HIGHER CAD

GRAPHIC COMMUNICATION



NAME: _____ TEACHER: _____

READ ME!

Computer Aided Design is an essential part of the Graphic Communication course. It builds upon the Technical Graphics unit that you should have completed before now.

You are expected to be able to use 2D and 3D CAD software to a good level. You should be able to quickly make 3D models, drawings and renders from given sketches or drawings.

In this unit, you will learn about 3D CAD and the terms associated. There are 30 tasks for you to produce, available at DesignClass.co.uk

You should produce these models and create drawings and renders to a sufficient standard. Your teacher will mark your work and provide feedback.

This booklet also covers most the knowledge required for an exam, along with covering the terminology and understanding required. Your teacher will mark your work. Make sure you pass it to them.

FIND STUFF!

This is a complex topic, so you need to know where to find resources...



You can find relevant documents at these two site:

Past exam papers and Course Specification: https://www.sqa.org.uk/sqa/47929.html
Taks, templates and videos: https://www.designclass.co.uk/higher-graphic-communication.html

KNOW THESE!

There are 62 terms that you must understand for this part of the course. A checklist is shown below. You will cover these terms during this unit and answer questions in the following pages.



2D Commands
- ☐ Line
- ☐ Circle
- ☐ Rectangle
- ☐ Ellipse
- ☐ Trim
- ☐ Offset
- ☐ Project edge
- ☐ Extend
- ☐ 2D Fillet
- ☐ 2D Chamfer

3D Commands
- ☐ Extrude
- ☐ Revolve
- ☐ Loft
- ☐ Helix
- ☐ Sweep
- ☐ Shell
- ☐ 3D Fillet
- ☐ 3D Chamfer

Constraints
- ☐ Linear
- ☐ Radius
- ☐ Diameter
- ☐ Perpendicular
- ☐ Fixed
- ☐ Tangent
- ☐ PCD
- ☐ Concentric

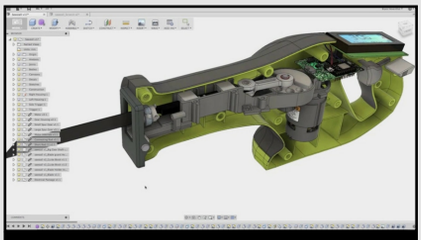
Assemblies
- ☐ Component
- ☐ Assembly
- ☐ Sub-Assembly

CAD Principles
- ☐ Workplane
- ☐ Sketch
- ☐ Face
- ☐ Edge
- ☐ Vertices
- ☐ Datum
- ☐ Suppress
- ☐ Top-Down Model
- ☐ Bottom-Up Model
- ☐ Modelling Tree
- ☐ Mirror
- ☐ Add
- ☐ Subtract
- ☐ Intersect
- ☐ Linear Array
- ☐ Box Array
- ☐ Radial Array

File Types & Processing
- ☐ DXF
- ☐ 3DS
- ☐ STEP/IGES
- ☐ CAD Library
- ☐ File Management
- ☐ Cloud Computing
- ☐ Cloud Storage
- ☐ CFD/FEA
- ☐ Cosmetic Thread
- ☐ CAM
- ☐ DRM
- ☐ Import/Export
- ☐ Input Devices
- ☐ Output Devices
- ☐ Taper
- ☐ PDF

UNDERSTANDING CAD!

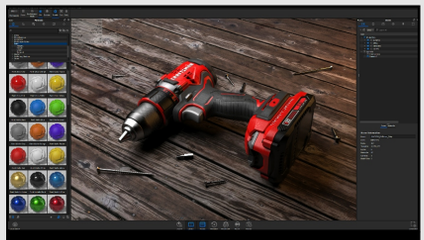
CAD software is a tool, and like every tool, each one has a specific purpose. 3D modelling is a broad term, but there are different forms of 3D modelling software, each with an intended function or purpose.



3D parametric CAD for product modelling and manufacture.



3D animation and physics rendering, for realistic movement and film.



3D model rendering and illustration software, for product visualisation

Parametric CAD is the most frequently used software by designers and engineers.
Describe the features of parametric CAD that make it suitable for 3D modelling by designers and engineers.

[4 MARKS]
[use separate paper if you need more space]

CAD files are often shared freely via websites such as 'GrabCAD', 'Thingiverse' and 'MyMiniFactory'.
Describe four potential problems with the free sharing of CAD files online.

[2 MARKS]
[use separate paper if you need more space]

Many design and engineering companies try to avoid printing documents and strive for a 'paperless office'.
Explain four reasons why companies want to have a 'paperless office'.

[4 MARKS]
[use separate paper if you need more space]

EXTRUDE FEATURE!

Extrude is the most common 3D feature tool and probably the easiest to understand. You draw a shape and 'pull' it a set distance. However, there are more to this simple tool than meets the eye...

Extrude has specific features and options that can impact how it functions.
Explain the following extrude-features.

SUBTRACT	TAPER	EXTRUDE-TO and EXTRUDE-BETWEEN
[1 MARK]	[1 MARK]	[2 MARK]

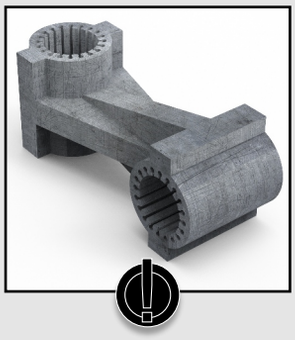
DESCRIBE THESE!

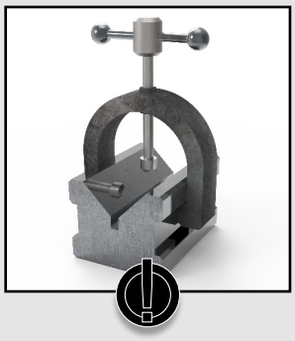
There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

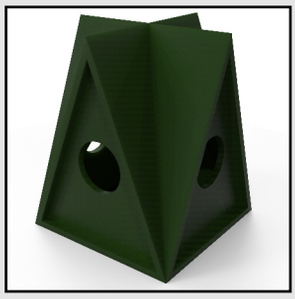
LINE Describe **two** different ways of drawing lines.	RECTANGLE Describe **two** different rectangle tools available.	CIRCLE Describe **two** different ways of drawing circles.
[2 MARKS]	[2 MARKS]	[2 MARK]

EXTRUDE THESE!

There are six tasks in the 'extrude' category. Three of these tasks are mandatory as they cover particularly important skills and processes. These are marked with a ◍. Use the list below to keep a record of which tasks you have completed.

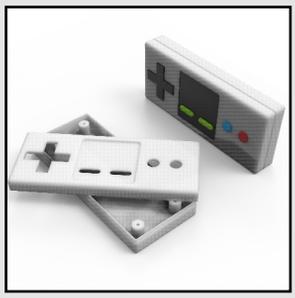












A valid 'sketch' is required for a successful extrude.
Describe the features of a valid sketch required to execute the extrude command.

[2 MARKS]

A sketch can be extruded from a workplane, symmetrically or asymmetrically
Describe the differences between extruding from a workplane, symmetrically or asymmetrically.

[2 MARKS]

UNDERSTAND TANGENCY!

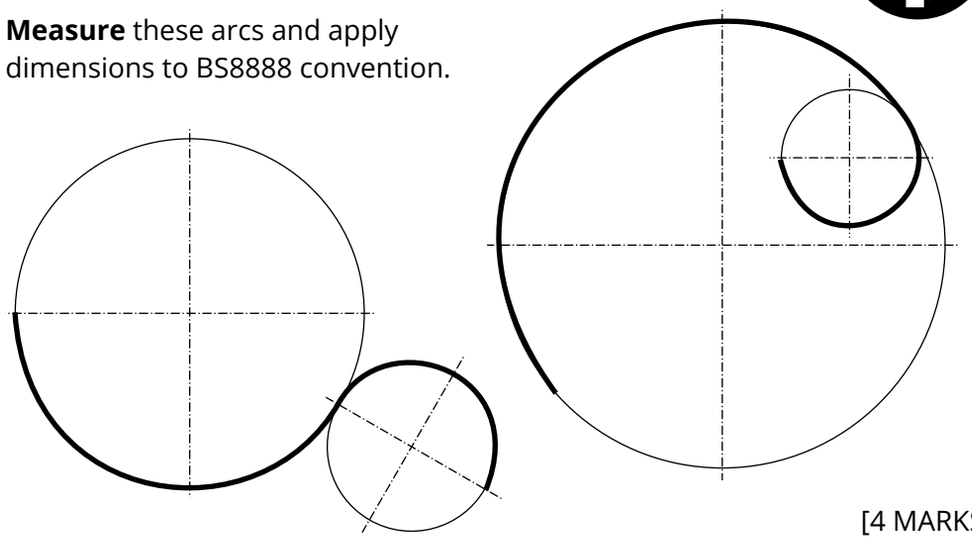
Tangency is a powerful tool for creating complex geometry.
You must understand tangency and how to make use of the principle.

Tangency is a key tool in creating sketches and making CAD assemblies.
Complete the following two questions.

Sketch the tangency tool icon used on your 3D CAD software.

[1 MARK]

Measure these arcs and apply dimensions to BS8888 convention.



[4 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

TANGENT	CONCENTRIC	PERPENDICULAR
[1 MARK]	[1 MARK]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk

ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

REPEAT THYSELF!

Some components can involve a lot of similar or repeating features. Knowing how to make models quickly involves knowing how to get certain features you to repeat themselves, either by mirror, rotation or array.

It is good practice when 3D modelling to name sketches, features, workplanes and axis.
Explain why it is good practice to name each sketch, feature, workplane and axis.

_____
_____
_____
_____
_____
_____[3 MARKS]

Some product will make use of 'webs'.
Describe a web, and its function in a product. Use sketches to support your answer.

_____
_____
_____
_____
_____
_____

[2 MARKS]

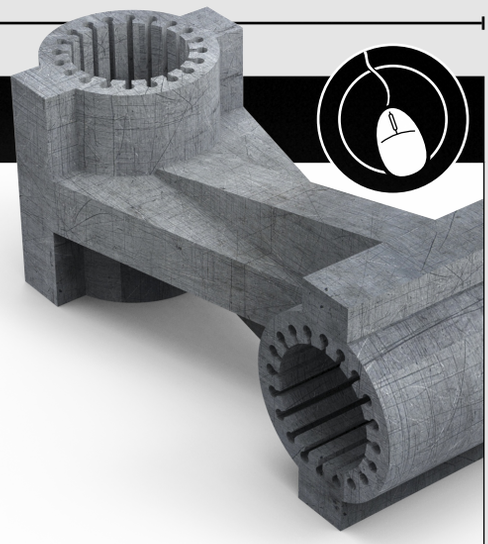
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

PCD	MIRROR	RADIAL ARRAY
[2 MARKS]	[2 MARKS]	[2 MARKS]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms

DRAWING PRINTED?	RENDER PRINTED?	TEACHER CHECKED?
☐	☐	☐

CONSTRAIN STUFF!

Even simple components can present some problems when modelling, especially if you don't know how to constrain sketches.

A good sketch requires 'constraints'.
Describe constraining a sketch. Provide examples of constraints.

[2 MARKS]

A 3D CAD model can become 'over-constrained'.
Explain 'over-constrained' in relation to sketches and assemblies

[2 MARKS]

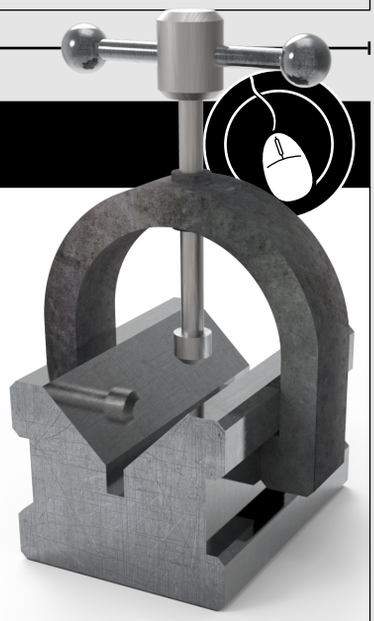
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

COSMETIC THREAD	TRIM	EXTEND
[2 MARKS]	[1 MARK]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms

DRAWING PRINTED?	RENDER PRINTED?	TEACHER CHECKED?
☐	☐	☐

REVOLVE FEATURE!

Revolve is almost as common as extrude, and a tool you should already be familiar with by the time you start this course. Revolve can be more powerful a tool than revolve, especially when you use different axis and more complex profiles.

Revolve has specific features and options that can impact how it functions.
Explain the following revolve-terms

ATTACHED AXIS	REMOVED AXIS
[2 MARKS]	[2 MARKS]

DESCRIBE THESE!

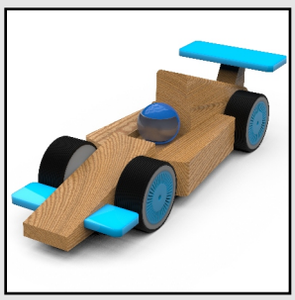
There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

REVOLVE	DIAMETER	RADIUS
[2 MARKS]	[1 MARK]	[1 MARK]

REVOLVE THESE!

There are six tasks in the 'revolve' category. Three of these tasks are mandatory as they cover particularly important skills and processes. These are marked with a ◍. Use the list below to keep a record of which tasks you have completed.













CAD files need to be organised on a storage device.
Describe good practice for naming and storing files. You may use sketches to support your answer.

[2 MARKS]

3D CAD models have entirely replaced drawing board, and are even starting to replace 2D CAD.
Explain why 3D CAD has overtaken drawing boards and 2D CAD-only applications.

[2 MARKS]

ROCKET REVOLVE!

With the toy rocket, al you you need is a simple revolve. However, you need to be comfortable with ellipses, tangency and radial arrays! This is all one part, not separate components... But how do we make it look like different parts...?

The revolve tool can be very useful for generating complex geometry.
Describe how you would model a sphere. Use sketches to support your answer.

[2 MARKS]

Parametric CAD software is not specially designed for creating renders, but can make simple illustrations.
Explain why parametric CAD software allows users to apply visual effects such as materials.

[2 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

ELLIPSE	OFFSET	PROJECT EDGE
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms

DRAWING PRINTED?	RENDER PRINTED?	TEACHER CHECKED?
☐	☐	☐

FITTING STUFF!

Designing components that must fit together is important, for obvious reasons. Components that fit together require a 'tolerance' applied to the models and drawings. You will learn more about that in the "Engineering Graphics" unit.

When designing components that must fit together, 'tolerance' becomes an important consideration.
Describe 'tolerance' and why it is important when designing components.

[2 MARKS]

There are different types of tolerance that can be applied to objects.
Describe three types of tolerancing. Show this to BS8888 standard.

[2 MARKS]	[2 MARKS]	[2 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

2D FILLET	2D CHAMFER	WORKPLANE
[2 MARKS]	[2 MARKS]	[2 MARKS]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk

ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

TESTING DESIGNS!

Remember, 3D CAD is a tool. As a tool, it is used principally used to develop products for manufacture. Design and engineering is a costly - and often time-consuming - process. Testing designs is an essential step.

There are different forms of computer simulation that can be made.
State the name of two different forms of computer simulation.



_____[1 MARK]

_____[1 MARK]

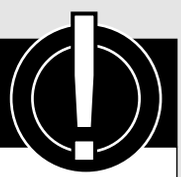
3D CAD models can be used for simulating different conditions or events that may impact designs.
Explain why simulation is a powerful tool to designers and engineers.



_____
_____
_____
_____
_____
_____[4 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.



CFD	FIXED CONSTRAINT	LINEAR CONSTRAINT
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED?	RENDER PRINTED?	TEACHER CHECKED?
☐	☐	☐

SWEEP FEATURE!

Sweep - also known as extrude-along-a-path - is a powerful tool for creating long, flowing shapes with a consistent cross-section. It is a simple command in principle, but can be tricky to execute in practice - especially defining a path for the sweep.

The sweep command requires two profiles to function. These sketches often require special constraints
Explain the following terms, used when creating profiles.

COINCIDENT CONSTRAINT	COLLINEAR CONSTRAINT	PARALLEL CONSTRAINT
[1 MARK]	[1 MARK]	[1 MARK]

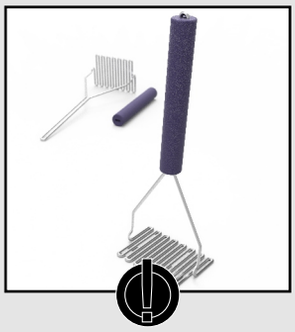
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

SWEEP	DRM	IMPORT/EXPORT
[2 MARKS]	[2 MARKS]	[1 MARK]

SWEEP THESE!

There are six tasks in the 'sweep' category. Three of these tasks are mandatory as they cover particularly important skills and processes. These are marked with a ◐. Use the list below to keep a record of which tasks you have completed.

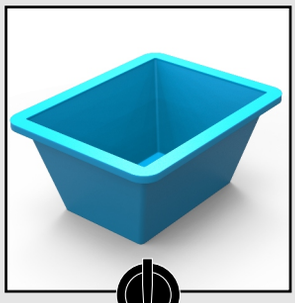












CAD software can make use of construction-lines
Explain construction-lines and why they are useful for designers and engineers.

[2 MARKS]

Removable storage devices such as USB memory sticks are common and useful devices.
Describe two disadvantages of removable storage devices.

[2 MARKS]

DESIGN MASH!

Sweep can be useful tool, especially if you have paths going in different directions. There are different ways for creating paths - your teacher will show you different techniques, or check videos at DesignClass.co.uk.

New workplanes are often required, often at different angles.
Describe the process of creating new workplanes at an angle of 45°.



[2 MARKS]

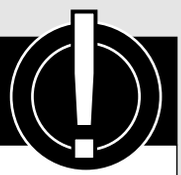
New axis are often required, often at different angles.
Describe the process of creating new axis at an angle of 45°.



[2 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.



FILE MANAGEMENT	3D FILLET	3D CHAMFER
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk

ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

HANDLE SWEEP!

Positioning a sketch-path can be the most complex part of using the Sweep command. You will need to ensure you constrain the sketch to the correct position, and that your profile can follow this path.

Different controls are used to navigate using CAD.
Describe the following terms:

PAN	ZOOM	ROTATE
[1 MARK]	[1 MARK]	[1 MARK]

CAD software can be used to determine different information about proposed designs via simulation.
Describe four different items of information that could be gathered from CAD simulation.

_____
_____
_____
_____
_____
_____[4 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

SHELL	ADD	INTERSECT
[2 MARKS]	[2 MARKS]	[2 MARKS]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

PROJECTING PATHS!

Sometimes, you don't need to create your own paths - just project one from a given edge. This can make the process far quicker and easier.

Graphics can be broken into 'three 'P's'; preliminary, production and promotion.
Describe the three terms, preliminary, production and promotion, including who would use each stage.

PRELIMINARY GRAPHICS	PRODUCTION GRAPHICS	PROMOTIONAL GRAPHICS
[3 MARKS]	[3 MARKS]	[3 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

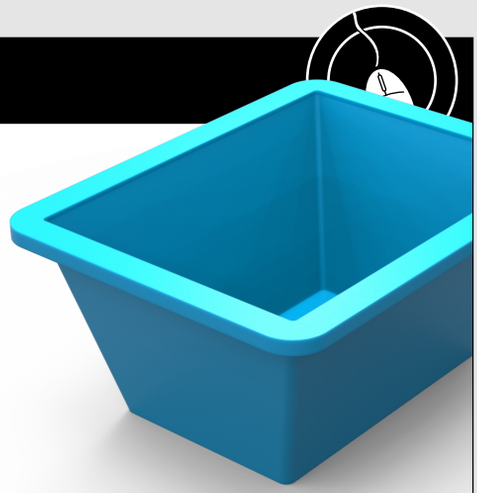
CLOUD COMPUTING	CLOUD STORAGE	INPUT DEVICES
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk

ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

LOFT FEATURE!

The loft feature is a lot of fun! You can create complex, flowing forms that transition from one shape to another over a given distance. At the lest, you require two profiles on two different workplanes set a distance apart.

Computers generate 3D models by calculating edges, faces and vertices.
Explain how a computer draws a 3D model on a screen.

[6 MARKS]

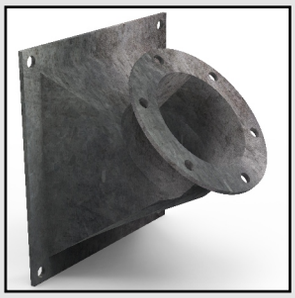
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

FACE	EDGE	VERTEX
[2 MARKS]	[2 MARKS]	[2 MARKS]

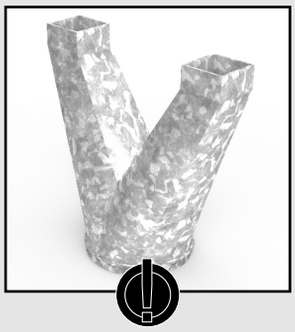
LOFT THESE!

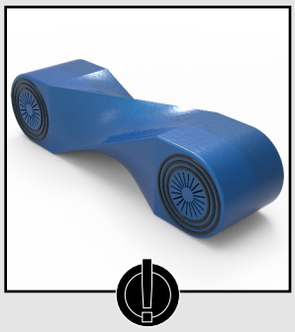
There are six tasks in the 'loft' category. Three of these tasks are mandatory as they cover particularly important skills and processes. These are marked with a ◍. Use the list below to keep a record of which tasks you have completed.













The number of vertices a model has can determine how well a computer performs.
Explain why the number of vertices in a CAD model can impact computer performance.

[2 MARKS]

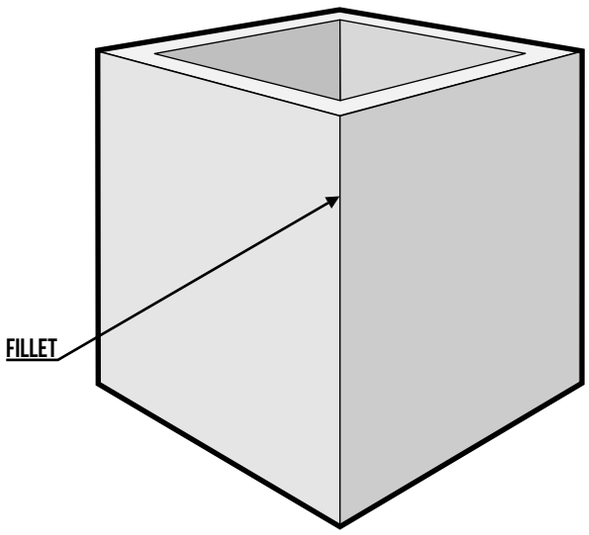
Computers that try to draw large assemblies can slow to the point where they are no longer usable.
Describe how a user can prevent a computer becoming too slow by clever modelling.

[4 MARKS]

MYSTERY LOFT!

The order in which you do things is important; 3D models need to be created in a specific sequence, if they are to appear correctly. Spending a few minutes planning your model is essential.

The fillet command can cause odd results when used incorrectly.
Describe what would happen to the model shown below, if a fillet was applied to the selected edge.



[4 MARKS]

DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

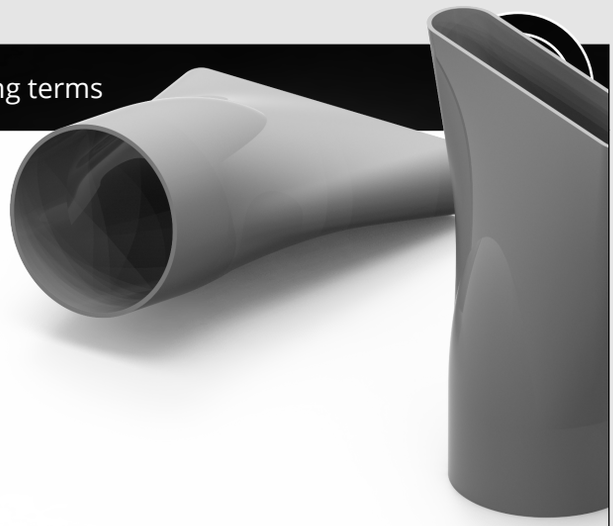
MODELLING TREE	LOFT	SUPPRESS
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk

ANSWER HERE!

Ensure you use correct CAD modelling terms



DRAWING PRINTED? ☐

RENDER PRINTED? ☐

TEACHER CHECKED? ☐

MIRROR LOFT!

Remember, the order you do things in is important. If you model things correctly, it becomes far easier and quicket to get what you are wanting. Consider how you can rotate, mirror or array features...

Curves do not have vertices for the computer to plot.
Describe how a computer is able to create 3D CAD models with curved surfaces in **lofted components**.

[4 MARKS]

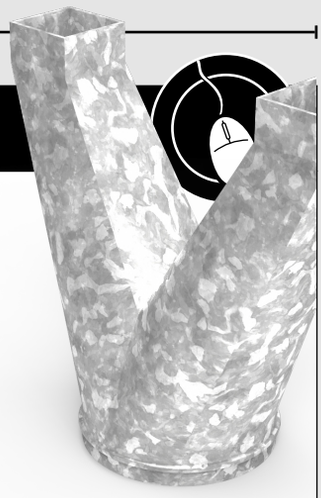
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

OUTPUT DEVICES	FEA	DATUM
[2 MARKS]	[2 MARKS]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
You must reference the sizes and geometry from the technical drawing. This can be found at DesignClass.co.uk



ANSWER HERE!

Ensure you use correct CAD modelling terms

DRAWING PRINTED?	RENDER PRINTED?	TEACHER CHECKED?
☐	☐	☐

TOP DOWN!

Lofts can create some complex forms. With this happening, it is important to understand how 'top-down' modelling can help you create assemblies that will work properly.

The 'Top-Down' approach to 3D CAD is the preferred method for creating complex models.
Explain the two approaches to 'Top-Down' modelling.

FROM PROJECTED COMPONENTS	FROM SOLID MODELS
[2 MARKS]	[2 MARKS]

DESCRIBE THESE!

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Describe the meaning of these terms in 3D CAD.

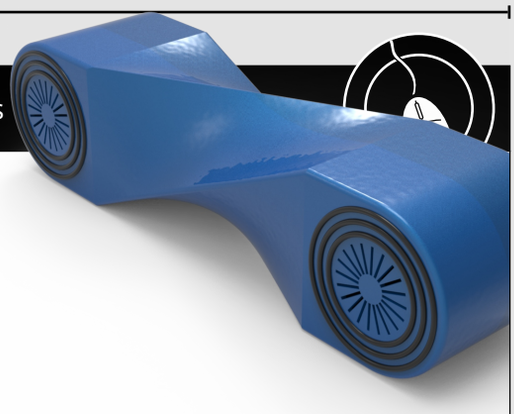
BOTTOM-UP MODELLING	CAD LIBRARY
[2 MARKS]	[2 MARKS]

MODEL THIS!

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ANSWER HERE!

Ensure you use correct CAD modelling terms



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☐	☐	☐

HELICE FEATURE!

Helices are a mix between revolve and sweep commands. A profile is rotated round an axis, whilst also changing in pitch. Typically it is used to model springs, it cannot also be used in more inventive ways.

Assemblies have a large range of possible command. You must know three particular commands.
Explain the following terms, used when creating assemblies.

MATE CONSTRAINT	ALIGN CONSTRAINT	CENTRE AXIS CONSTRAINT
[1 MARK]	[1 MARK]	[1 MARK]

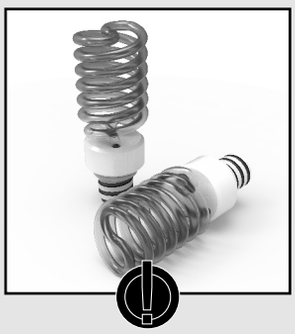
DESCRIBE THESE!

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Describe the meaning of these terms in 3D CAD.

HELICE	TAPER	PDF
[2 MARKS]	[2 MARKS]	[2 MARKS]

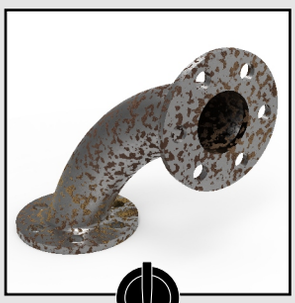
HELICE THESE!

There are six tasks in the 'helice' category. Three of these tasks are mandatory as they cover particularly important skills and processes. These are marked with a ◍. Use the list below to keep a record of which tasks you have completed.

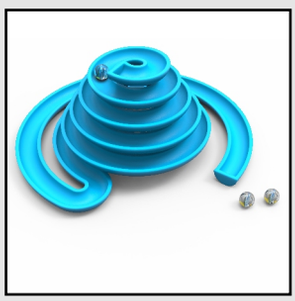












Helics make use of a 'pitch' value.
Describe the term pitch in relation to 3D CAD helices.

_____
_____
_____
_____
_____
_____

[2 MARKS]

CAD libraries are essential for many industries. Official CAD libraries can be expensive to purchase.
Explain why CAD libraries can be expensive and why companies will pay for them.

_____
_____
_____
_____
_____
_____[4 MARKS]

WIDER NARROWER!

Helices can also taper to get wider or narrower as required...

3D printing is a popular method for creating prototypes.
Describe the process of preparing a model for 3D printing, the printing process and any limitations.

[8 MARKS]



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Describe the meaning of these terms in 3D CAD.

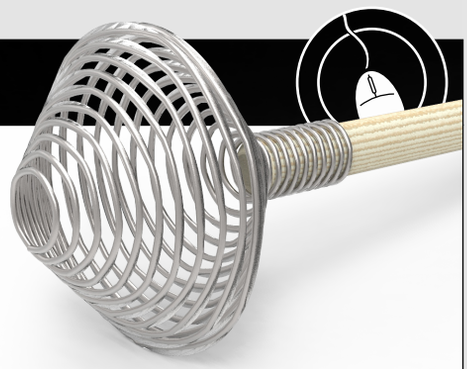
DXF	3DS	STEP/IGES
[1 MARK]	[1 MARK]	[1 MARK]

MODEL THIS!

Describe the 3D CAD techniques used to model the part shown below.
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ANSWER HERE!

Ensure you use correct CAD modelling terms



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☐	☐	☐

PARTIAL HELICE!

A helice does not need to rotate a full 360°. Rotating by a smaller angle can help generate more useful components.

Capturing 3D data through scanning can help in the modelling process.
Discuss 3D scanning, including the advantages and limitations of the process.



[8 MARKS]

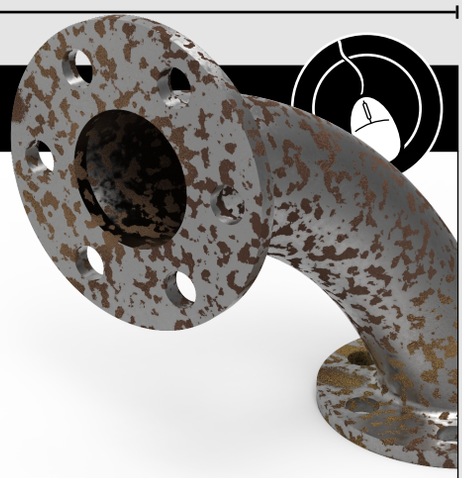
DESCRIBE THESE!

There are 62 terms you must understand as part of this course.
Describe the meaning of these terms in 3D CAD.

CAM	LINEAR ARRAY	BOX ARRAY
[2 MARKS]	[1 MARK]	[1 MARK]

MODEL THIS!

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ANSWER HERE!

Ensure you use correct CAD modelling terms

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TEACHER CHECKED? ☐

ONE WAY OR ANOTHER!

Now, can you combine helices and revolutions to make a component part? Can you make some helices turn clockwise and other counter-clockwise?

Multiple people can work on a CAD project simultaneously.
Describe any potential problems with multiple people working on the same CAD file.

[2 MARKS]

3D CAD is still used to create traditional, printed engineering drawings.
Describe the advantages paper-based drawings offer over digital solutions.

[2 MARKS]

DESCRIBE THESE!

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Describe the meaning of these terms in 3D CAD.

COMPONENT	ASSEMBLY	SUB-ASSEMBLY
[1 MARK]	[1 MARK]	[1 MARK]

MODEL THIS!

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ANSWER HERE!

Ensure you use correct CAD modelling terms

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☐	☐	☐



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