NCFE Level 1/2 Technical Award in Engineering (603/2963/4)

Past Paper

March 2020

Unit 01 Understanding the engineering world

Mark Scheme

This mark scheme has been written by the Assessment Writer and refined, alongside the relevant questions, by a panel of subject experts through the external assessment writing process and at standardisation meetings.

The purpose of this mark scheme is to give you:

- examples and criteria of the types of response expected from a learner
- information on how individual marks are to be awarded
- the allocated assessment objective(s) and total mark for each question.

Marking guidelines

General guidelines

You must apply the following marking guidelines to all marking undertaken throughout the marking period. This is to ensure fairness to all learners, who must receive the same treatment. You must mark the first learner in exactly the same way as you mark the last.

- The mark scheme must be referred to throughout the marking period and applied consistently. Do not change your approach to marking once you have been standardised.
- Reward learners positively giving credit for what they have shown, rather than penalising them for what they might have omitted.
- Utilise the whole mark range and always award full marks when the response merits them.
- Be prepared to award zero marks if the learner's response has no creditworthy material.
- Do not credit irrelevant material that does not answer the question, no matter how impressive the response might be.
- The marks awarded for each response should be clearly and legibly recorded in the grid on the front of the question paper.
- If you are in any doubt about the application of the mark scheme, you must consult with your Team Leader or the Chief Examiner.

Guidelines for using extended response marking grids

Extended response marking grids have been designed to award a learner's response holistically and should follow a best-fit approach. The grids are broken down into levels, with each level having an associated descriptor indicating the performance at that level. You should determine the level before determining the mark.

When determining a level, you should use a bottom up approach. If the response meets all the descriptors in the lowest level, you should move to the next one, and so on, until the response matches the level descriptor. Remember to look at the overall quality of the response and reward learners positively, rather than focussing on small omissions. If the response covers aspects at different levels, you should use a best-fit approach at this stage, and use the available marks within the level to credit the response appropriately.

When determining a mark, your decision should be based on the quality of the response in relation to the descriptors. You must also consider the relative weightings of the assessment objectives, so as not to over/under credit a response. Standardisation materials, marked by the Chief Examiner, will help you with determining a mark. You will be able to use exemplar learner responses to compare to live responses, to decide if it is the same, better or worse.

You are reminded that the indicative content provided under the marking grid is there as a guide, and therefore you must credit any other suitable responses a learner may produce. It is not a requirement either, that learners must cover all of the indicative content to be awarded full marks.

Assessment objectives

This unit requires learners to:

AO1	Recall knowledge and show understanding.
AO2	Apply knowledge and understanding.
AO3	Analyse and evaluate knowledge and understanding.

The weightings of each assessment objective can be found in the qualification specification.

Qn.	Mark scheme	Total marks

Total: 80 marks

1	**What type of engineering includes the construction of bridges, roads and railways?** Answer: A Civil	**1** **AO1=1**

2	**What regulations control the use of chemicals in engineering?** Answer: A COSHH	**1** **AO1=1**

3(a)	**An employer must make sure that employees are kept safe when they are working in an engineering workshop.** **Discuss** two other **duties that the employer has under the Health and Safety at Work Act.** Award 2 marks for each to a max of 4 marks (one mark for a description, one mark for a linked response indicating its significance): • to provide a safe system of work • provide safe equipment, plant and machinery • provide supervision, instruction and training • safe access and egress from place of work. Accept any other suitable response.	**4** **AO2=2** **AO3=2**

3(b)	**State** three **items of personal protective equipment (PPE) that workers must use when they are welding steelwork.** Award one mark each to a max of 3 marks: • welding mask/full-face welding visor/welding safety glasses • overalls/welding jacket/apron • welding cap • gloves/welder's gloves • welding helmet • respirator • steel toe-capped boots Accept "eye protection" but do not accept "goggles". Accept any other suitable response.	**3** **AO1=3**

3(c)	**Explain** two **employee duties under the Manual Handling Operations Regulations.** Award 2 marks each to a max of 4 marks (one mark for describing the duty and one mark for a linked response that explains the reason/s for it). • Use the training and instructions provided to ensure that you lift correctly (eg bend at the knees with back straight) (1) and avoid injury to yourself, such as back strain, caused by lifting that isn't in accordance with training and instructions. (1) • Follow the safe systems of work such as wearing correct PPE or not entering safety zone to help reduce risks (1) by avoiding identified hazards, such as moving machinery, that could lead to injury through direct contact. (1) • Follow the risk assessment and the control measures contained within it, designed to identify potential risks such as storage/stacking of items (1), to ensure safer practice and avoid injury where possible. (1) • Use any equipment provided for lifting, particularly when lifting heavy or irregularly-shaped items, (1) to avoid injuries such as back strain, sprains and falls, whilst lifting and/or in transit. (1) • Use mechanical means wherever possible (eg forklift) to avoid any manual handling by yourself (1) that could otherwise result in injuries such as cuts, sprains of bruises due to the item (eg sharp edges) and the way it is moved. (1)	**4** **AO2=2** **AO3=2**

	Linked response to include any of the above points which are taken directly from the regulations. Do not accept bulleted lists. Accept any other suitable response.	

4(a)	**The engineering industry uses many different combinations of materials to manufacture products.** **Which** one **of the following is a hardwood timber?** Answer: B Oak	**1** **AO1=1**

4(b)	**State** two **thermal properties of a metal.** Award one mark each to a max of 2 marks: • conduction/conducts heat/thermal conductivity • gets hot/absorbs heat quickly • expands/expansion • melting point/bends under heat • dissipates heat. Accept any other suitable response.	**2** **AO1=2**

4(c)	**Give** two **examples of pure non-ferrous metals.** Award one mark each to a max of 2 marks: • aluminium • copper • lead. Accept any other suitable response.	**2** **AO1=2**

5	**Modern automotive engineering designs are using more composite materials and fewer traditional steel materials.**	**9** **AO1=3** **AO2=3**

Explain why using composite materials would benefit the consumer.

AO3=3

Level	Marks	Description
3	7–9	A wide range of relevant knowledge and understanding is shown, which is accurate and detailed. Subject specific terminology is used consistently throughout. Application of knowledge and understanding is appropriate, with clear relevance to the context. Analysis and evaluation are present and very effective. The conclusions drawn are fully supported by judgements.
2	4–6	A range of relevant knowledge and understanding is shown, but may be lacking in sufficient detail, with a few errors. Subject specific terminology is used, but not always consistently. Application of knowledge and understanding is mostly appropriate, but sometimes lacks clarity, and there may be a few errors. Analysis and evaluation are present and effective but may be lacking appropriate development. There are attempts to draw conclusions, which are supported by judgements, but it is likely that some will be irrelevant.
1	1–3	A limited range of relevant knowledge and understanding is shown, but is often fragmented. Subject specific terminology, if used, is often inappropriate and a lack of understanding is evident. Application of knowledge and understanding is inappropriate, with any attempt showing fundamental errors. Analysis and evaluation, if present, is of limited effectiveness. Attempts to draw conclusions

		are seldom successful and likely to be irrelevant.
	0	No creditworthy material.

Indicative content:

- Lighter weight compared to steel, providing fuel efficiency savings
- Percentage of a car has to be recycled
- Composites can be mass produced
- Steel materials corrode and rust
- Composites last for longer periods
- High strength-to-weight ratio
- Carbon fibre looks good
- Stronger/stiffer materials than steel
- Weight for weight much stronger than steel
- Increased rigidity
- Faster due to power-to-weight ratio
- Suited to electric vehicles/improved range.

MB2 must extend from a brief description into the start of some evaluative statements or justification as to why modern automotive engineering designs utilise more composite materials.

MB3 must carry some evaluative statements from the learner regarding benefits to the consumer to be awarded.

6	**Which** one **of the following is** not **a property of aluminium?** Answer: D Poor malleability	**1** **AO1=1**

7	**Calculate the density of a metal if its mass is 15kg and volume is 0.25m^3.** **Use the formulas on pages 2 and 3.** **Show your working.** Award one mark for working out and one mark for correct answer to a max of 2 marks. **density = mass ÷ volume** = 15 kg/0.25 (1 mark) = 60 kg/m^3 (1 mark)	**2** **AO2=2**

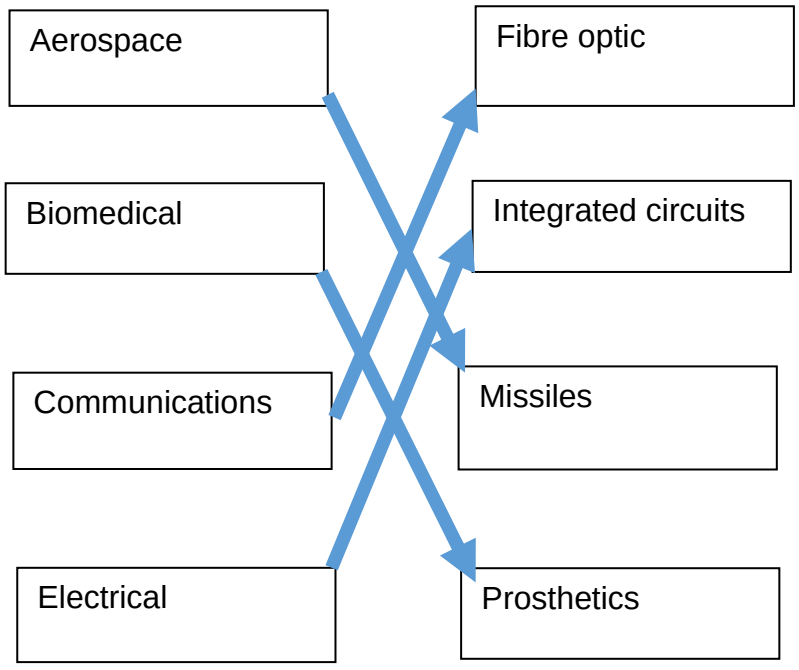
8	**A hydraulic cylinder is 150mm long and has an internal diameter of 40mm. The cylinder is filled with hydraulic oil when the valve is operated.** **Calculate the volume of oil.** **Use the equations on pages 2 and 3.** **Show your working.** Award one mark for working out and one mark for correct answer to a max of 2 marks**.** **Cylinder volume = π x radius² x height of cylinder** PI x r^2 x 150 3.142 x 20^2 x 150 = 188,520 mm^3 3.14 x 20^2 x 150 = 188,400 mm^3 Accept any value between 188400 and 188600	**2** **AO2=2**

9	**What is a lathe used for?**	**1** **AO1=1**

	Answer: D Turning	

10	**Which** one **of the following reduces the environmental impact of engineering activities?** Answer: C Sustainability	**1** **AO1=1**

11	**Which** one **of the following is measured in kelvin?** Answer: D Thermodynamic temperature	**1** **AO1=1**

12	**Each type of engineering discipline covers specific products which have shaped the modern world.** **Draw a line to connect each engineering discipline on the left to an example of a product manufactured on the right.**  **Award 3 for all 4 correct,** **Award 2 marks for two correct** **Award 1 mark if one correct**	**3** **AO1=3**

13	**What does British Standard 8888 refer to?** Answer: A Engineering drawings	**1** **AO1=1**

14	**Which** one **of the following is an optical property of a material?** Answer: B Photosensitivity	**1** **AO1=1**

15	**What type of property is 'oxidation state'?** Answer: A Chemical	**1** **AO1=1**

16	Figure 1 **shows an early steam-powered excavator and** Figure 2 **shows a modern excavator.** Figure 1. Steam-powered excavator  Figure 2. Modern excavator  **Explain the technological advances between the excavators in** Figure 1 **and** Figure 2 and **discuss how these advances have affected the modern world.**	**9** **AO1=3** **AO2=3** **AO3=3**

Level	Marks	Description
3	7–9	A coherent explanation with reference to the impact of technology on the modern world. A wide range of relevant knowledge and understanding is shown, which is accurate and detailed. Subject specific terminology is used consistently throughout. Application of knowledge and understanding is appropriate, with clear relevance to the context. Analysis and evaluation are present and very effective. The conclusions drawn are fully supported by judgements.
2	4–6	A coherent explanation of what technology is but without reference to the impact on the modern world. A range of relevant knowledge and understanding is shown, but may be lacking in sufficient detail, with a few errors. Subject specific terminology is used, but not always consistently. Application of knowledge and understanding is mostly appropriate, but sometimes lacks clarity, and there may be a few errors. Analysis and evaluation are present and effective but may be lacking appropriate development. There are attempts to draw conclusions, which are supported by judgements, but it is likely that some will be irrelevant.

1	1–3	A basic explanation of technology, which may not be fully accurate. Doesn't mention hydraulics at all. A limited range of relevant knowledge and understanding is shown, but is often fragmented. Subject specific terminology, if used, is often inappropriate and a lack of understanding is evident. Application of knowledge and understanding is inappropriate, with any attempt showing fundamental errors. Analysis and evaluation, if present, are of limited effectiveness. Attempts to draw conclusions are seldom successful and likely to be irrelevant.
	0	No creditworthy material.

Indicative Content:

Steam-powered excavator:

- less efficient method
- polluting
- requires burning of coal
- less manoeuvrable
- limited capacity
- less sensitive and accurate to control
- noisy
- requires more people to run as one has to stoke coal
- needs to be started early so head of steam builds up for it to be available when work starts
- needs a low loader to move it from job to job
- needs a coal bunker and water bowser next to it to refuel.

Modern excavator:

- hydraulics offers better force
- accurate movement of arms
- able to dig downwards and not just at ground level
- range of attachments available
- fuel efficient
- economical machine to use
- can be easily hired
- transportable between tasks

	• doesn't need a low loader to move • can be driven on the road • safety of driver ensured • very versatile machine with buckets and shovel at each end • has several uses besides a straight front acting shovel. MB2 must extend from a brief explanation into the start of some evaluative statements about the two types of excavator or justification as to why such advances occurred. MB3 must carry some evaluative statements from the learner relating to impact on the wider world to be awarded	

17a	**Name the modification tool shown in** Figure 3 **and state what it is used for.** Award one mark for its name and one mark for its use. Hacksaw Used for manually cutting metals into shapes such as squares, rectangles, or for cutting solid or hollow sections across the section.	**2** **AO1=1** **AO2=1**

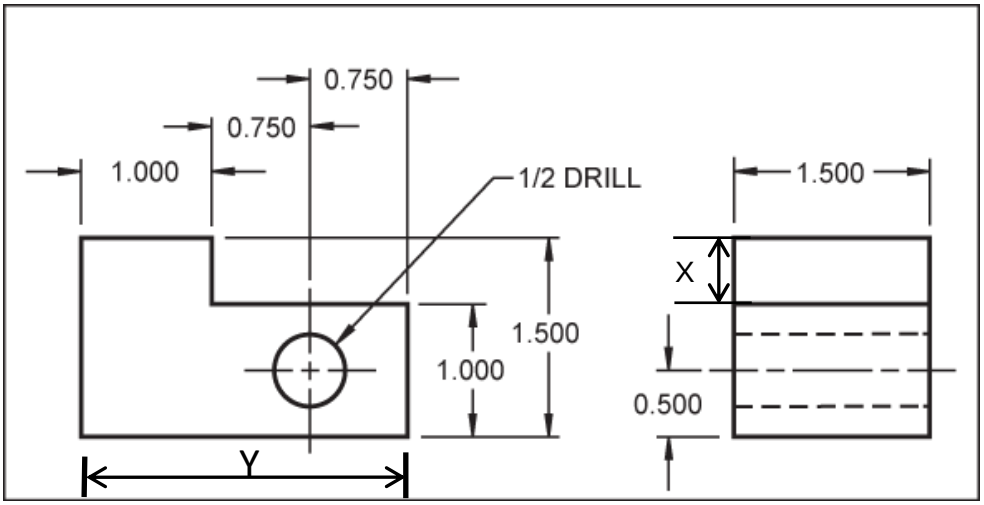
17b	**Describe how you would operate the modification tool shown in** Figure 3**.** Award one mark for each of the following to a maximum of 4 marks. Hacksaw is held with one finger against the frame and gripped by the handle. (1) Starting point is pulled back to place a starting cut against the indicated cutting line. (1) Other hand is used to hold the front of the hacksaw frame. (1) Hacksaw cuts on the draw as work proceeds. (1) Accept any other suitable response. Would you be able to use the hacksaw using the description given.	**4** **AO2=4**

18(a)	**Name** one **finishing tool used to complete a metal surface.** Award one mark for any of the following: • hand sander • disc sander • buffing wheel	**1** **AO1=1**

	• paint brush • file • milling machine (vertical or horizontal). Accept any other suitable response.	

18(b)	**Explain how** two **control measures ensure that a pillar drill can be used safely.** For each control measure, award one mark for the explanation of the safety measure (AO2) and one mark for the explanation of the risk and how the control measure prevents it (AO3). • Foot operated pedal that allows for immediate stop when operator lifts foot off it, reducing the risk of injury by quickly stopping the drill if the operator becomes ensnared in it (1), reducing harm from the moving drill tip which could otherwise cause injury. (1) • Emergency stop button that allows for immediate stop when pressed, allowing colleagues to stop the drill (1) in circumstances when the operator is unable to do so (eg error, distraction or accident), reducing the risk of injury/further injury from the moving drill tip. (1) • PPE- such as safety glasses/goggles to reduce risk of particles entering eye when drilling (1) causing injury/distraction and preventing the operator from safely using the drill which could lead to further injury. (1) • Machine guards to prevent debris flying when the drill is in operation by containing it (1) thus reducing the risk of injury to the operator and other colleagues nearby (eg they may be less aware of the hazards and not have the necessary protective equipment worn by the operator). (1) • Do not enter zones around worker to keep others at a safe distance from the drill (1) that may otherwise cause injury (eg flying debris) to those who are unaware of the risk and do not have the necessary protective equipment used by the operator. (1) • Drill bit is secure in chuck and tight, work is clamped down Evaluative responses will justify the control measure in terms of reducing the risk down to an acceptable level that does not harm the operator. Accept any other suitable response.	**4** **AO2=2** **AO3=2**

19(a)	**The designer has drawn two images, one in first angle projection and one in third angle projection.** **Which image** (Figure 4 or 5) **is in first angle projection?** Figure 4	**1** **AO1=1**

19(b)	**Calculate the height** (X) **and length** (Y) **of the product shown in** Figure 6**.** **Show your working.** **Figure 6.**  X = 1.500 – 1.000 = 0.50 (award one mark for working out and one mark for correct answer to a max of 2) Y = 1.000 + 0.750 + 0.750 = 2.5 (award one mark for working out and one mark for correct answer to a max of 2)	**4** **AO1=2** **AO2=2**

20	**An engineer wants to mark a drill hole before machining. What tool should they use? Explain how they should use this tool.** Award one mark for naming the tool: Must name a centre punch (1). Award a max of 2 marks for an explanation. Point placed on centre of drill hole (1) and punched with an engineer's hammer to form an indent that the drill can locate onto (1).	**3** **AO1=1** **AO2=2**

21	**State** two **types of dimension that callipers can measure.** Award one mark each for any of the following to a max of 2 marks: • internal measurements • external measurements accept width or length (1 mark only) • depth gauge on calliper. Examples accepted around Vernier callipers. Do not accept drill holes (needs to be depth of…)	**2** **AO1=2**

22	**It is important to use SI units and equations in engineering to make sure that applications function and are safe to operate.** **Explain the ways that SI units and equations have been applied to aerospace engineering**.	**9** **AO1=3** **AO2=3** **AO3=3**

Level	Marks	Description
3	7–9	A coherent explanation with reference to the mathematics involved in aerospace design and construction. A wide range of relevant knowledge and understanding is shown, which is accurate and detailed. Subject specific terminology is used consistently throughout. Application of knowledge and understanding is appropriate, with clear relevance to the context. Analysis and evaluation are present and very effective. The conclusions drawn are fully supported by judgements.

		2	4–6	A clear explanation of some mathematics applied in an aerospace context. A range of relevant knowledge and understanding is shown, but may be lacking in sufficient detail, with a few errors. Subject specific terminology is used, but not always consistently. Application of knowledge and understanding is mostly appropriate, but sometimes lacks clarity, and there may be a few errors. Analysis and evaluation are present and effective but may be lacking appropriate development. There are attempts to draw conclusions, which are supported by judgements, but it is likely that some will be irrelevant.	
		1	1–3	A basic explanation of mathematics applied in an aerospace context. A limited range of relevant knowledge and understanding is shown, but is often fragmented. Subject specific terminology, if used, is often inappropriate and a lack of understanding is evident. Application of knowledge and understanding is inappropriate, with any attempt showing fundamental errors. Analysis and evaluation, if present, are of limited effectiveness. Attempts to draw conclusions are seldom successful and likely to be irrelevant.	
			0	No creditworthy material.	

Indicative Content:

SI Units:

- use of an internationally recognised standard
- ensures consistency if parts made in different countries

	• enables all manufacturers in different countries to understand the measurement unit used • measurement of dimensions for engineering product • enables tolerances to be specified and applied • distances can be calculated • fuel measurements • area of wings measured = lift • weight of plane • size, shape, volume, capacity. Equations: • missile travel and distance established • how far you can fly on one tank of fuel • fuel efficiency calculations • number of passengers carried • weight calculations • aerodynamic lift calculations • how far you can fly calculations – distance vs fuel • friction on the surface of the plane's wings • amount of lift per surface area • weight of plane • weight of missile • weight of fuel • engineer design. Higher mark bands require some justification of the use of SI or equations in what they produce that adds value to the technological aspect. MB3 must carry some evaluative statements from the learner to be awarded. MB2 must extend from a brief description into the start of some evaluative statements or justification as to why.	

Assessment Objective Grid

Question	AO1	AO2	AO3	Total
1	1			1
2	1			1
3a		2	2	4
3b	3			3
3c		2	2	4
4a	1			1
4b	2			2
4c	2			2
5	3	3	3	9
6	1			1
7		2		2
8		2		2
9	1			1
10	1			1
11	1			1
12	3			3
13	1			1
14	1			1
15	1			1
16	3	3	3	9
17a	1	1		2
17b		4		4
18a	1			1
18b		2	2	4
19a	1			1
19b	2	2		4
20	1	2		3
21	2			2
22	3	3	3	9
Total	**37**	**28**	**15**	**80**