | second moment of area. | | |
|---|---|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| $mm^4$ **or** length to the power of 4 (1) | n/a | 1 |

| 9 | With reference to the section shown in Figure 2: |
|---|---|
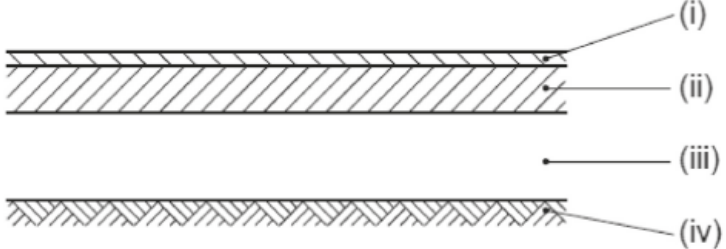


Figure 2

| 9a) | Calculate the moment of inertia about the x-x axis. |
|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| $I_{xx}$ = $BD^3/12$ - $bd^3/12$ = (140 x $320^3/12$) (1) - (128 x $270^3/12$) (1)<br><br>= $3.82 \times 10^8$ - $2.095 \times 10^8$<br>= $1.72 \times 10^8$ (1) $mm^4$ (1) | n/a | 4 |

| 9b) | Determine the moment of resistance of the beam, if the maximum bending stress in either tension or compression is 165 $N/mm^2$. |
|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| M/I = f/y  so  M= fI/y (1) = 165 x $1.72 \times 10^8$/160 (1) = 1.774 x $10^8$ (1) mm  = 177.4 kNm (1) | n/a | 3 |

| 10 | An excavation is to take place on a site with a foundation of depth 1.5 m.<br>A site investigation has confirmed the presence of gas pipes in the ground. |
|---|---|
| 10a | Identify **one** risk associated with the gas pipe to those working on site. |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| • Associated Risk - Explosion leading to injury or death (1)<br>Any other suitable answers. | n/a | 1 |

| 10b | Identify **one** control measure to minimize the risk. |
|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| **One** mark for any of the following:<br>• Control Measure - Locate underground services (1)<br>• Use of local gas company plans to find the location of services<br>• Use of CAT (cable avoidance tool)<br>Any other suitable answers. | n/a | 1 |

| 11 | Name the **four** components of the flexible highway construction shown in Figure 3. |
|---|---|



Figure 3

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| **One** mark each for the following:<br>(i) wearing course<br>(ii) base course<br>(iii) sub-base or roadbase<br>(iv) sub-grade | n/a | 4 |

| 12 | Explain **one** disadvantage of a rigid highway construction form. |
|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| An explanation of the following, marks as shown to a max of **two** marks in total.<br><br>The pavement is noisier to drive along as a result of the need to provide a rough riding surface (1) due to the need to provide skid resistance (1).<br>More complex specification form (1) as joints are required for contraction and expansion (1).<br>Higher repair/maintenance costs (1) as usually greater sections of the pavement, compared to a flexible pavement, need to be cut out (1).<br><br>Accept any other appropriate answers. | n/a | 2 |

| 13 | A fast food chain intends to build a number of new outlets.<br>These outlets will have a pre-fabricated structural steel frame and will be delivered to the site ready for erection. | | |
|---|---|---|---|
| 13a | Name **two** items of health and safety legislation which should be applied during the design and construction phases of the project. | | |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Any **two** from the following at **one** mark each:<br>• Health & Safety at Work Act<br>• CDM Regulations<br>• Health & Safety Management Codes L21, L144<br>• Control of Substances Hazardous to Health (COSHH)<br>Accept any other appropriate answers. | n/a | 2 |

| 13b | Explain why a pre-fabricated structural steel frame has been specified for the outlets. | | |
|---|---|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Any **two** of the following. **One** mark for an identified advantage and **one** mark for a linked response. Maximum **four** marks.<br><br>• Reduced wastage on site (1) because components are made to measure (1)<br>• Lower installation costs (1) speed of erection/use of less skilled workforce (1)<br>• Minimises impact on the local environment (1) due to reduced construction traffic etc. (1)<br>Accept any other appropriate answers. | n/a | 4 |

| 14 | Explain why a pile foundation would be preferred to a strip foundation for the construction of a low-rise commercial building. | | |
|---|---|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Any **two** of the following. **One** mark for an identified advantage and **one** mark for a linked response. Maximum **four** marks.<br><br>• economical (1) when bearing capacity of soil make strip unsuitable (1)<br>• less excavation required (1) resulting in less disposal of off-site surplus material (1) | n/a | 4 |

| | | | |
|---|---|---|---|
| | • minimal impact on the ground (1) reduces the risk of sites of archaeological interest being disturbed/encountering further poor ground conditions (1)<br>Accept any other appropriate answers. | | |

| 15 | A developer has planning permission for a three-storey office block. This is to be built from concrete cast in situ. The new building will be rectangular and have plan dimensions of 85 m x 25 m. |
|---|---|
| 15a | Explain how the datum is transferred from an Ordnance Survey Bench Mark (OSBM) to Temporary Bench Marks (TBMs) on the four corners of the site. |

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| Any **three** from the following:<br>Identify from OS plans nearest OBMs (1), check OBMs are still available (1), complete check level exercise between OBMs to ensure datum level is still accurate (1), transfer to site using flying levels, ensuring the distance between back sight and foresight readings do not exceed 50m (1), calculate closing error when transferring from OBM to TBM-error should be within site/project tolerance (1). | n/a | 3 |

| 15b | Discuss how the decision to use concrete, cast in situ, will affect the design and construction of the structure. |
|---|---|

| Acceptable answer(s) | Guidance | Max marks |
|---|---|---|
| **Mark Band 1 (1-3 marks)**<br>The learner identifies a limited number of structural considerations to specify how concrete cast in situ will affect the design and construction of the structure and there is little in the way of description. The learner's response lacks detail and is not clearly linked to the scenario.<br><br>**Mark Band 2 (4-6 marks)**<br>The learner identifies a wide range of structural considerations of how concrete cast in situ will affect the design and construction 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.<br><br>**Mark Band 3 (7-9 marks)**<br>The learner identifies a comprehensive range of the structural considerations to specify how concrete cast in situ will affect the design and construction 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. | **Indicative content:**<br>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. Construction: bigger section, shorter spans, more labour intensive, material supply issues, longer construction time.<br><br>***For no awardable content, award 0 marks.*** | 9 |