designclass
design | engineering | technology

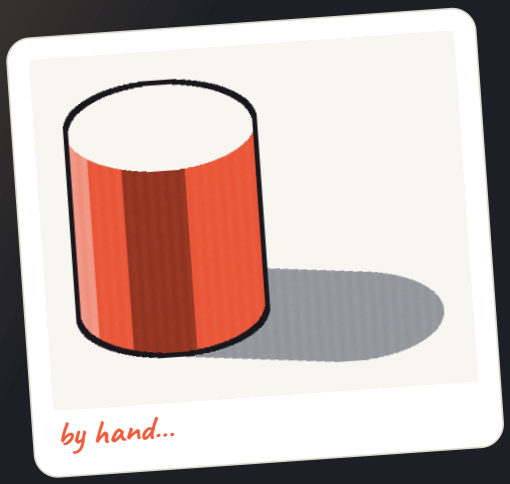
NATIONAL 5 · GRAPHIC COMMUNICATION

Render *it real.*

Light, tone and materials — by hand with pencil, spirit marker and pastel, and on screen with **RenderClass**.

...and on screen





COURSE NOTES

NAME

CLASS

INSIDE THIS BOOKLET

Six topics. *One idea:* light.

1 **Light, tone & materials** — Light source, highlight, tone, shade, shadow, reflection and how to show what things are made of. 03

2 **Pencil rendering** — Graphite and colour pencil: pressure, layering, hatching and burnishing. 10

3 **Spirit marker rendering** — Fast, bold, professional: layering, streaks, white space and cool-grey shadows. 14

4 **Pastel & mixed media** — Smooth gradients with pastel dust, eraser highlights, and mixing media together. 18

5 **RenderClass: materials & stickers** — Load a CAD model, paint it with real materials and add decals. 22

6 **RenderClass: camera, lights & studio** — Frame the shot, light it like a photographer and save a ray-traced render. 28

\+ **Rendering in the assignment & the exam** — Other software, what markers look for, exam questions, glossary and a final check. 34

WHAT IS RENDERING?

Rendering means adding colour, tone, texture and light to a drawing or CAD model so it looks **three-dimensional** and shows **what it is made of**. A rendered illustration lets anyone — not just designers — understand what a product will look like.

WHERE IT COUNTS

ASSESSMENT	RENDERING
Question paper 80 marks · 2 hours	Name and explain 3D CAD illustration techniques; why rendered graphics are used to promote products.
Assignment 40 marks · 8 hours	A 3D CAD **rendered** pictorial, and a **manual** rendered pictorial sketch.

LOOK OUT FOR

EXAM TIP

ASSIGNMENT LINK

TRY IT

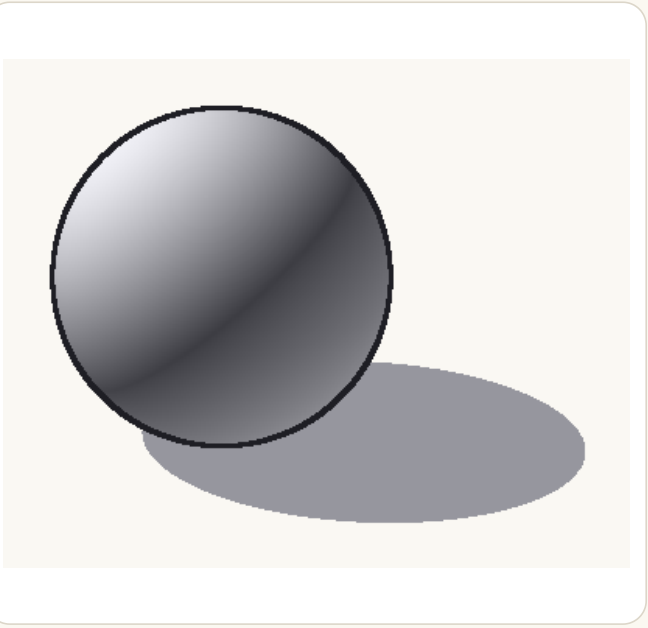
COMMON MISTAKE

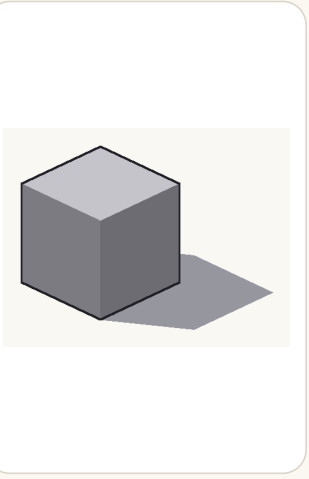
1

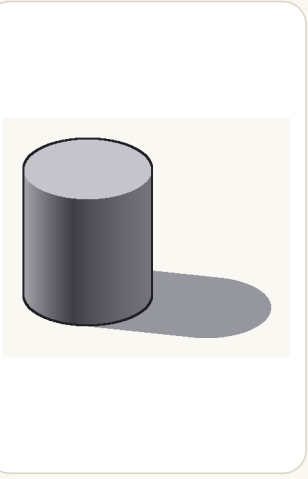
TOPIC 1

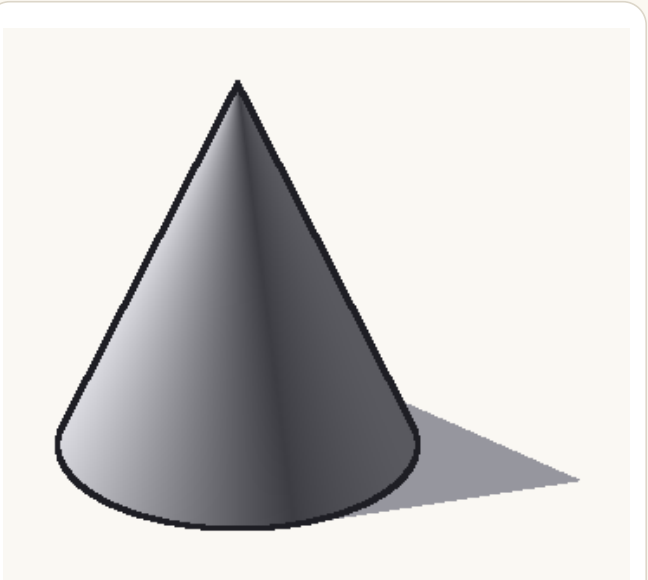
Light, *tone* & materials

Before you pick up a marker or open a CAD program you need to **see light**. Every rendering — by hand or on screen — is really a drawing of where light lands and where it does not.









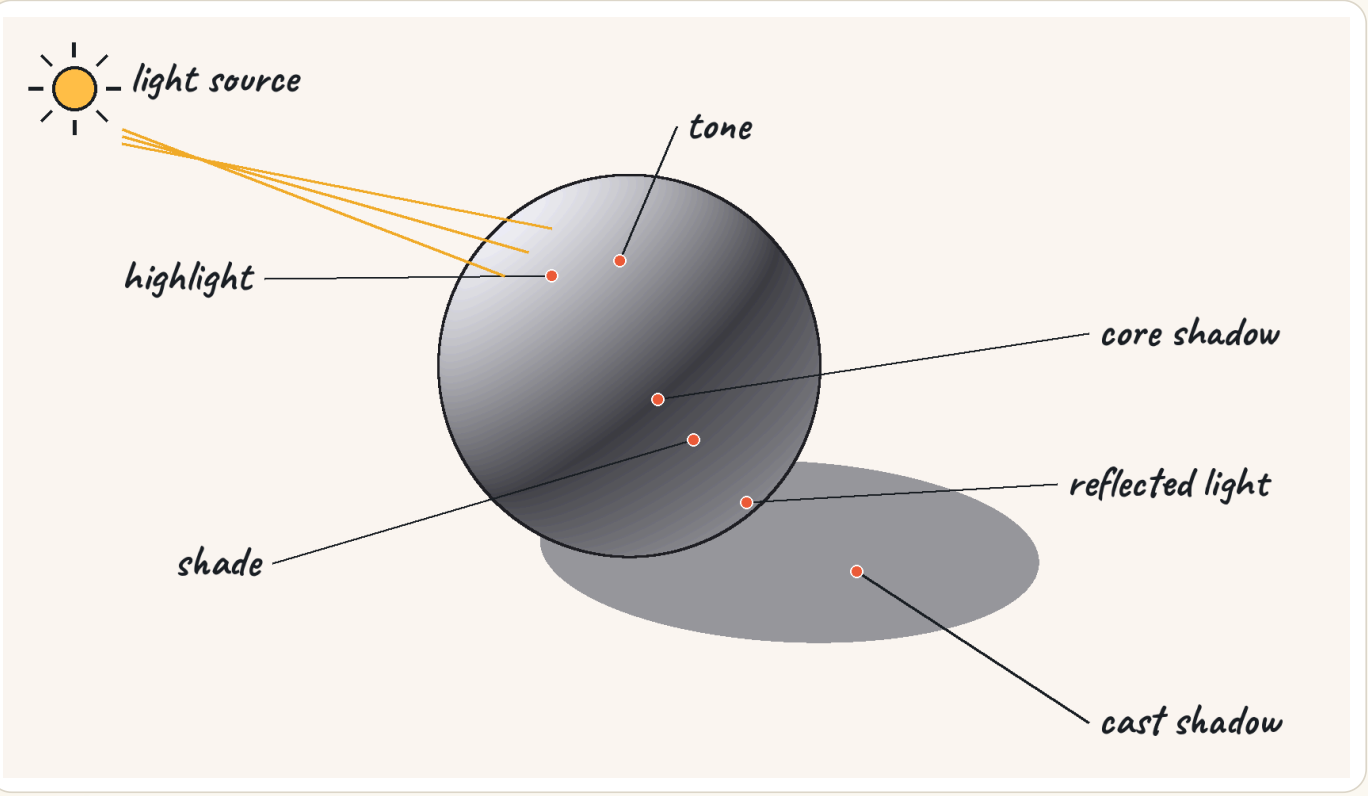
LEARNING INTENTIONS

- Identify the light source, highlight, tone, shade, shadow and reflection on an object.
- Use a tonal scale to show form on cubes, cylinders, spheres and cones.
- Recognise how metal, plastic, wood, glass and rubber are represented.
- Use the correct SQA terms to describe rendering.

1.1 · THE ANATOMY OF LIGHT

Six things light does to an object

Put one light above and to the left of a ball. Everything you need to render is already there — you just need the words for it.



Light source — where the light comes from. Choose it first and keep it the same for the whole drawing.

Highlight — the brightest spot, where light hits the surface most directly. On paper it is often the white of the page.

Tone — how light or dark a surface is. Tone changes gradually across curved surfaces and in steps on flat faces.

Shade — the darker side of the object, turned away from the light. The darkest band is the **core shadow**.

Shadow — the **cast shadow** the object throws onto the surface it sits on, always on the side away from the light.

Reflection / reflected light — light bouncing back from the ground or nearby objects. It lifts the edge of the shaded side, so never make the shaded side pure black.

EXAM TIP

The course specification lists **light, shade, shadow, reflection, tone, gradient, material and texture**. Learn these words exactly — they are what markers look for when you describe a rendering.

TRY IT · 5 MINUTES

Put a ball, a mug or a can under a desk lamp. Move the lamp round. Sketch where the highlight and the cast shadow go each time. **The shadow always moves the opposite way to the light.**

1.2 · TONE BUILDS FORM

Flat faces step, *curves glide*

Every product can be broken down into four **geometric forms**. Learn to render these and you can render almost anything — a flask is a cylinder, a torch is a cylinder and a cone, a speaker is a cylinder with a lid.

The tonal scale

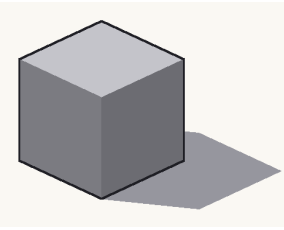
A tonal scale runs from the white of the paper to your darkest dark. Five steps is enough for most renderings.



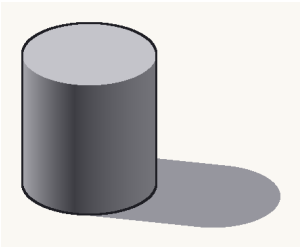
HIGHLIGHT LIGHT MID SHADE DARKEST

THREE RULES

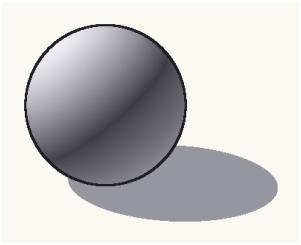
1. Faces pointing at the light are **lightest**.
2. Faces pointing away are **darkest** — but leave room for reflected light.
3. Flat faces get **one even tone each**; curved faces get a **smooth gradient**.



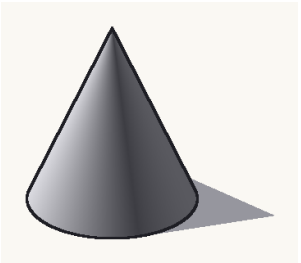
CUBE



CYLINDER



SPHERE



CONE

CUBE — THREE FACES, THREE TONES

Light from the top left: top face lightest, left face mid, right face darkest. If two faces end up the same tone the cube looks flat.

CYLINDER & CONE — BANDS

Tone changes in vertical bands. The darkest band sits just past the middle, then it lightens again at the far edge (reflected light). The highlight is a thin strip, not a spot.

COMMON MISTAKE

Changing the light direction halfway through — e.g. a highlight on the left but the cast shadow also on the left. Draw a small sun and arrow in the corner of your page before you start.

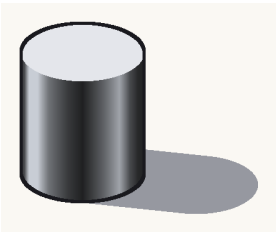
ASSIGNMENT LINK

Your manual rendered sketch is judged on how well it shows **light, shade, shadow, tone** and the **material**. A consistent light source is the quickest way to make it look convincing.

1.3 · MATERIALS & TEXTURE

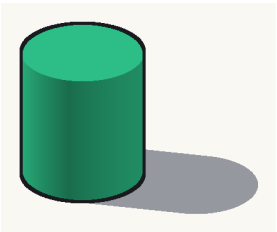
Show what it's *made of*

The same cylinder can look like a steel flask, a plastic bottle or a glass jar. What changes is **contrast** (how big the jump is between light and dark), the **shape of the highlight**, and the **texture**.



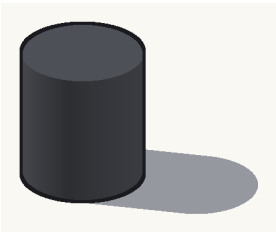
Metal

Very high contrast. Sharp bands of near-black next to pure white, because metal reflects its surroundings. Hard edges between bands.



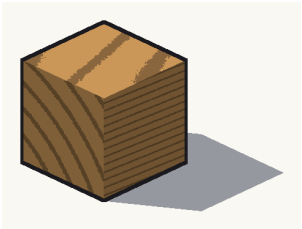
Glossy plastic

One strong colour, a smooth gradient and a crisp white highlight. Fewer, softer bands than metal.



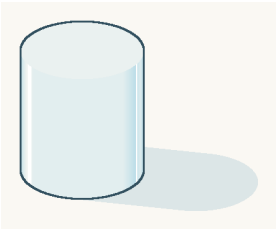
Rubber / matt

Even, dark tone and no bright highlight. Matt surfaces scatter light so there are no sharp reflections.



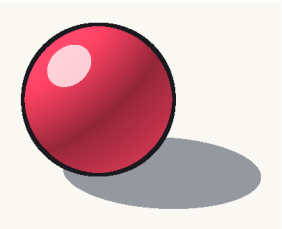
Wood

Base colour first, then grain lines with a darker pencil or fineliner. Long grain runs along the length; end grain shows growth rings.



Glass / clear acrylic

Mostly the colour of the background. Show the edges with a tinted line, add thin white highlight streaks, and let the far edges show through.



Polished surfaces

A small, sharp highlight close to the light source plus reflected light at the opposite edge.

MATERIAL VS TEXTURE

Material is what the object is made from (aluminium, ABS, oak). **Texture** is the surface quality you can see or feel — wood grain, brushed lines, knurling, a matt or gloss finish. A good rendering shows both.

EXAM TIP

"How has the illustrator made the bottle look like metal?" — talk about **high contrast tones, sharp highlights and reflections**. Just writing "colour" will not get the mark.

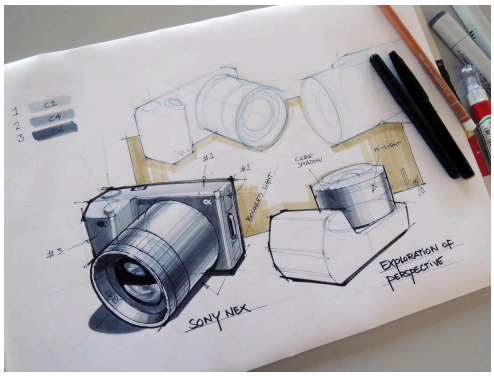
1.4 · WHY RENDER AT ALL?

Rendering *sells* ideas

Designers render at every stage of a project. Quick marker renders help a team choose between concepts. A polished 3D CAD render goes on the box, the website and the advert — often **before the product has even been manufactured**.

WHY A RENDERED ILLUSTRATION WORKS FOR PROMOTION

- It looks **realistic**, so customers can picture owning it.
- It shows the **materials, colours and textures** of the product.
- It is easily **understood by non-specialists** — no technical drawing knowledge needed.
- Products can be shown in different colourways or settings without making them.



Concept render of a camera: marker, fineliner and white highlights on layout paper.

RENDERED VS LINE DRAWING

	ADVANTAGE	DISADVANTAGE
Rendered illustration	Realistic; shows materials, colour and finish.	Costs more to print in colour; shadows can hide some details.
Exploded / line drawing	Shows how parts fit together; clear details.	Less realistic; harder for a customer to picture the finished product.

EXAM TIP

Answers like **"it shows what it looks like"** or **"it looks good"** are **not** accepted. Say *what* it shows: materials, colour, texture, realism.

CHECK YOUR UNDERSTANDING · TOPIC 1

1 Name the part of a rendering that shows where light bounces back onto the shaded side of an object. — 1 mark

2 Explain how the tone on a cylinder differs from the tone on a cube. — 2 marks

3 Describe two ways an illustrator could make a cylinder look like polished metal. — 2 marks

YOUR TURN · TOPIC 1

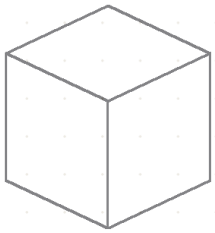
Light *lab*

You need an HB and a 2B pencil. Check the sun in the corner of each box before you start.

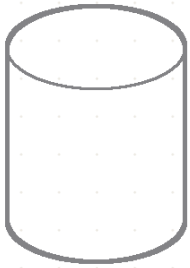
TASK 1 Shade each form for its light source

Use three different tones on the cube, a smooth gradient on the curved forms, leave the highlight as white paper and add a cast shadow on the side away from the light.

CUBE



CYLINDER



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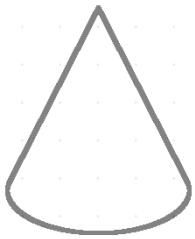


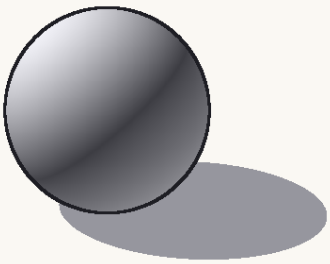
TASK 2 Build a five-step tonal scale

Same HB pencil all the way — change only the pressure and the number of layers.

1 · highlight | 2 · light | 3 · mid | 4 · shade | 5 · darkest

TASK 3 Which way is the light?

3 marks



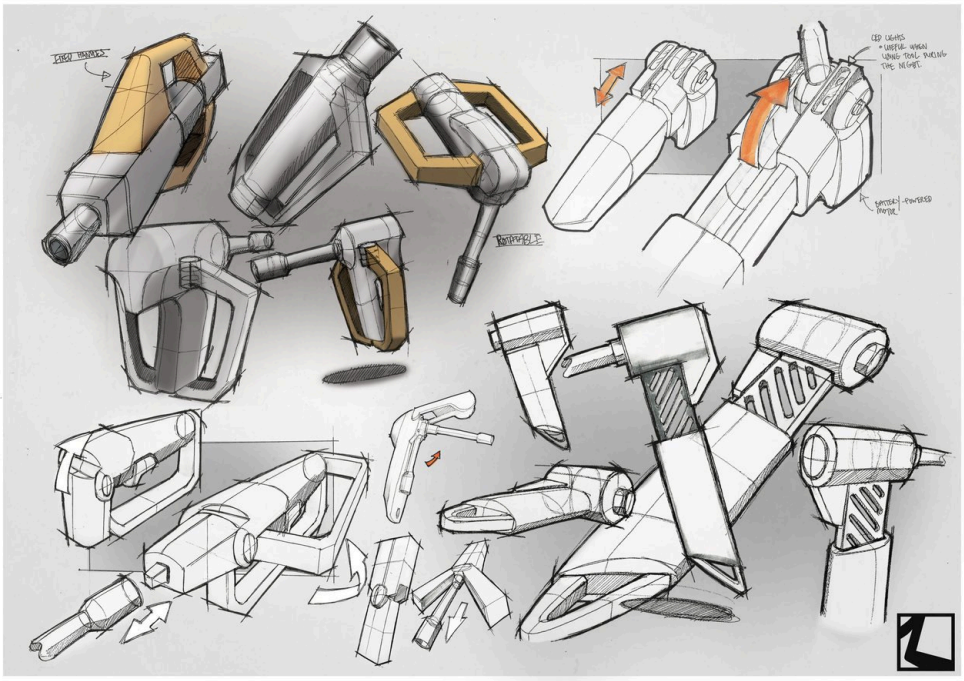
a State where the light source is. 1

b Give two clues in the drawing that tell you this. 2

YOUR TURN · TOPIC 1

Read a designer's *render*

Professional designers use exactly the same rules you have just practised. Study this concept render of a power tool, then answer the questions.



TASK 4 Analyse the render

8 marks

a Describe how the designer has shown that the chuck (the front of the drill) is **metal**. 2

b Describe how the designer has shown that the grip is **rubber or matt plastic**. 2

c Explain why the designer has left some edges as **white paper**. 1

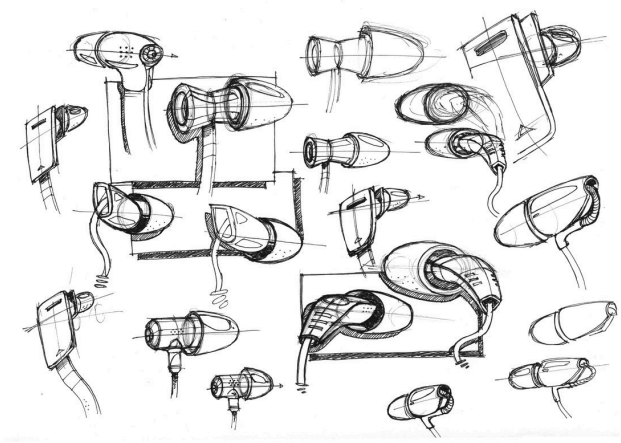
d Name three rendering terms from Topic 1 that you can see on this page, and say where. 3

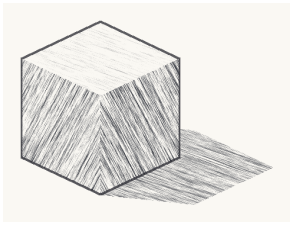
2

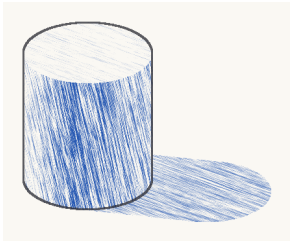
TOPIC 2

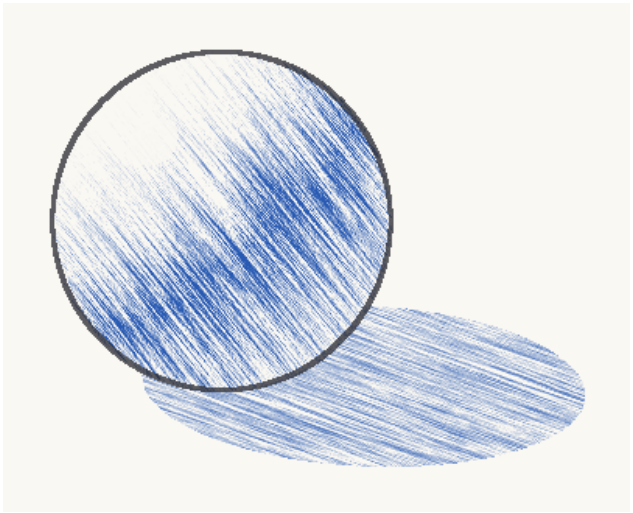
Pencil *rendering*

Pencil is the most controllable medium you own. With nothing more than pressure and patience you can build a full tonal range — and colour pencils add the material.









LEARNING INTENTIONS

- Select pencil grades for light and dark tones.
- Build tone with pressure, layering, hatching and cross-hatching.
- Render a cylinder and a cube with a consistent light source.
- Add colour and texture with colour pencils.

2.1 · KIT & TECHNIQUES

Pressure is *your dimmer switch*

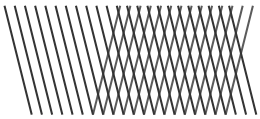
KIT LIST

2H–HB	Hard leads: light construction lines and pale tones.
2B–6B	Soft leads: rich darks, shade and shadow.
Colour pencils	Layered for material colour; a white pencil adds highlights on tinted paper.
Putty rubber	Lifts graphite to pull out highlights.
Fineliner	Crisp outlines (thick for outside edges, thin for inside edges).

FOUR TECHNIQUES



Hatching
Parallel lines. Closer lines = darker tone.



Cross-hatching
Second layer at an angle for the dark side.



Smooth blending
Light, even pressure in small circles; build up slowly.



Layering & burnishing
Light layers of colour on top of each other; press hard at the end to polish.

TRY IT

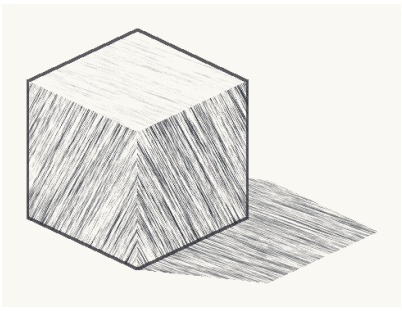
Draw a 5-box tonal scale using one HB pencil and only changing pressure. Then do it again with a 2B. Which reaches a darker dark?

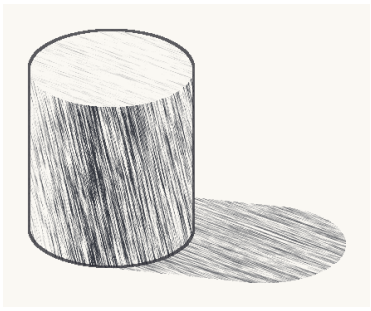
COMMON MISTAKE

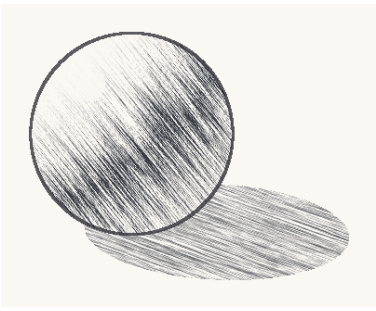
Pressing hard straight away. Dark graphite is shiny and hard to rub out — build tone in light layers and keep the darkest pressure until last.

DIRECTION OF STROKES

Let your strokes follow the form. On a **cylinder**, run them along its length. On a **cube**, change direction for each face so the faces read as separate planes. On a **sphere**, use one direction and let pressure do the work.



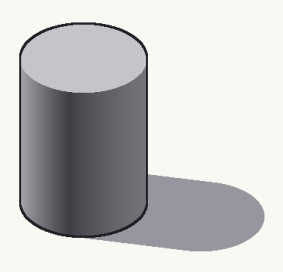




2.2 · STEP BY STEP

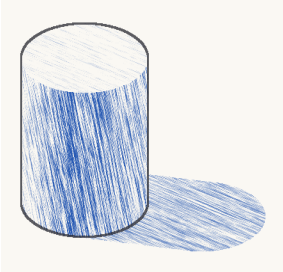
Render a *colour pencil* cylinder

1 Plan the light



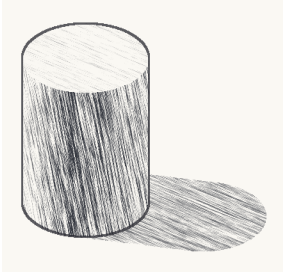
Lightly draw the outline. Mark the light source with a small sun and arrow. Decide where the highlight strip and cast shadow will go.

2 First layer



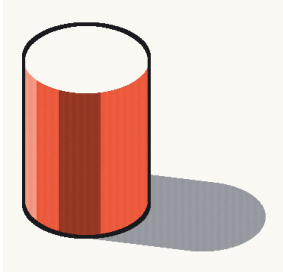
Light, even layer of the base colour over the whole side, leaving the highlight strip as white paper.

3 Build the shade



Add more layers on the side away from the light. Use a darker colour (not black) for the core shadow.

4 Finish



Lighten the far edge for reflected light. Add the cast shadow. Go over the outline with a fineliner.

COLOUR PENCIL TIPS

- Use **two or three pencils of the same colour family**: a light, a mid and a dark.
- For shade, add the **complementary colour** or a dark blue rather than black — black makes colours muddy.
- The top face of a cylinder (an ellipse) is usually the lightest surface.
- Wood grain: base colour first, then grain lines with a sharp dark brown pencil.

ASSIGNMENT LINK

Markers look for rendering that shows the **material** clearly. Using only one colour with no change in tone limits the marks you can get.

TRY IT

Render the same cylinder twice: once as **wood** and once as **red plastic**. Swap with a partner — can they tell which is which without being told?

CHECK YOUR UNDERSTANDING · TOPIC 2

1 State why an illustrator would use a 2H pencil and a 4B pencil on the same rendering. 2 marks

2 Describe how cross-hatching is used to show the darker side of an object. 1 mark

YOUR TURN · TOPIC 2

Pencil *practice*

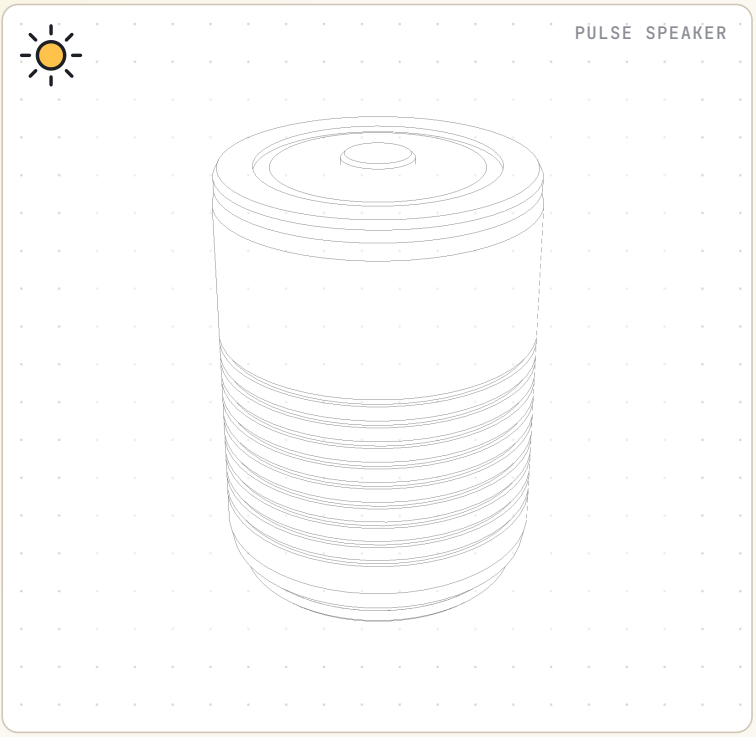
Use a 2H for light tones and a 2B or 4B for dark. Colour pencils are optional for Task 2.

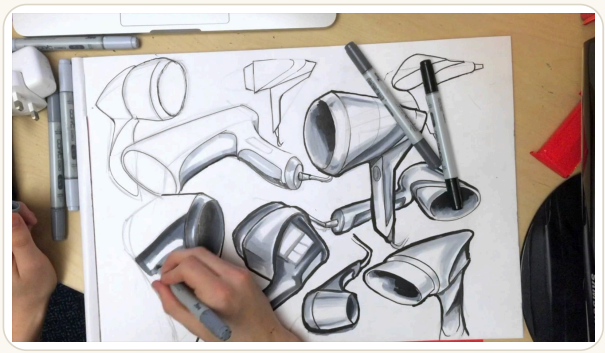
TASK 1 Four technique swatches

Hatching | Cross-hatching | Smooth blending | Layering + burnishing

TASK 2 Render the Pulse speaker

The light is top left. Render the body as **matt**, the top ring as **polished metal** (high contrast bands) and the rubber foot as a flat dark tone. Strokes follow the form.





Pencil and grey-marker concept sheet for a hairdryer.

a Describe how the designer of this hairdryer has used tone to make the sketches look 3D. 2

TASK 3 Check yourself

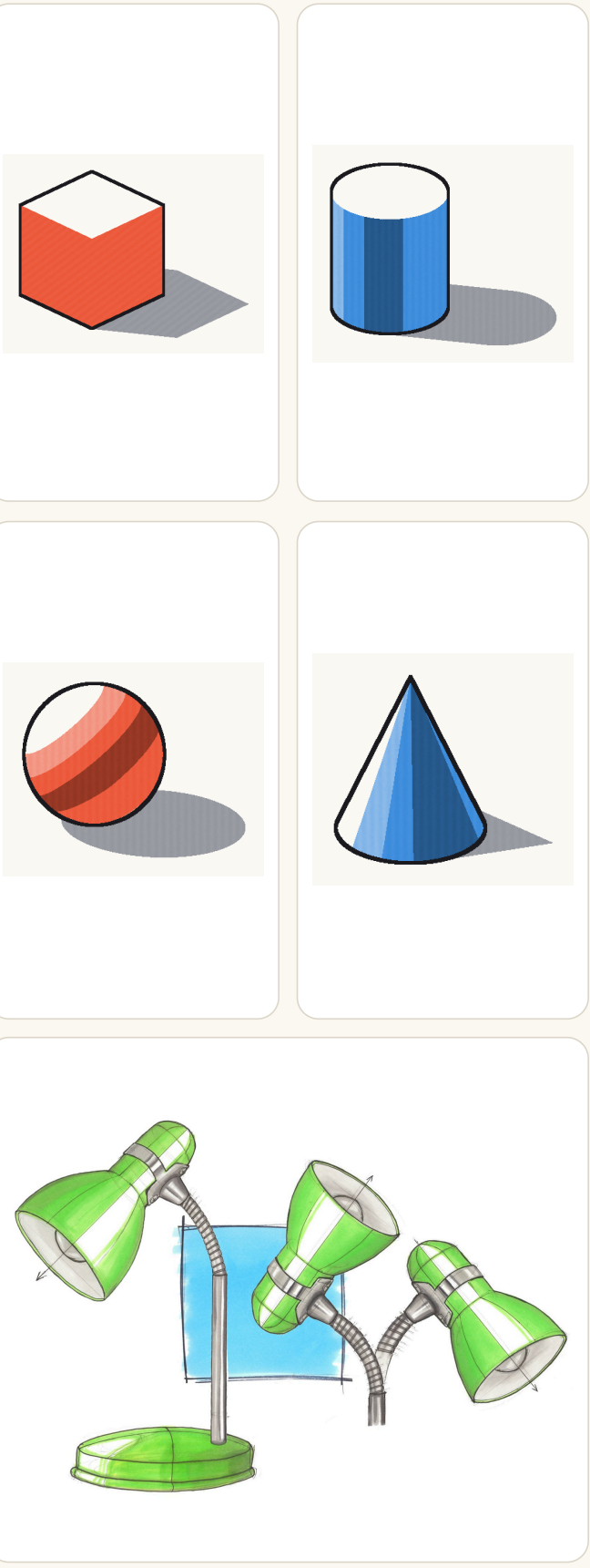
- ☐ My light source is the same on every part.
- ☐ I used at least three tones.
- ☐ My strokes follow the form.

3

TOPIC 3

Spirit *marker* rendering

Spirit (alcohol-based) markers are what product designers use for fast, bold concept renders. They dry in seconds, layer cleanly and give a confident, professional look.



LEARNING INTENTIONS

- Describe the equipment used for marker rendering.
- Build tone by layering marker passes.
- Use white space and white highlights for shine.
- Render metal, plastic, wood and glass with markers.

3.1 · KIT & TECHNIQUES

Layer it, *don't scrub it*

KIT LIST

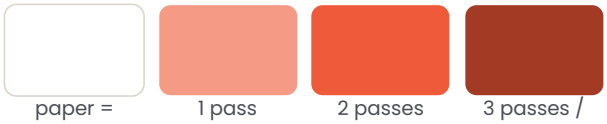
Spirit markers	Alcohol-based, transparent ink. Chisel nib for areas, fine/bullet nib for edges.
Cool greys	Shading and cast shadows (e.g. Cool Grey 2, 4, 6).
Marker / layout paper	Smooth and bleed-proof, so edges stay crisp.
White gel pen / white pencil	Sharp highlights added at the end.
Fineliner & ruler	Outlines; a ruler or masking paper keeps edges straight.

COMMON MISTAKE

Going over wet ink again and again. It makes blotches and can tear the paper. Let each layer dry (a few seconds) before the next pass.

HOW MARKER TONE WORKS

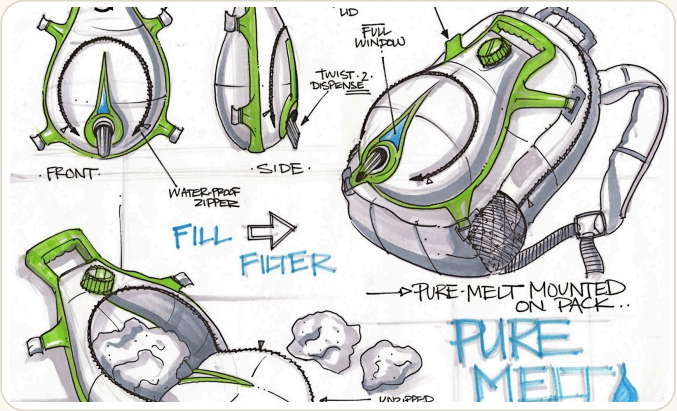
Spirit marker ink is **transparent**. Each pass of the **same** marker makes the colour darker. So instead of pressing harder you build tone in **layers**:

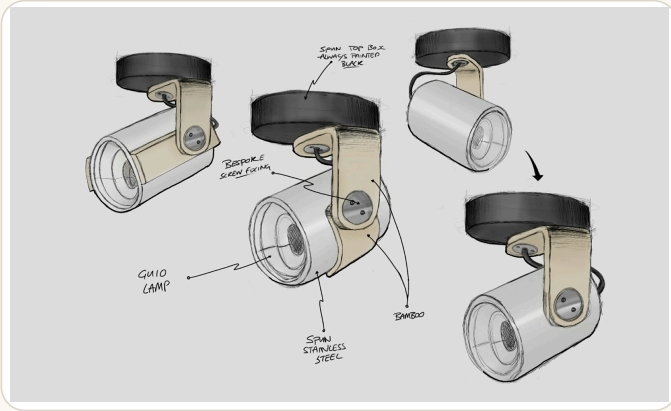


paper = highlight | 1 pass | 2 passes | 3 passes / darker marker

FIVE TECHNIQUES

1. **Flat fill** — quick, overlapping strokes in one direction while the ink is wet.
2. **Streaking** — fast strokes that leave gaps, giving a glossy feel.
3. **White space** — leave the paper bare for the brightest highlights.
4. **Graded tone** — extra passes towards the shaded edge.
5. **Cast shadow** — cool grey, on the opposite side from the light.





Marker concept sheets: bold outlines, two or three tones per colour, and white paper kept for the highlights.

3.2 · STEP BY STEP & MATERIALS

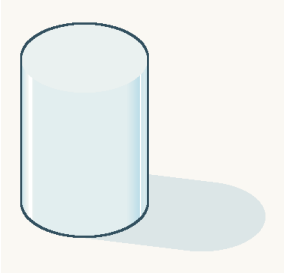
Marker a *metal flask*

1 Outline



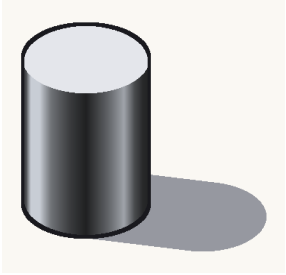
Light pencil or fineliner outline. Mark the light source. Plan vertical bands on the cylinder.

2 Light greys



Fill the body with the lightest cool grey, leaving a white strip on the light side.

3 Dark bands



Add sharp dark bands with a darker grey or black. Metal needs **high contrast** and crisp edges.

4 Details



Rubber band: flat dark grey, no highlight. Lid: glossy black with a white streak. White gel pen for sparkle.

MARKER MATERIALS CHEAT SHEET

MATERIAL	MARKER RECIPE
Metal	Greys + black in sharp vertical bands; white paper strips; very high contrast.
Gloss plastic	One colour, two passes for shade, crisp white highlight.
Matt plastic / rubber	Even flat colour, gentle shade, no sharp highlight.
Wood	Light tan base, darker brown grain lines while still damp for a soft look.
Glass / acrylic	Mostly paper; pale blue-grey edges; white highlight streaks; show the parts behind.

EXAM TIP

If you are asked how the designer made a product look **glossy**, mention the **highlights** and **reflections** — and where they are in relation to the **light source**.

ASSIGNMENT LINK

Markers are ideal for the assignment's manual rendered pictorial sketch: they are quick, so you can spend your time on accuracy and showing the material.

CHECK YOUR UNDERSTANDING · TOPIC 3

1 Explain how a darker tone is created with a single spirit marker. 1 mark

2 State two items of equipment, other than markers, used in marker rendering and what each is used for. 2 marks

YOUR TURN · TOPIC 3

Marker *practice*

Spirit markers on layout paper. Let each layer dry before the next pass.

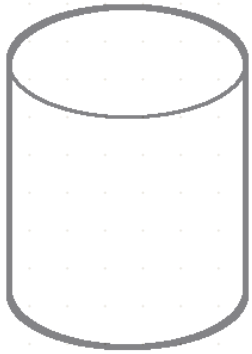
TASK 1 Layer test — one marker only

paper (no ink) | 1 pass | 2 passes | 3 passes

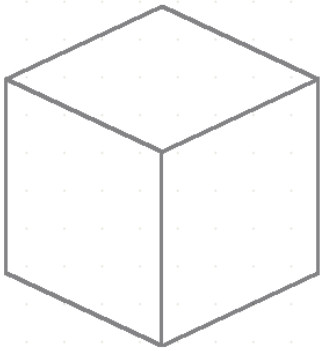
TASK 2 Two materials, one light

Render the cylinder as **polished metal** (greys and black in sharp vertical bands) and the cube as **wood** (tan base, grain added while damp). Light top left; cool-grey cast shadows.

METAL

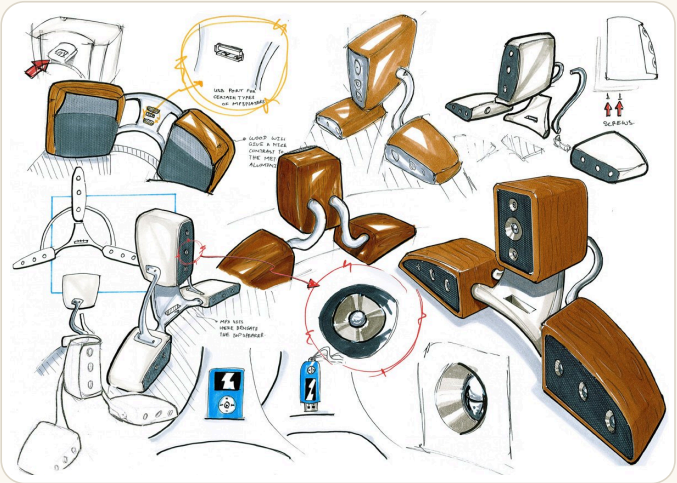


WOOD



TASK 3 Learn from a professional

5 marks



a Name two materials the designer has shown and describe how each one has been rendered. 4

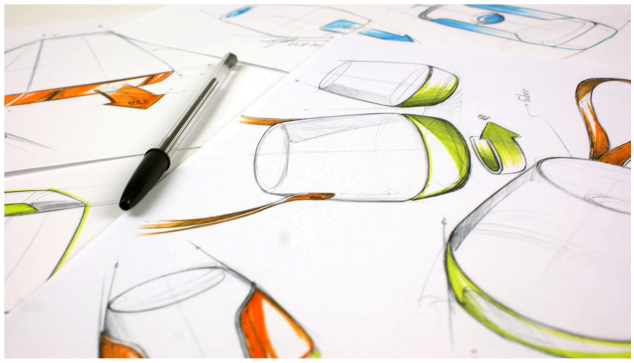
b State why marker is a good choice for this kind of concept sheet. 1

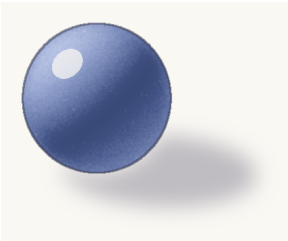
4

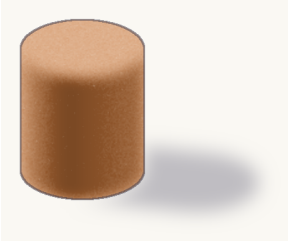
TOPIC 4

Pastel & *mixed media*

Soft pastel gives the smoothest gradients of any manual medium — perfect for large curved surfaces like car bodies, bottles and helmets. Mix it with marker and pencil and you have the designer's full toolkit.







soft gradients, eraser highlights, no harsh lines

LEARNING INTENTIONS

- Prepare and apply pastel to create smooth gradients.
- Use masks and an eraser to control edges and highlights.
- Combine pastel with marker, pencil and white highlights (mixed media).
- Choose the best medium for a task.

4.1 · PASTEL TECHNIQUE

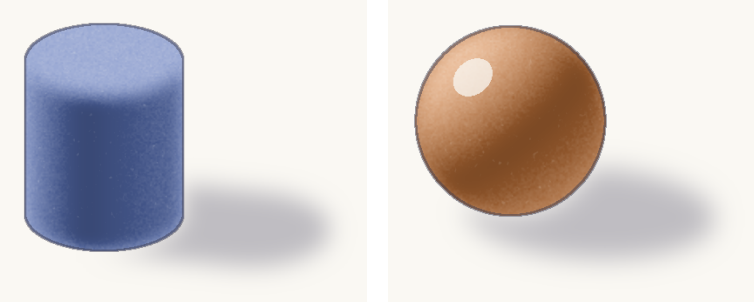
Scrape, rub, *lift*

1 Make dust
Scrape a soft (chalk) pastel stick with a craft knife or sandpaper to make a little pile of powder.

2 Mask
Cover areas you want to stay clean with paper or low-tack masking tape.

3 Rub on
Pick up dust with cotton wool or tissue and rub it on in small circles. Build up towards the shaded side.

4 Lift & fix
Use a clean eraser to lift out highlights. Spray with fixative so it does not smudge.



Pastel gradients on a cylinder and sphere. The highlights were lifted out with an eraser.

WHY PASTEL?

- Very smooth, even gradients over large areas.
- Easy to correct — lift it off with an eraser.
- Great base layer for **mixed media**.

COMMON MISTAKE

Using the pastel stick directly on the paper. It leaves streaky lines — always apply pastel as dust.

MIXED MEDIA — THE DESIGNER'S COMBO

1 · Pastel
Smooth base gradient over the whole form.

2 · Marker
Strong colour and darks in the shaded areas and details.

3 · Pencil / fineliner
Crisp edges, texture and outlines.

4 · White
Gel pen or white pencil for the sharpest highlights.

EXAM TIP

The course specification lists **pencils, markers, pastels, inks and airbrush** as rendering media, and says it is important to develop skills in **mixed media**.

TRY IT

Render a sphere with pastel only, then add marker in the core shadow and a gel-pen highlight. Which looks more three-dimensional?

4.2 · CHOOSING A MEDIUM

Which tool, *when?*

MEDIUM	BEST FOR	STRENGTHS	LIMITATIONS
Graphite pencil	Quick tonal studies; early ideas	Cheap, controllable, easy to correct	No colour; can smudge; slow for big areas
Colour pencil	Detailed renders; textures such as wood grain	Fine detail; layers and blends well	Slow to cover large areas; colours can look pale
Spirit marker	Fast concept renders; presentation sketches	Bold, clean, professional; dries fast; transparent layers	Expensive; mistakes are hard to fix; can bleed
Pastel	Large smooth curves; backgrounds	Smoothest gradients; erasable highlights	Messy; needs fixative; poor at fine detail
Mixed media	Final presentation renders	Best of every medium	Takes longer to plan and finish



A designer's sketchbook: fineliner ideas with marker colour added to the best ones.

MANUAL RENDERING CHECKLIST

1. One light source, marked on the page.
2. Highlights left white (or added with white).
3. At least three tones on each form.
4. Shade on the side away from the light.
5. Cast shadow on the surface the object sits on.
6. Material shown by contrast, highlight shape and texture.
7. Clean outline — thick outside edges, thin inside edges.

CHECK YOUR UNDERSTANDING · TOPIC 4

1 Describe how highlights are created when rendering with pastel. 1 mark

2 Give one advantage and one disadvantage of pastel compared with spirit marker. 2 marks

YOUR TURN · TOPIC 4

Pastel & *mixed media*

Scrape the pastel to dust first. Mask the edges with paper or low-tack tape.

TASK 1 Masked gradient strip

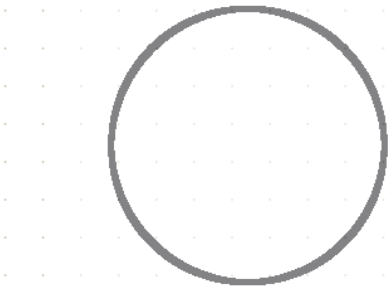
Mask the top and bottom edges. Rub the pastel on from dark (left) to light (right) with cotton wool, then peel the masks off for crisp edges.

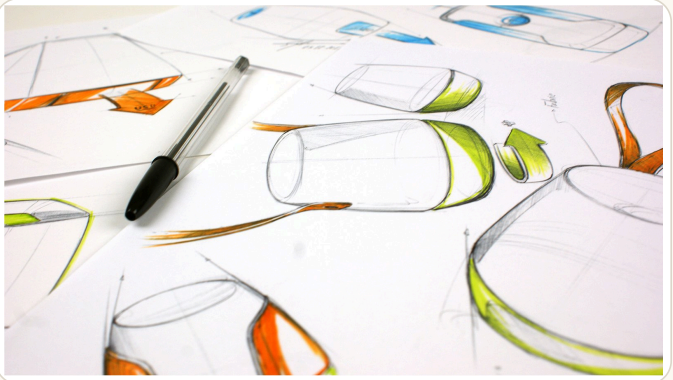
DARK → LIGHT

TASK 2 Pastel sphere with an eraser highlight



SPHERE





a This concept sheet uses mixed media. Suggest which media were used and give evidence from the image. 2

TASK 3 Choose the medium

3 marks

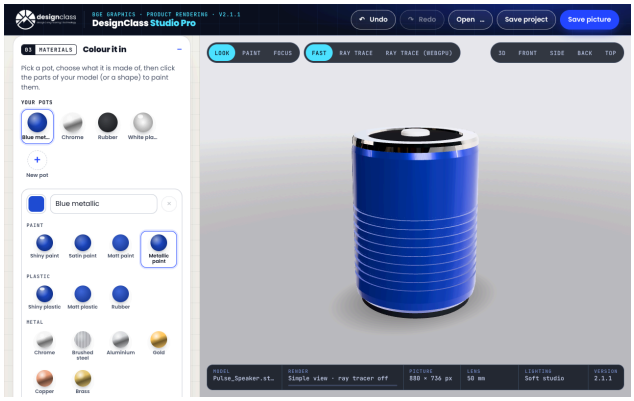
JOB	BEST MEDIUM AND WHY
Ten quick concept ideas in a 20-minute client meeting	
A large, smooth, glossy car body for a presentation board	
Fine wood grain on a small jewellery box	

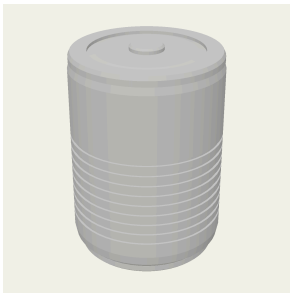
5

TOPIC 5

RenderClass: *materials* & stickers

3D CAD rendering turns a grey model into something that looks like a photograph. **RenderClass** runs in your browser: load a STEP file from Fusion, Inventor or Onshape, paint it with real materials, add stickers and save a ray-traced picture.







plain CAD model → materials → (next: light it & ray trace)

OPEN THE APP

detscotland.co.uk/RenderClass

Chrome or Edge · nothing is uploaded — it all runs on your computer

LEARNING INTENTIONS

- Describe the stages of producing a 3D CAD rendered illustration.
- Load a STEP model and set it the right way up.
- Apply materials to parts and faces.
- Add a sticker (decal) for logos and graphics.

5.1 · THE 3D CAD RENDERING PROCESS

From grey model *to photo*

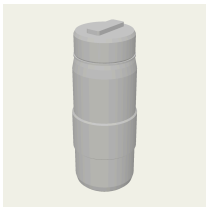
STAGE 1
Model
Build the 3D CAD model and export it (STEP).

STAGE 2
Materials
Apply a material to each part: metal, plastic, glass, wood.

STAGE 3
Textures & decals
Add surface texture (grain, brushed finish) and stickers/logos.

STAGE 4
Lighting
Set the light source(s) and the environment so the model has highlights, shadows and reflections.

STAGE 5
Camera & render
Choose the view, then ray trace and save the image.



A · NO MATERIALS



B · MATERIALS APPLIED



C · LIGHTING + RENDER

EXAM TIP · VERY IMPORTANT

When asked to **name the 3D CAD illustration techniques** used, the accepted answers are **material**, **texture** and **light source / lighting**.

"Colour", "highlights" and "shadows" on their own are **not** accepted — highlights and shadows are what you get *because* you added lighting and materials.

WHAT IS RAY TRACING?

The computer follows rays of light from the camera into the scene and bounces them off every surface. This makes realistic **shadows, reflections and transparency**. The more **passes** it does, the less grainy the picture.

RENDERCLASS AT A GLANCE — NINE NUMBERED CARDS DOWN THE LEFT

01	02	03	04	05	06	07	08	09
Start	Shapes	Materials	Stickers	Camera	Lights	Studio	Save	Explore

Above the picture: **Fast** (quick preview while you set up), **Ray trace** (the real render) and **Ray trace (WebGPU)** (a back-up ray tracer). The top bar has **Undo**, **Redo**, **Open**, **Save project** (.dcstudio) and **Save picture** (PNG).

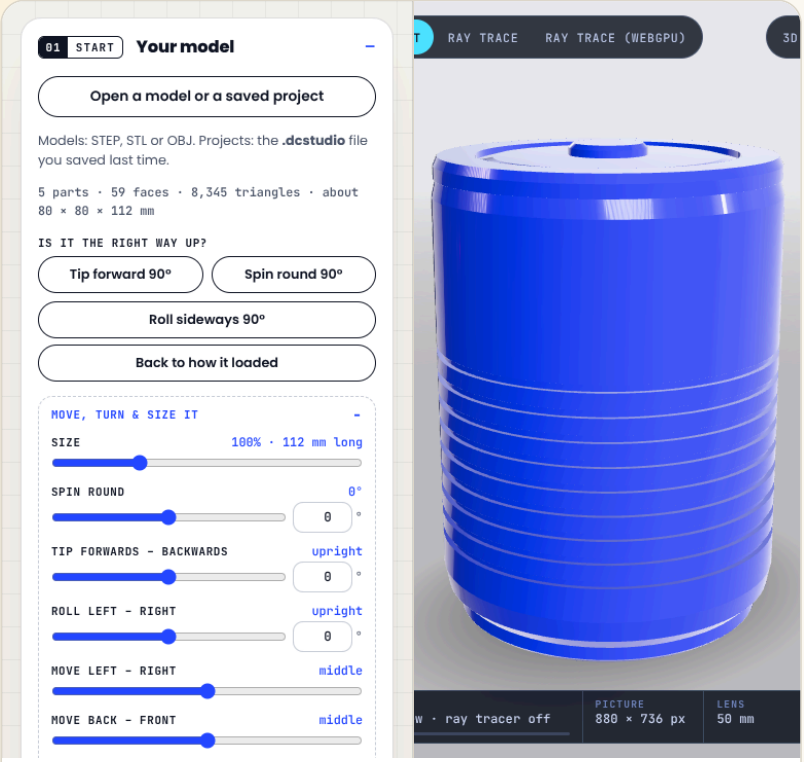
WHAT THE EXAMINERS SAID

2025 course report: many candidates answered "colour", "highlights" or "shadows" when asked to name 3D CAD illustration techniques. Only **materials, textures and light source** were accepted — highlights and shadows are *by-products* of applying lighting and materials.

2023 & 2024 course reports: most candidates could not correctly name the CAD illustration techniques. This is one of the easiest marks on the paper once you know the three words.

5.2 · CARDS 01 & 02 — LOAD YOUR MODEL

Load it, *stand it up*



The Pulse speaker STEP file loaded into RenderClass (Fast view).

1. In Fusion, Inventor or Onshape, export your model as a **STEP** file (.step or .stp). STL and OBJ also work.
2. Open **detscotland.co.uk/RenderClass** and drop the file on the page, or click **Open**.
3. If it is lying on its side, use **Tip forward 90°**, **Spin round 90°** or **Roll sideways 90°**.
4. **Move, turn & size it** has sliders for size, angle and position. The model always sits on the floor.

02 SHAPES — STANDS & PROPS

Add a **cube, cylinder, cone or sphere** to stand your model on or place beside it. Give it a material in **Made of**, then use **Stand my model on it**. A simple plinth makes a product look like it is in a shop display.

SAVE YOUR WORK

Save project saves a **.dcstudio** file with your model, materials, stickers, lights and camera, so you can carry on next lesson. Keep it in your OneDrive.

TRY IT

Download **Pulse_Speaker.step** from the DesignClass N5 Rendering page and load it. Try each “right way up” button, then **Back to how it loaded**.

COMMON MISTAKE

Exporting the wrong file type. A Fusion **.f3d** or Inventor **.ipt** will not open — export a **STEP**.

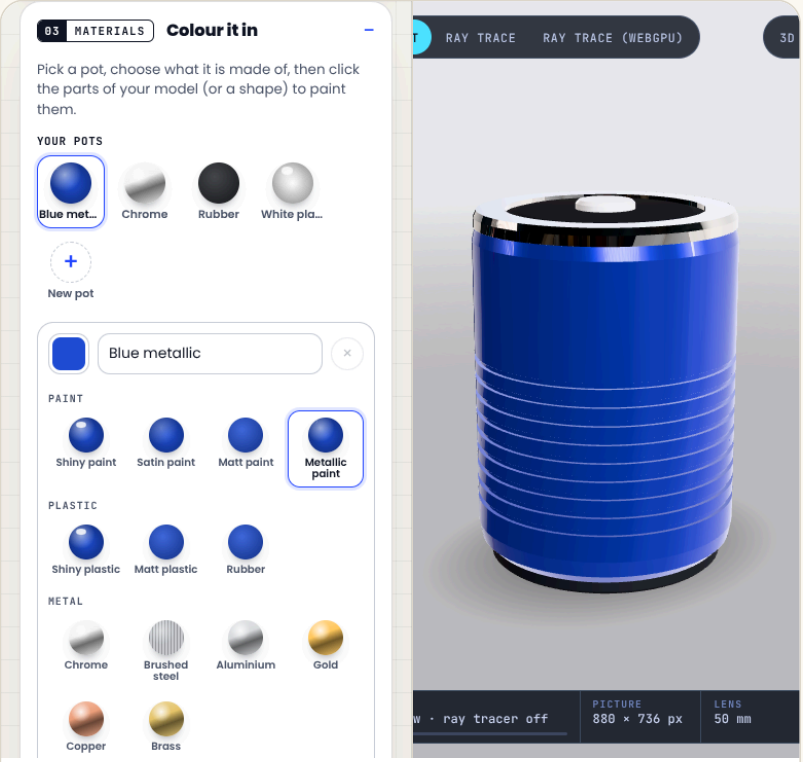
5.3 · CARD 03 — MATERIALS

Paint pots, *real materials*

Materials are kept in **pots** (up to 12). Each pot has a **colour** and is **made of** a material:

FAMILY	MATERIALS
Paint	Shiny, satin, matt, metallic
Plastic	Shiny, matt, rubber
Metal	Chrome, brushed steel, aluminium, gold, copper, brass
Acrylic & glass	Clear, coloured, frosted acrylic; glass
Wood	Oak, pine, mahogany, beech, MDF — with real grain
Glowing	Glow (LED), lamp shade, screen

Painting: choose **A whole part**, **One face** or **Everything**, click **Paint: click the model**, then click the part you want to paint.



Four pots: blue metallic paint, chrome, rubber and white plastic.

CHOOSING MATERIALS WELL

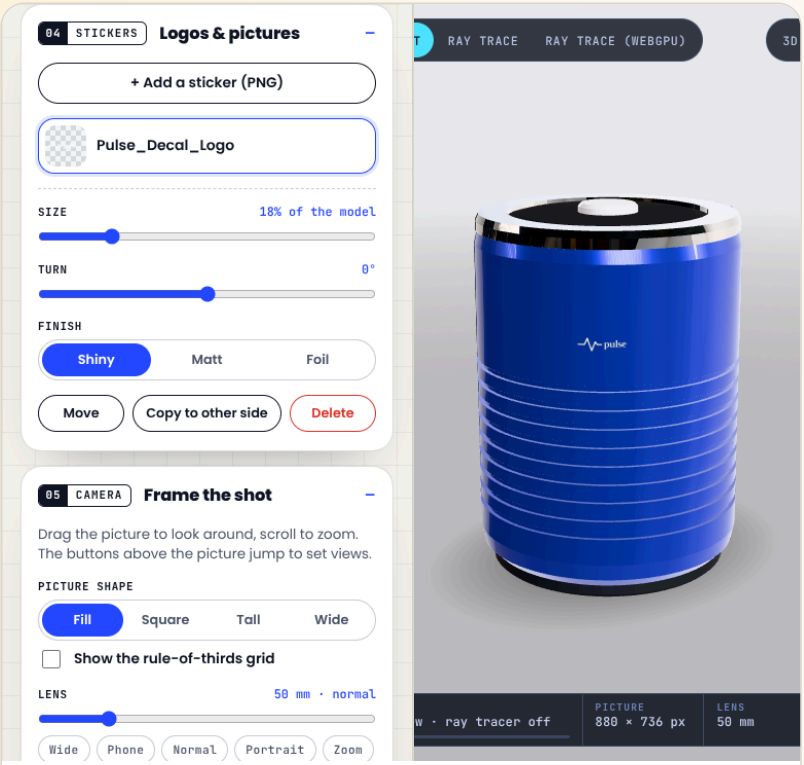
- Match the material to how the product would really be **manufactured** — injection-moulded parts are plastic, a flask body is stainless steel.
- Use **contrast**: a matt rubber grip next to shiny metal makes both stand out.
- Glass and acrylic need more **light bounces** (card 08) to look right.

ASSIGNMENT LINK

Your 3D CAD rendered pictorial is credited for **suitable materials** and for **appropriate lighting / highlights / shadows** in a pictorial view. Pick materials that make sense for the product.

5.4 · CARD 04 — STICKERS (DECALS)

Logos, labels & *texture*



A transparent PNG logo added as a sticker on the speaker body.

A **sticker** (also called a **decal**) is a 2D image wrapped onto the surface of the model — a logo, a label, buttons or a screen graphic.

1. Make your logo in your DTP or vector software and save it as a **PNG with a transparent background**.
2. Click **+ Add a sticker (PNG)**, then click the model where it should go.
3. Adjust **Size** and **Turn**. Choose a **Finish**: **Shiny**, **Matt** or **Foil**.
4. **Move** it, **Copy to other side**, or **Delete** it.

TEXTURE IN 3D CAD

A **texture** is an image or pattern on a surface that makes it look real — wood grain, brushed lines on steel, carbon fibre, knurling. In RenderClass, wood and brushed steel already contain texture. A decal is one way of adding a printed graphic.

EXAM TIP

A question showing a model change from grey to "wood" is asking about **material** or **texture**. A model changing from flat to having highlights and a shadow on the floor is about the **light source**.

CHECK YOUR UNDERSTANDING · TOPIC 5

1 Name the 3D CAD illustration technique used to turn stage A into stage B on page 23. 1 mark

2 State why a logo for a decal should be saved as a PNG with a transparent background. 1 mark

YOUR TURN · TOPIC 5

Plan your *render*

Good renders are planned before you click anything. Plan the Brew flask, then load it in RenderClass and test your plan.



TASK 1 Materials plan — Brew travel flask

PART	RENDERCLASS MATERIAL	REASON
Body		
Grip band		
Lid		
Flip tab		
Lid seal		

TASK 2 Exam practice

4 marks

a A pupil adds a logo sticker but it shows with a white box round it. Explain why, and how to fix it. 2

b Name the 3D CAD illustration technique that makes a grey model look like brushed steel, and the one that adds the shadow on the floor. 2

TASK 3 Design a sticker

Sketch a logo for the Brew flask. Keep it simple and bold so it still reads when it is small on a curved surface.

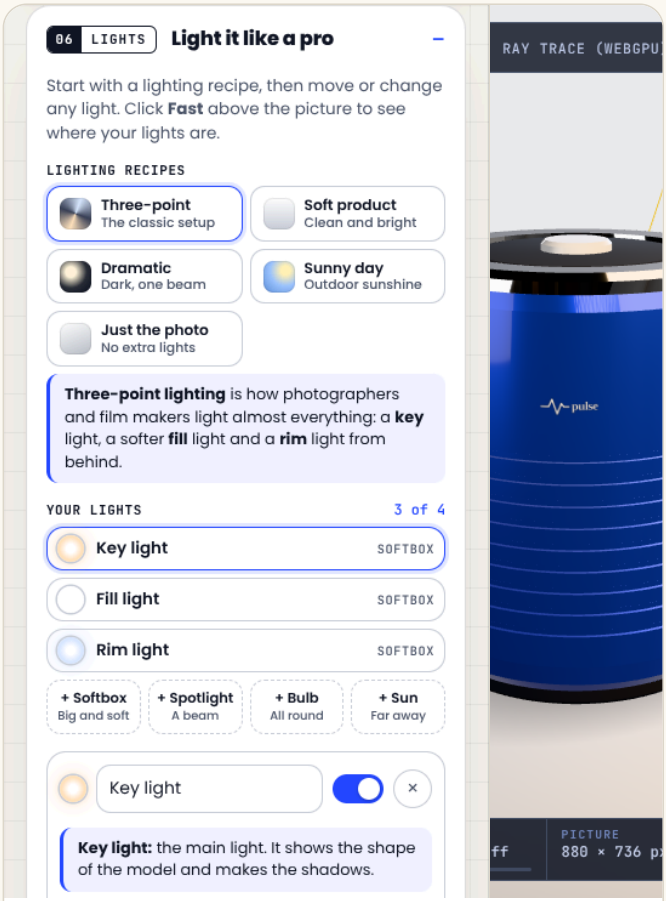
LOGO IDEA

6

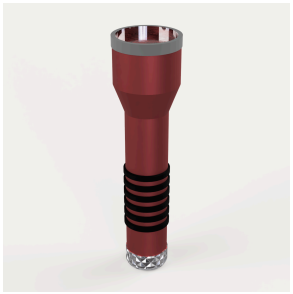
TOPIC 6

Camera, *lights* & studio

A photographer can make a cheap product look expensive — with the right angle, lens and lights. RenderClass gives you the same tools. This is where your render goes from “CAD model” to “advert”.



Card 06 Lights with the three-point recipe.



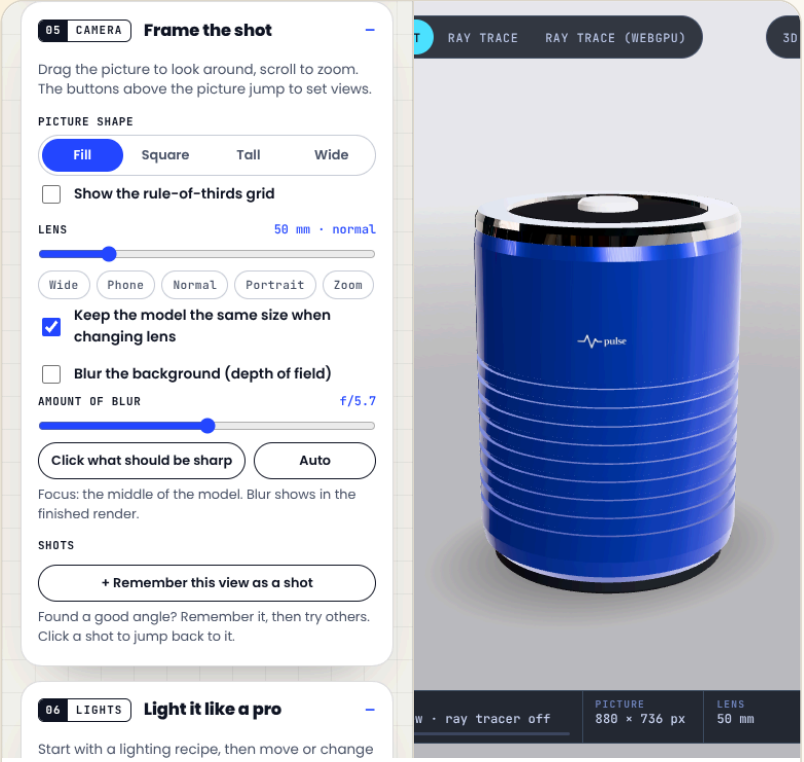


LEARNING INTENTIONS

- Frame a shot using views, picture shape, lens and the rule of thirds.
- Use lighting recipes and three-point lighting.
- Set the studio background, floor and HDRI.
- Choose quality settings and save a ray-traced render.

6.1 · CARD 05 — CAMERA

Frame *the shot*



Camera card: picture shape, lens, depth of field and saved shots.

Drag to orbit round the model and **scroll** to zoom. The view buttons jump to **3D, Front, Side, Back** and **Top**.

SETTING	WHAT IT DOES
Picture shape	Fill, Square (social media), Tall 4:5 (poster), Wide 16:9 (slide/TV)
Rule-of-thirds grid	Place the important part where lines cross
Lens	Wide · Phone · Normal · Portrait · Zoom. Longer lenses flatten perspective — good for products
Depth of field	Blurs the background so the eye goes to the product
Shots	Remember good camera angles and jump back to them

CHOOSING A VIEW

A **pictorial view** (seeing three sides, slightly from above) shows the most of a product. A low camera makes a product look big and powerful; a high camera makes it look small and neat. Avoid views that hide the key features.

ASSIGNMENT LINK

The rendered graphic must be a **pictorial view**. Save two or three shots, render them all, then choose the best one for your promotional layout.

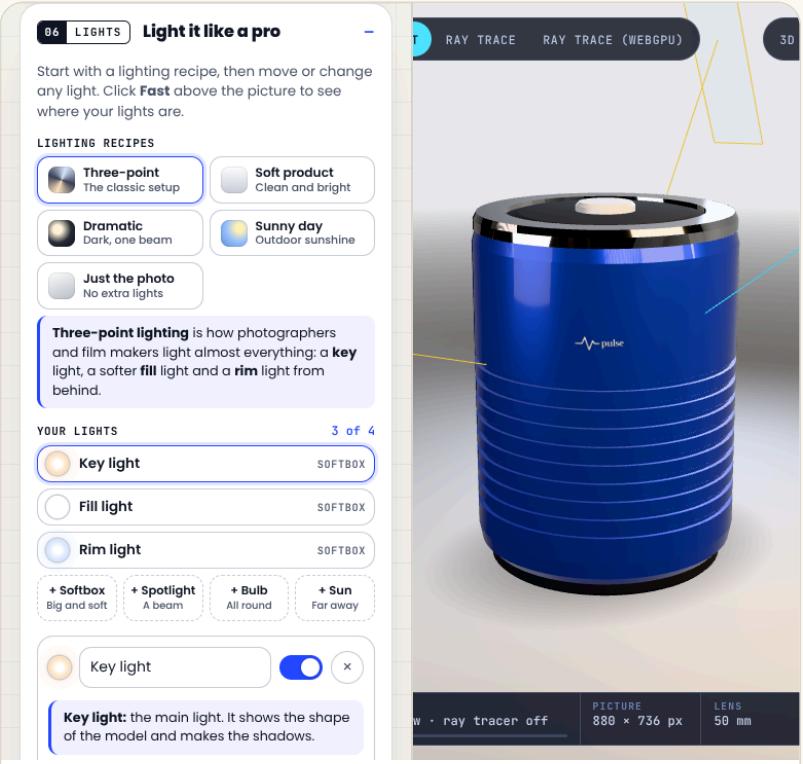
6.2 · CARD 06 — LIGHTS

Light it *like a pro*

Lighting recipes set up a whole studio in one click:

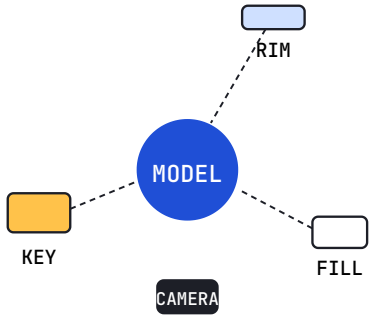
RECIPE	USE IT FOR
Three-point	The classic: key, fill and rim
Soft product	Adverts and online shops; long clean reflections
Dramatic	One spotlight, lots of darkness
Sunny day	Outdoor products, crisp shadows
Just the photo	Only the studio photo (HDRI) lights it

Add up to four of **your own lights** — **softbox, spotlight, bulb** or **sun** — and change colour, brightness, size, beam and position (**around**, **height**, **distance**).



Three-point lighting recipe applied.

THREE-POINT LIGHTING



Key light — the main light. It shows the shape of the model and makes the shadows.

Fill light — a softer light on the other side. It lifts the dark side so you can still see detail (like reflected light in a hand rendering).

Rim light — behind the model. It draws a bright edge round it so it stands out from the background.

LIGHT LAB

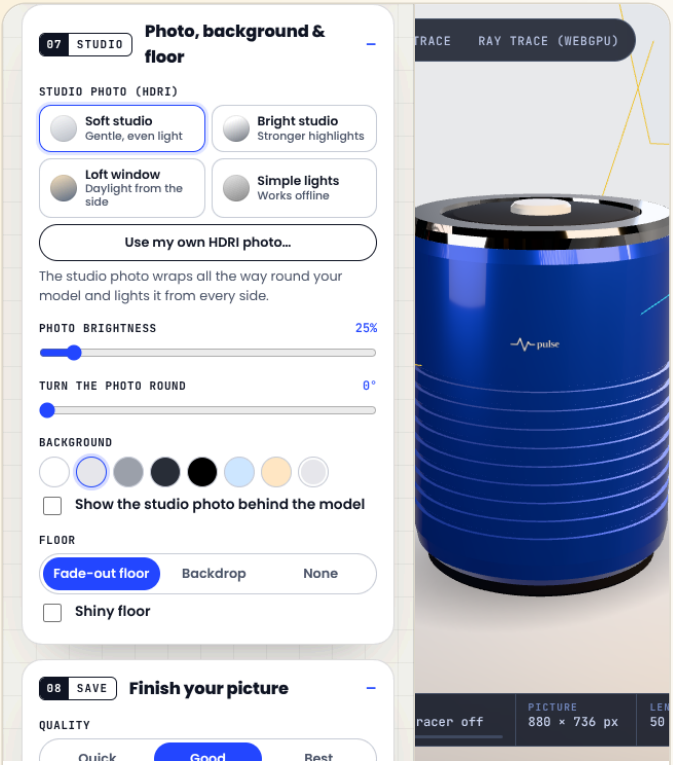
A light further away gives **sharper** shadows; a bigger softbox gives **softer** shadows. Click **Fast** to see where your lights are.
Note: three-point lighting is a RenderClass and assignment skill — the exam only asks about the **light source**.

EXAM TIP

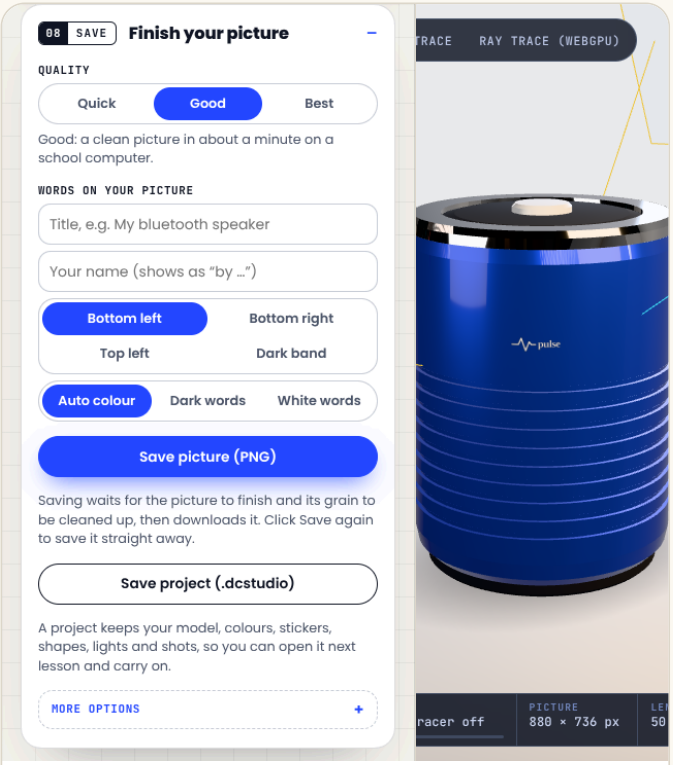
In the exam, call this technique **lighting** or **light source**. Describe the effect: it creates highlights, shade, shadows and reflections, making the model look **realistic**.

6.3 · CARDS 07 & 08 — STUDIO AND SAVE

Set the scene, *press save*



07 Studio: studio photo (HDRI), background and floor.



08 Save: quality, words on the picture and more options.

07 STUDIO

- **Studio photo (HDRI)** — a 360° photo that lights the model from all round and appears in its reflections. You can use your own.
- **Fade-out floor**, curved **Backdrop** (no corner line, like a real product shoot) or **None**.
- **Shiny floor** — the model is reflected in the floor.

08 SAVE

- **Quality**: Quick (setting up), Good (final), Best (lots of time).
- **Passes** — more passes = less grain. **Clean up the grain** removes what is left.
- **Light bounces** — 6+ for glass and acrylic.
- **See-through background** — a transparent PNG that drops straight into your DTP layout.

EXAM TIP

"The render is dark, pixelated and poor quality. Suggest an improvement." Accepted: **increase the render settings / quality**, **render at a higher resolution**, **improve the lighting**, or **edit the material / texture**.

TRY IT · CARD 09 EXPLORE

Run **What do passes do?** and **What do light bounces do?** on your own model. Each takes about a minute and shows why render settings matter.

YOUR TURN · TOPIC 6

Set up *the shot*

Plan the camera and lighting for a promotional render of the Beam torch.

TASK 1 Three camera angles

Sketch the torch from a low, an eye-level and a high camera. Circle the one you would use on a poster.

Low angle | Eye level | High angle

TASK 2 Picture shape

3 marks

WHERE THE RENDER WILL BE USED	PICTURE SHAPE (SQUARE / TALL / WIDE)
Social media post	
A3 poster on a corridor wall	
Presentation slide	

TASK 3 Fix this render

4 marks



a This render is dark, grainy and pixelated. Suggest two improvements. 2

b Explain how adding a light source improves a CAD render. 2

6.4 · BEYOND RENDERCLASS

The same ideas, *other software*

Every rendering program uses the same stages: **materials** → **textures/decals** → **lighting & environment** → **camera** → **render settings**. Learn them once and you can use any package.

SOFTWARE	WHERE RENDERING LIVES	WORDS YOU WILL SEE
Autodesk Fusion	The **Render** workspace. Appearances are dragged onto bodies or faces; Scene Settings control the environment, ground and camera; In-canvas render previews, then a local or cloud render saves the image.	Appearance, Scene Settings, Environment Library, Decal, In-canvas render
Inventor Studio	The **Inventor Studio** environment (Environments tab). Uses the part's appearances, then Lighting Styles, Scene Styles and Cameras before **Render Image**.	Appearance, Lighting style, Scene style, Camera, Render image
Blender	Free, open-source 3D software used for films and product visuals. Materials are built in the Shading tab; renders with **Cycles** (ray tracing) or **Eevee** (fast).	Material, Shader, HDRI, Cycles, Eevee, Samples



Rendered in Autodesk Fusion — the same models you load into RenderClass.

EXAM TIP

Exam answers are **never** about a particular program. Use general terms — "applied a material", "added a light source" — not button names from one package.

ASSESSMENT · THE ASSIGNMENT

Rendering in your *assignment*

The assignment is worth **40 marks** (8 hours). Rendering appears in two places — once on screen, once by hand.

ON SCREEN

3D CAD rendered pictorial

- A **pictorial view** of your model.
- **Appropriate lighting** — highlights and shadows.
- **Suitable materials** for the product.
- Usually goes into your **promotional layout**, so a transparent background is useful.

BY HAND

Manual rendered pictorial sketch

- Freehand sketching — a straight edge is fine.
- Rendering must **clearly show the material**.
- Use a range of tones, not just one colour.
- **No** tracing, 3D CAD or shape tools.

BEFORE YOU HAND IT IN

1. Is the light source consistent on every part?
2. Do highlights, shade and shadow all agree with it?
3. Would someone know what each part is made of?
4. Is the CAD render a clear pictorial view?
5. Are the materials realistic for how it would be made?
6. Is the render free of grain and saved at a good size?

COMMON MISTAKE

Rendering the wrong material — e.g. making a moulded plastic part look like wood. Check your manufacturing notes and render to match.

ASSIGNMENT LINK

The examples in this booklet are for practice. In the assignment the work must be your own, done under supervision, following your teacher's instructions.

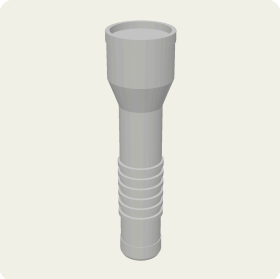
ASSESSMENT · THE QUESTION PAPER

Rendering in your *exam*

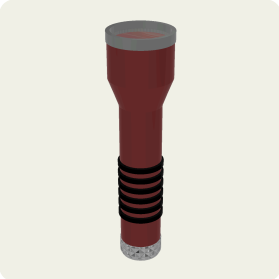
The question paper is worth **80 marks** (2 hours). Rendering questions are usually short — 1 or 2 marks — and use the words **state**, **describe** or **explain**. Here are the types that come up most.

QUESTION TYPE	WHAT GETS THE MARKS	NOT ACCEPTED
Name the 3D CAD illustration techniques used to go from one stage to the next.	Material · texture · light source / lighting	**colour · highlights · shadows (on their own)**
Explain one effect of a technique.	Makes it look realistic; shows what it is made of; shows highlights/shadows from the light.	**"looks better"**
Suggest an improvement to a poor render.	Increase render quality; higher resolution; improve lighting; edit material/texture.	**"ray trace it"**
Why use a rendered illustration to promote a product?	Realistic; shows materials/colours/textures; understood by non-specialists.	**"shows what it looks like"**
Compare a rendered illustration with an exploded view.	One advantage and one disadvantage of each (see page 7).	**"more realistic" with no reason**

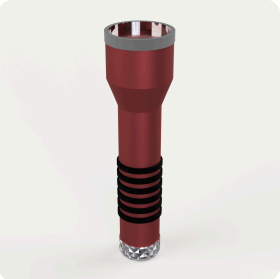
WORKED EXAMPLE



STAGE 1



STAGE 2



STAGE 3

Q. Name the 3D CAD illustration technique used at stage 2 and at stage 3. **(2)**

A. Stage 2 — **material** applied (red aluminium, rubber, chrome). Stage 3 — **light source / lighting**, giving highlights and a shadow on the floor.

COMMAND WORDS

State — a short answer. **Describe** — say what it is like or how it is done. **Explain** — give a reason: "… because …".

TRY IT

Cover the right-hand column of the table and test a partner on each question type.

GLOSSARY

Words to *own*

Cast shadow
The shadow an object throws onto another surface, on the side away from the light.

Contrast
The difference between the lightest and darkest tones. High contrast suggests metal or gloss.

Decal / sticker
A 2D image (e.g. a logo) applied onto the surface of a 3D model.

Depth of field
Blurring parts of a render that are nearer or further than the point in focus.

Environment / HDRI
A 360° image that lights a 3D scene and appears in reflections.

Gradient
A smooth change of tone or colour across a surface.

Highlight
The brightest area, where light hits most directly.

Light source
Where light comes from. Should be consistent across a rendering.

Material
What an object is made from; in CAD, the settings that make a surface look like that material.

Mixed media
Using more than one rendering medium together, e.g. pastel with marker.

Pass / sample
One round of ray tracing. More passes give a cleaner image.

Ray tracing
Rendering by following rays of light to create realistic shadows, reflections and transparency.

Reflected light
Light bounced back onto the shaded side from nearby surfaces.

Reflection
An image of the surroundings seen in a shiny surface.

Render
To add colour, tone, texture and light to make a drawing or model look three-dimensional and real.

Shade
The darker side of an object, turned away from the light.

Texture
The visual surface quality: grain, brushed, knurled, matt or gloss.

Tone
How light or dark something is.

FINAL CHECK · WHOLE BOOKLET

Are you *exam ready?*

1 State the term for the brightest area on a rendered object. 1

2 Explain why the shaded side of a rendered object should not be coloured pure black. 1

3 Describe how spirit markers are used to show a darker tone on the shaded side of a cylinder. 1

4 Name three 3D CAD illustration techniques used to make a CAD model look realistic. 3

5 A pupil's render is grainy and pixelated. Suggest two improvements. 2

6 Explain two reasons why a rendered illustration would be used on a product's packaging. 2

7 A pupil's hand-rendered cube looks flat. Describe three improvements they could make. 3

Total _____ / 13

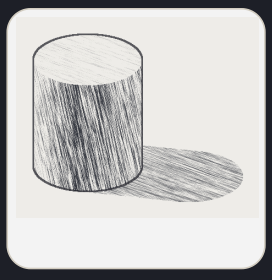
KEEP GOING

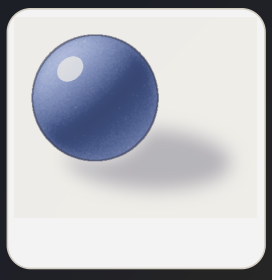
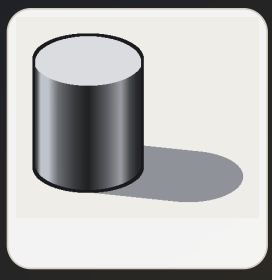
Every product you own was *rendered* before it was made.

Worksheets, homework, STEP files, stickers and videos for this unit are on the DesignClass N5 Rendering page.

RENDER ONLINE
detscotland.co.uk/RenderClass

RESOURCES
detscotland.co.uk/n5-rendering

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