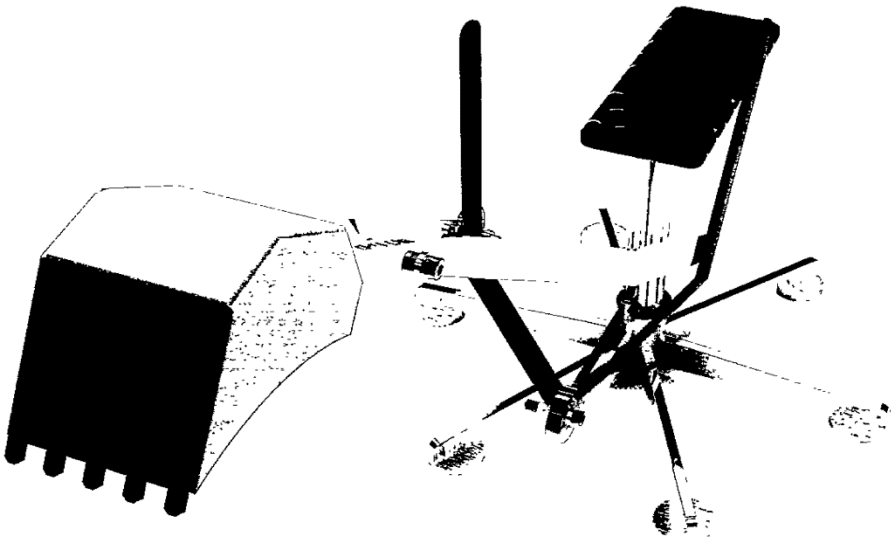
Total marks — 80

Attempt ALL questions

DO NOT WRITE IN THIS MARGIN

1. A manufacturing company has produced an excavator toy, which is shown below.



A CAD technician working for the company used bottom up modelling to create the individual parts. Sub-assemblies were then produced before being joined in the final model.

Drawings generated from the model are shown on the **Supplementary Sheets 1 and 2 for use with Question 1.**

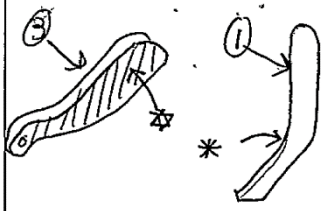
1. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(a) Describe the 3D CAD constraints used to assemble the lever bend to the lever extension. You may use sketches to support your answer. 4

You should refer to the left-hand lever sub-assembly shown on **Supplementary Sheet 1 for use with Question 1(a).**

~~Constrain the visible surface~~



- Constrain the hatched surface of the lever extension to the non-visible surface of the lever bend.
- Create a point on the lever bend just above the ~~curve~~ point * and create a point on the lever extension at point ✡ and constrain these points.
- Using a perpendicular constraint set the long edge of the lever extension perpendicular to the long edge of the lever bend.

[Turn over

X7357701 03

Page 03

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1. **(continued)**

(b) On **Supplementary Sheet 2 for use with Question 1(b)** various views and a dimension have been annotated with the letters A to C.

Name each view or dimension **and** describe the information that it would provide to the manufacturer. You must use the correct British Standard terms.

(i) View A Angled plan view. Provides info on the design from a different angle to the other views — 1

(ii) View B ~~Section~~ Full section Y-Y — 1
Provides information on the internal details of a component and the shape of the cross section.

(iii) Dimension C Angular dimension in degrees with a tolerance of ±2 minutes. Provides info on the angle the component ~~forms~~ is bent/manufactured to. — 1

1. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(c) A problem has been identified with the seat of the excavator toy and a redesign is required. Specific information about the current seat is saved within the following file formats — .DWG, .STL and .3DS

Explain how the information contained in these files would be used in the redesign of the replacement seat.

(i) .DWG Used to store the technical graphics as shown on Supplementary Sheet 1. These would be updated with the redesigned components 1

(ii) .STL Used in CAM software and 3D printing. If the redesigned part is to be 3D printed or manufactured this file type would be used. 1

(iii) .3DS Used in 3D CAD software. The toy would be edited and redesigned in this format using 3D CAD software 1

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1. (continued)

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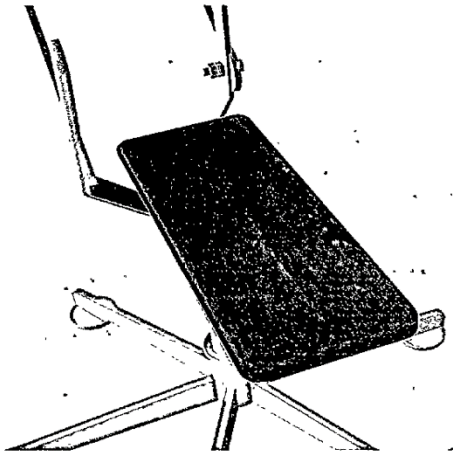
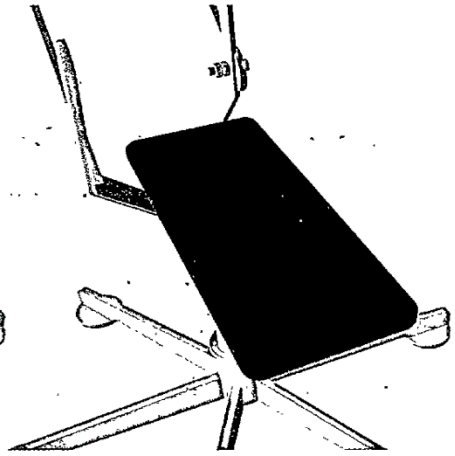
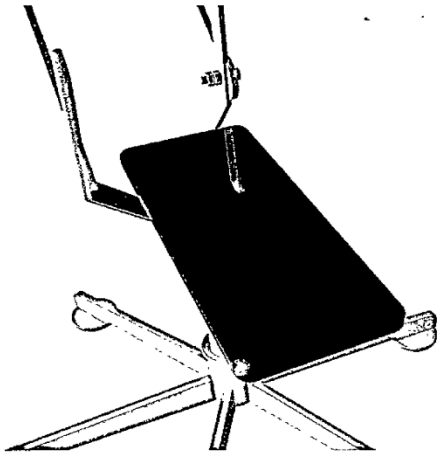
(d) A CAD illustration of the seat detail is produced. The stages of creating this detail are shown below. Stage 4 shows the final illustration.



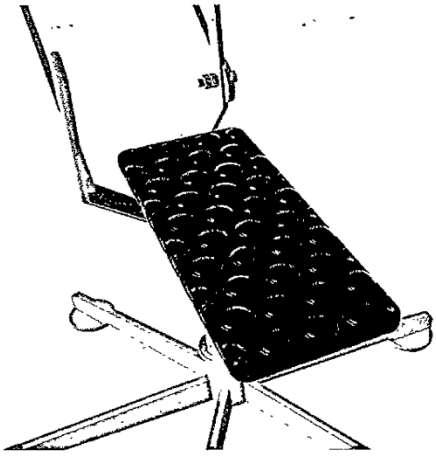
Stage 1



Stage 2



Stage 3



Stage 4

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1. (d) (continued)

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Name the computer-aided techniques which have been applied between the following stages of the process **and** explain how they have been used.

(i) Stage 1 to Stage 2 — 1

Texture mapping. The 2D image of the red surface has been wrapped round the seat to give a realistic look.

(ii) Stage 2 to Stage 3 — 1

Reflections have been added. The light source will create reflections on certain parts of the seat and these have been added.

(iii) Stage 3 to Stage 4 — 1

Bump mapping has been used to adjust the brightness of each pixel to give the appearance of depth and ~~shad~~ to add shadows and reflections to create realism.

[Turn over

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1. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(e) A presentation about the excavator toy is to be created in printed and digital media using a variety of file types.

(i) State the name of a file type that could be used to show an animation of how the excavator toy is assembled. 1

.avi Audio Video Interleave

(ii) State the name of a **vector** file type that could be used to show a rendered image of the finished excavator toy. 1

Adobe Illustrator (.ai)

(iii) The printed presentation takes the form of a poster, which includes both images and text.

Explain what would need to be considered by the designer prior to the poster being sent to the print technician. 3

The colour space should be set to CMYK and not RGB.
The fonts should be in vector form
The images should all be of high quality (300dpi for printing
Crop marks & registration marks should be added.
Should be sent as a .pdf file to ensure the layout remains the same

MARKS | DO NOT WRITE IN THIS MARGIN

2. A vacuum cleaner manufacturer uses **motion capture** technology as a test procedure to ensure that their products are easy and comfortable to use.

An image of the test is shown below.

(a) Motion capture has advantages and disadvantages.

(i) Describe three **advantages** of motion capture technology to the manufacturer. 3

It ~~is~~ recording ~~stimulating~~ real human motion so it is very realistic.

It allows very complex motion to be replicated in an animation. The animation can be in any environment.

It allows them to conduct analysis of the way the ~~vacuum~~ vacuum cleaner is used in real life. This could lead to improvements in ergonomics

The data recorded can be stored and used again in future animations with a different character or person moving around. The results can be compared with future tests to show improvements.

MARKS | DO NOT WRITE IN THIS MARGIN

2. (a) (continued)

(ii) Describe three **disadvantages** of motion capture technology to the manufacturer. 3

Large amounts of data are collected in a short space of time. This is time consuming to process and manipulate.
It requires expensive specialist software for post production and manipulation
The equipment required for recording the data is expensive and time consuming to set up.

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2. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

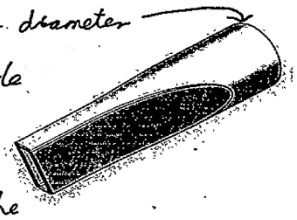
(b) After testing, the manufacturer wants to design a new nozzle. Two designs are being considered.

You should refer to **Supplementary Sheets 3 and 4 for use with Questions 2b(i) and (ii).** Nozzle 1 is shown on Supplementary Sheet 3. Nozzle 2 is shown on Supplementary Sheet 4.

Describe the 3D CAD modelling techniques used to create the two replacement nozzles. You may use sketches to support your answer. Dimensions do **not** need to be included in your responses.

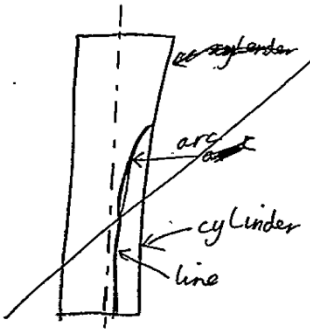
(i) Nozzle 1 — 5

1) Draw circle the size of the outer diameter



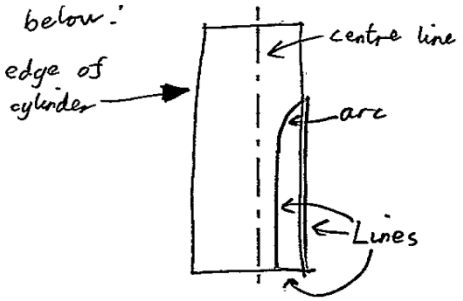
2) Extrude the full length of the nozzle

3) On a plane perpendicular to the first sketch draw the shape of the arc as shown below using the line and arc tools



4) Mirror the line and arc in the centre line

3) On a plane tangent to the surface of the cylinder, draw 3 lines & an arc as shown below:



4) Reflect sketch in centre line.

5) Extrude both sketches to remove material from sides of cylinder

6) Shell model to make it hollow

7) Draw inner circle with same centre as in step 1

8) Extrude inwards removing material by the thickness of the shell. Continued on P26

ADDITIONAL SPACE FOR ANSWERS

2bi) 9) Draw inner rectangle on nozzle end and extrude inwards by thickness of shell.

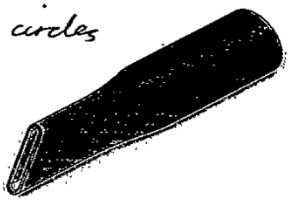
10) Create cutting plane on nozzle end to remove material. This creates the angled end.

11) Apply chamfers to all the internal & external edges except along the 2 circles.

2. (b) (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(ii) Nozzle 2 4

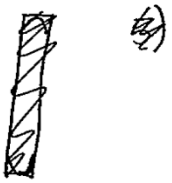


1) Using circle tool, draw 2 concentric circles to form the attachment end

2) Extrude the area between the circles by ≈55mm

3) Create plane offset from the extruded circles by ≈30mm

4) Sketch 2 rectangles then fillet the ~~edg~~ corners as shown below:



Fillets shown in purple

5) Loft the area between the circles to the area between the rectangles.

6) Extrude the area between the rectangles

7) Apply cutting plane on the end of the extruded rectangles.

8) Apply fillet to cut edges.

[Turn over

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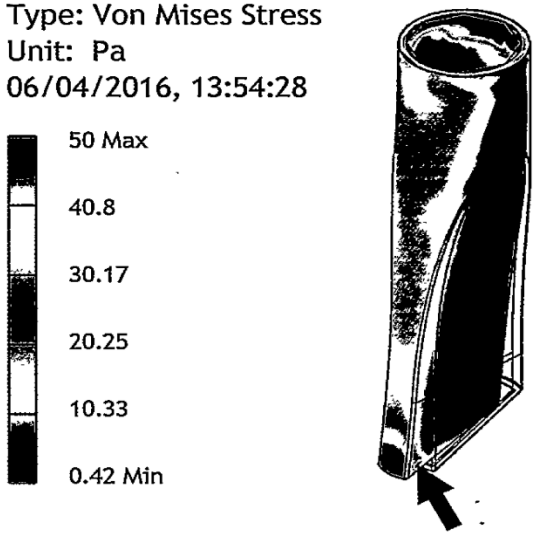
2. **(continued)**

MARKS | DO NOT WRITE IN THIS MARGIN

The 3D CAD models of the nozzles are being tested using Finite Element Analysis (FEA) methods.

The results of the test on Nozzle 1 are shown below.



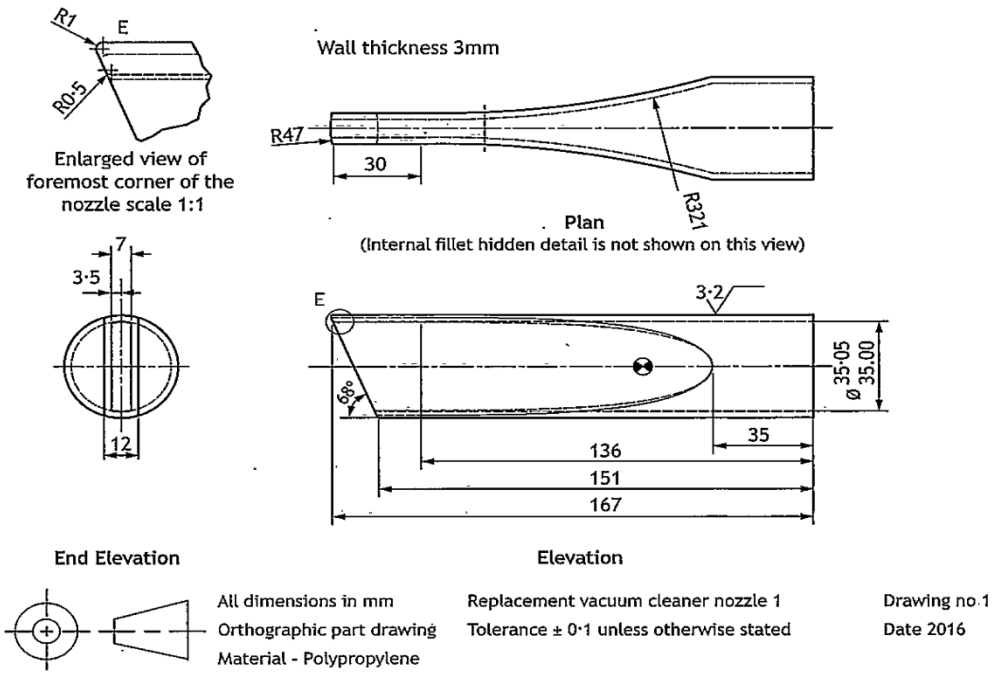
(c) Describe four set-up requirements that are necessary **before** the FEA simulation test can begin. 4

- The material and its specific properties must be defined
- The areas of the model that are fixed must be defined.
- The area/point where the force/forces are to be exerted must be defined.
- The magnitude and direction of the forces must be defined.
- The type of stress to be measured
- How the stress is to be displayed.

2. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

An orthographic CAD drawing of Nozzle 1 is shown below.



(d) Identify three pieces of information which have been included in the orthographic views shown above **and** explain how they would allow the nozzle to be manufactured using CAD CAM processes. 3

Dimensions - allow the part to be manufactured to size

Tolerances - specify the permissable variation in the size of the manufactured product. All tolerances are ±0·1 mm apart from the dameter which is between 35·05mm and 35·00mm.

Detail view E shows the ~~radius~~ radius of the fillets that would otherwise be missed out.

The wall thickness of 3mm shows how thick the material should be.

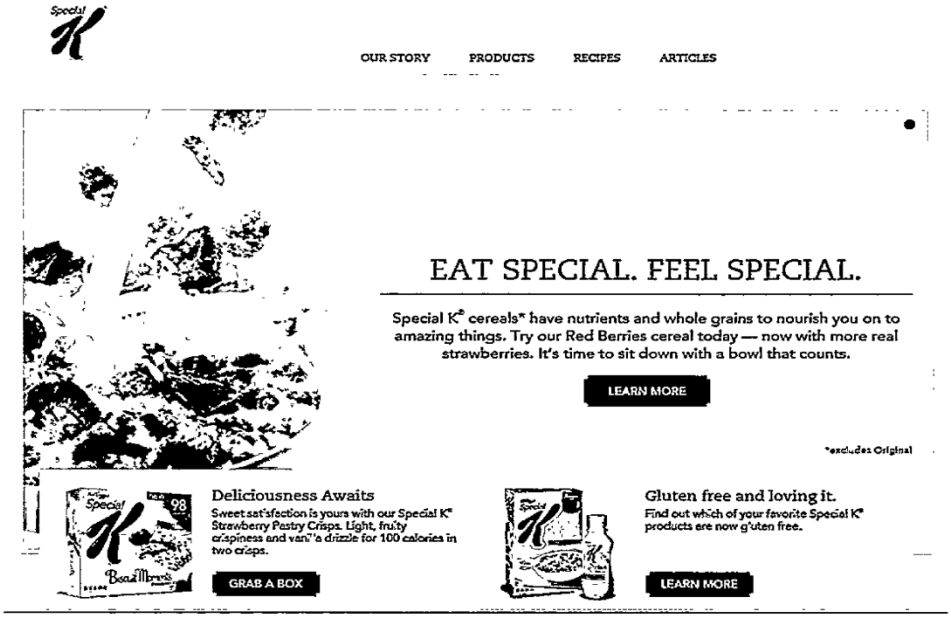
The material is specified so manufacturers can use the correct material

* X 7 3 5 7 7 0 1 1 5 *

MARKS | DO NOT WRITE IN THIS MARGIN

3. A company has launched a series of products that carry the same branding.

The graphic designer has maintained the brand across a range of products and a website using design elements and principles.



Special K website homepage

(a) Identify four design elements or principles **and** explain how they have been used in the web page shown above. 4

1 Line - The line under 'Eat Special' is used to emphasise the title and separate it from the text below. This line also links the image on the left to the text.

2 White Space - The middle section of the page has a lot of blank (plain coloured) space that emphasises the image and text & declutters the page

3 Colour is used to link the red in the cereal to the red title and 'learn more' icons. This connects the text to the image.

3. (a) (continued) MARKS | DO NOT WRITE IN THIS MARGIN

4 Texture - The photo of the cereal creates a lot of texture which adds depth and interest to the page.

(b) It is important that the branding on the web page exactly matches that on the product packaging. Three examples of this packaging are shown below.

Coated cardboard packaging for biscuits

Plastic packaging for individual cereal bars

Coated cardboard and foil yoghurt container with plastic lid

Describe three factors that a company may have to consider when maintaining consistency across digital and printed media. You must mention specific printed and digital media in your responses. 3

Screens such as on tablets use RGB colour space which can display colours differently to CMYK colours in print. Pantone Matching System can be used to ensure colour consistency across all media. Print examples include cardboard. The same fonts should be used to promote brand regognition. ~~across~~ The sizes of the logo and title should be kept the same relative to each other across all print and digital mediums. For example on the website and on the plastic packaging.

3. (continued) MARKS | DO NOT WRITE IN THIS MARGIN

(c) A camera-ready copy of the biscuit packaging is produced.

Describe four requirements of a camera-ready copy for commercial printing. 4

Fonts in vector format

Colour space set to CMYK

Images that are to bleed should extend 3-5mm past the crop marks.

Crop marks and registration marks should be added.

The camera ready copy ~~se~~ should be the final design of the document.

Colour calibration marks should be added.

(d) State a suitable printing process to mass produce the cardboard biscuit packaging. 1

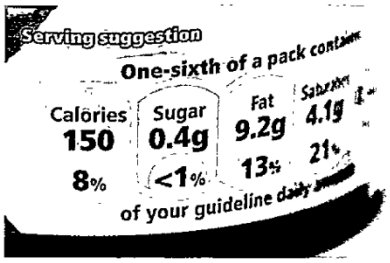
Commercial laser printing

3. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(e) Food manufacturers are required to display nutritional information on food packaging.

Two examples are shown below.



Label 1

Label 2

Explain, with reference to the labels shown above, how graphic techniques have been used to make the nutritional information as clear as possible. 4

Label 1: Contrast has been created between the sections using colour. This clearly separates every catagory.

Label 2: Colour has been used to make the nutrition info stand out by making the background darker than the boxes with info.

Both: The ~~text~~ numbers inside the boxes are larger than the text ~~make~~ emphasising them.

The repetition of the shape ▢ with a white border helps inform the reader that similar info is contained in each box.

The layout of the boxes with a title, ~~number~~ the number of grams and the percentage is consistent between products making it easy for customers to interpret.

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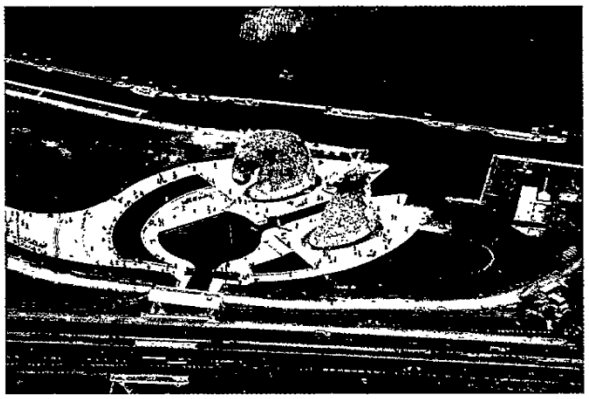
MARKS | DO NOT WRITE IN THIS MARGIN

4. The Kelpies and surrounding Helix Park have become a popular tourist attraction in the heart of Scotland.



Aerial photograph of the Kelpies and the visitor's map of the Helix Park

(a) Prior to the construction of the Kelpies and Helix Park, three different surveys were undertaken.

Name three surveys and explain their purpose in ensuring the success of this project. 6

Survey 1 Topographical Survey

Purpose To show the shape of the land and the locations of water ~~etc~~ & trees etc. Used to ensure the statues can be seen and that they fit in with their surroundings. Also used to inform the construction of foundations if the ground is sloped.

4. (a) (continued)

DO NOT WRITE IN THIS MARGIN

Survey 2 Drainage Survey

Purpose To check that the planned ~~location~~ location is not a flood plane and to find out the depth of the water table. To ensure the suitability of the location for the proposed development.

Survey 3 Underground Survey

Purpose To show the geological makeup of the land. For example ~~where the~~ ~~we~~ the type of rock and soil and the depth of bedrock. This informs the construction of foundations to ensure structural strength & safety. Also shows underground pipes to ensure they are not damaged.

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4. **(continued)**

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(b) Many professionals from the built environment sector were involved in the design and construction of the Kelpies sculptures. These included a model maker, structural engineer and a representative from the construction trades.

During the project they all made use of a computer generated 3D model of the sculptures.

Describe two ways the following professions could make use of the 3D computer model. **You must give different answers for each profession.**

(i) model maker 2

To export as an .stl file for use with rapid manufacturing technology or 3D printing. To extract drawings and dimensions to enable them to create other models to scale.

(ii) structural engineer 2

To conduct digital tests such as Finite Element Analysis to ensure safety and structural strength. To analyse the number and size of load bearing walls. To determine the best materials to use based on the design & intended use.

(iii) construction trades 2

To inform them of dimensions and tolerances To inform them of the materials to be used in construction. To see how the building is to be assembled. To see what the exterior render/finished building should look like.

MARKS | DO NOT WRITE IN THIS MARGIN

5. Advances in technology have changed the way in which we access information.

(a) Describe three ways an advertiser can use digital media to appeal to the consumer. **3**

- Targeted advertising can show only people who are in the target audience ~~the~~ advertising.
- Interactive graphics such as VRML models & videos can be used to engage viewers and provide them with more information.
- Links to websites or online content can be shared between freinds quickly and easily
- Enabling consumers to find out information on any device from any location through a website
- Up to date information can be shared instantly with consumers

5. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

A website called "foodfactsaware.com" helps consumers understand more about information displayed on food packaging. The web page shown in the image below features drop down menus allowing consumers to access additional content. This takes the form of video interviews with professionals, printable fact sheets on nutrition and annotated photographs explaining food labelling.

1 →

(b) Explain how the web designer has made the website shown above informative and easy to use, with reference to the following.

(i) Web page layout 3

The web page is layed out in rows which helps link related hyperlinks or content together. The repetition of shape (1) shows that the content is related. ~~and that once~~ Once the viewer realises that one box is a hyperlink, it is clear the others are as well. The contrasting colours of the boxes shows that although related, the content is not the same.

5. (b) (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(ii) User interface 3

The use of arrows in the header bar makes it clear there is more content that can be accessed by clicking on the arrow The use of (1 ~~three~~ identically shaped boxes at (1) provides another method of accessing the sites content. This is more graphic and images are provided to help understanding. The clear boxes in the 'Dietary Resource Console' gives direct access to 3 parts of the website

(iii) Graphic media file formats 3

The website is made informative through use of images, probably in JPEG form. These are high quality files but feature compression to reduce file sizes and thus load times. The ~~graphics~~ graphics help to make the website more intuative intuative to use because it provides an ~~additio~~ additional source of information to the text.

Text, ~~and~~ shapes and colour will be in HTML format. They provide information ~~and~~ HTML also enables hyperlinks which make navigation easy

[END OF QUESTION PAPER]

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