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

Past Paper

November 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	**Which of the following engineering disciplines includes hydraulics?** Answer: C Mechanical	**1** **AO1=1**

2	**The Manual Handling Operations Regulations give a ranking of measures for assessing heavy loads.** **What is the** first **of these measures?** Answer: A Avoid lifting	**1** **AO1=1**

3	**Operatives wear safety footwear to protect their feet.** **Describe** two **ways that safety footwear protects the wearer from hazards.** Award up to two marks for a description of how safety features protect the wearer: • a steel toe cap that makes sure that any weight applied or dropped (1) onto the toe can be resisted to prevent damage or crushing injuries to the bones within the foot (1) • a steel plate in the sole that prevents sharp objects such as nails from entering or puncturing the base of the foot (1) which can cause a puncture wound or a fracture to a bone (1) • laces to ensure that the boot remains on the foot (1) so it cannot come off during work activities (1) • an ankle guard which wraps around three sides of the ankle (1) and also retains the foot by the laces preventing sprains from twisting. (1) Accept any other suitable response. Give 1 mark for an identification 1 mark for a description. Give 2 marks for two ways.	**2** **AO2=2**

4 (a)	**Dust is a hazard in an automotive workshop. It can be removed by extraction.** **Name** one other **hazard that can be removed from a workshop by extraction.** Award one mark for any of the following: • fumes • steam • smoke • particulates don't accept wood chippings • welding gasses – accept gasses • heat. Accept any other suitable response. Accept sweeping up with a brush/dustpan (1).	**1** **AO1=1**

4 (b)	**Extraction is one method of controlling dust in a workshop.** **Identify and describe** one other **method of controlling dust in a workshop.** Award one mark for identification of the method and 2 marks for a detailed description of how it reduces the hazard to a max of 3 marks: • by the use of a water spray (1) that is pumped during the work activity (1) to control the escape of dust into the air (1) • by isolation (1) within a purpose-built enclosure (1) or by the use of dust extraction systems attached to machinery (1) • wearing a face mask, respirator, dust mask (1) which reduces inhalation or breathing in (1) of particles into the nose and lungs. (1) • accept cleaning down dust surfaces (1) sweeping up with a brush (1) Accept any other suitable response. Must be a linked description to the identification for full marks.	**3** **AO1=1** **AO2=2**

5	**State** two **SI units for the measurement of mass.** Award one mark each to a max of 2 marks: • milligram	**2** **AO1=2**

	• gram • kilogram. • Accept abbreviations (symbols)	

6 (a)	**Which of the following properties refers to a material's melting point?** Answer: D Thermal	**1** **AO1=1**

6 (b)	**Identify** two **mechanical properties of lead** and **justify how** one **of these properties could be useful to an engineer.** Award one mark for identification (AO1) to a maximum of 2 marks and 2 marks for a linked justification (AO3): • elasticity (1) means that it can expand under heat and contract under colder conditions (1) therefore it can be used as a roofing material where it will expand in summer and contract in winter without cracking (1) • malleability (1) enabling it to be bent around objects (1) so that three dimensional curves, for example around pipes, can be formed (1) • plasticity (1) enables tight bends to be achieved (1) without breaking/rupturing, for example on flanges (1) • durability (1) giving lead a long life (1) in areas where acid rain can be a problem to engineering materials (1) • ductility (1) means that it doesn't fracture under extreme colder conditions (1) for example, downpipe formed in lead on an old house (1) Don't accept low melting point, water pipes Accept any other suitable response.	**4** **AO1=2** **AO3=2**

6 (c)	**Which** one **of the following is a ferrous alloy?** Answer: D Stainless steel	**1** **AO1=1**

7	**Surface finish and texture are two aesthetical properties required for kitchenware.**	**2** **AO1=2**

	Identify two **ceramics which could be used for kitchenware.** Award one mark each to a max of 2 marks: • glass • pottery • clay Don't accept examples unless it states use of ceramic. Accept any other suitable response.	

8	**A park has a river flowing through it. The local council is considering designing and installing a pedestrian bridge across the river. The river is 6 metres wide.** **Explain how modern engineering can enable a bridge to span across the river without any middle supports.**	**9** **AO1=3** **AO2=3** **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:

3: Justification or evaluative statements may include the following:

- the use of lightweight materials
- such as cold formed mild steel sections
- bolted together
- in a matrix that is load bearing
- light-weight truss type frames
- enabling a good span to weight ratio
- use of off the shelf beams already tested and able to span
- use of a variety of materials such as precast concrete
- engineered timber.

2: Reasoned statements with some justification may include the following:

- use of lighter materials
- in a framework that spans further as a beam
- larger spans can be achieved with composite materials
- such as glass-reinforced plastic and precast concrete mixtures of materials such as steel and concrete.

1: Brief statements with no justification may include the following:

- use of mild steel solid beams across the river
- using concrete planks
- little or no justification statements made by the candidate in relation to material vs distance.

No written material that has any reference to the context of a bridge and reference to the materials used in its construction.

9	**A client wants to know the efficiency of their conveyor belt system.** **Calculate the efficiency of the conveyor belt system using the following data:**	**2** **AO2=2**

	Total energy consumption = 50 watts/hour **Useful energy out = 42.5 watts/hour** **Use the equations on pages 2 and 3.** **Show your working.** Award one mark for dividing energy out by energy in and one mark for converting to a percentage to a max of 2 marks. efficiency (%) = (useful energy out divided by total energy in) x 100 = 42.5 / 50 x 100 (1 mark) = 0.85 x 100 = 85% or 85 (1 mark for correct answer)	

10 (a)	**Engineering drawings may be in imperial measurements.** **Convert 1 inch to millimetres.** Answer: • 25.4mm • accept 25mm	**1** **AO1=1**

10 (b)	**Which of the following is the correct name for the line made of long and short dashes shown in** Figure 1**?** Answer: A Centre	**1** **AO1=1**

10 (c)	**On an engineering drawing a hidden line is represented by which one of the following?** Answer: C Dashed line	**1** **AO1=1**

10 (d)	**Name the following three-dimensional projection methods:** Answer: Projection A = 2 point perspective (accept perspective only) Projection B = isometric	**3** **AO1=3**

	Projection C = axonometric	

11	**Which statement describes a tolerance?** Answer: B A limit of size	**1** **AO1=1**

12	**Which unit is used to measure the amount of a substance?** Answer: B Micromoles	**1** **AO1=1**

13	**Which of the following involves a transfer from one body to another?** Answer: D Work done	**1** **AO1=1**

14	**Which of the following applications is used in chemical engineering?** Answer: B Pharmaceuticals	**1** **AO1=1**

15	**A customer has asked an engineering company to recommend a product to secure bolts that will hold down a drilling machine to a concrete floor.** **Explain why epoxy resin would be recommended for the application shown in** Figure 2**.** Award one mark for each point up to a maximum of three marks for a linked response: • higher strength bond achieved compared to other types of adhesive (1) • liquid can be poured down the hole easily, unlike other types of adhesive (1) • flexible until it sets allowing changes to be made (1) • better product compared to one-part adhesives due to speed of setting (1) • longer shelf life than other products (1) • durability - it doesn't break down quickly meaning toughness over time. (1)	**3** **AO3=3**

	Accept any other suitable response. No marks for repeating the stem i.e. secure the bolt.	

16 (a)	**Identify the engineering tool shown in** Figure 3**.** Answer: Angle grinder Accept "handheld angle grinder" any variation Don't accept "grinder" or "angle"	**1** **AO1=1**

16 (b)	**State** one **control measure for an operative using the tool in** Figure 3 and **describe** one **way this measure controls any hazards.** Award one mark for identification and one mark for a description: • abrasive wheels training (1) so operative knows how to correctly change a disc and use the tool correctly (1) • PPE, goggles, overalls, gloves, boots (do not accept safety glasses) (1) that prevent hot metal and sparks from causing harm 1) • screens (1) to protect general public passing close to the activity (1) • risk assessment (1) to show potential hazards have been anticipated and addressed (1) • hot work permit (1) to show a level of competence that assures H&S compliance. (1) • accept guard is in place (1) Accept any other suitable response. Don't accept sawing.	**2** **AO1=1** **AO2=1**

16 (c)	**Identify the tool shown in** Figure 4 and **briefly describe how you would use it safely.** Award one mark for identification: • glue gun • hot glue gun.	**3** **AO1=1** **AO2=2**

	Award two marks for a description. • Make sure that the handle is held securely (1) so you don't drop the gun and cause an injury. (1) • No contact is made with the high temperature nozzle (1) which would cause a burn to the skin. (1) • Not touching any molten adhesive (1) so it doesn't bond to skin. (1) • Leave sufficient time for the glue to cool down (1) so it doesn't inadvertently bond to something else. (1) • Use of gloves and practice in the use of the glue gun (1) so you can use it competently. (1) Accept any other suitable response.	

17	**The engineering sector has contributed greatly to the communications industry.** **Evaluate how engineering has transformed the communications sector.**	**9** **AO1=3** **AO2=3** **AO3=3**

Level	Marks	Description
3	7–9	A coherent explanation with reference to the impact of communications 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 communication 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 communications context 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:

3: Justification or evaluative statements may include any of the following:

- the development of advanced digital phones with internet capabilities, advanced camera functions, which has made business faster and more efficient for users
- superfast fibre optic broadband installation across the country for superfast streaming, and communication across the world
- DAB radio network established across the country replacing analogue communications as it is more effective, less likely to drop out and can carry other text information
- cloud services enabling instant backup of files, documents and photos to be stored externally so they are secure and cannot be lost

	• 5G communications network across UK enabling much faster communication • internet connectivity across the world enabling real time communications applications such as FaceTime to be used effectively. 2: Reasoned statements with some justification may include any of the following: • some statements on internet related to fibre optic cable installation • related to superfast internet • talks about 4G/5G network on mobile phones and the mobile network • strong context to the smartphone and its capabilities • reference to telephone lines/improved technology mentioned • some references to internet radio • brief mention of DAB radios. 1: Brief statements with no justification may include the following: • use of a mobile device • smartphone and the internet • brief statements on digital communication, use of telephones, hand-held devices. No written material that has any reference to the context of telecommunications. Accept any other suitable response including digital video, streaming.	

18 (a)	**Magnetism is a valuable engineering property of some materials.** **Identify** one **product that uses this property** and **give** one **reason why magnetism is useful to this product.** Award one mark for identification and one mark for a useful reason: • car aerial (1) so it can be stuck on a car roof and removed easily, for example a taxi which is then used when not working as a domestic vehicle (1) • magnetic drill (1) to enable precision holes to be drilled in steelwork on site by clamping to steelwork to improve accuracy (1) • screwdriver bit holder (1) to hold different bits in place securely so they don't fall out during use (1) • car phone holder (1) so it holds phone in place firmly while driving to avoid any movement while navigating. (1) • a speaker (1) vibrates creating sound (1) • electrical motors (1) creating rotation (1) • child/pet locks (1) opening lock (1)	**2** **AO1=1** **AO3=1**

	Accept any other suitable response.	

18 (b)	**State** one **application of diamond in an engineering product** and **give a reason why it would be useful.** Award one mark for a description and one mark for an explanation: • used to cut metals (1), as diamond is a hard material (1) • used to drill holes (1), as a diamond drill has good cutting power in hard materials (1) • used as a stylus for a record player (1), as it is long lasting/durable. (1) • useful as hard substance (1) Accept any other suitable response. Accept reason without application	**2** **AO2=1** **AO3=1**

19 (a)	**A designer has drawn an engineering component to a scale of 1:5. The length of the component in the drawing measures 50mm.** **Calculate the actual length of the component.** **Show your working.** Award one mark for working out and one mark for correct answer to a maximum of 2 marks. 5 x 50 = 250mm	**2** **AO2=2**

19 (b)	**Calculate the total volume** and **density of the aluminium component with the cylindrical hole cut through it.** **Mass of the product = 247.37g** **Value of π = 3.14** **All dimensions are in mm.** **Use the equations on pages 2 and 3.**	**5** **AO2=5**

	Show your working. Award four marks for working out and one mark for correct answer to a max of 5 marks. Volume of cube = 4.74 x 4.74 x 4.74 = 106.50 cm^3 (1 mark) **deduct** Volume of cylinder Area of circles = **π** x r^2 4.74 – 1.37 – 1.37 = 2 / 2 = 1 (1 mark) = 3.14 x 1^2 x 4.74 = 14.88 cm^3 (1 mark) Total volume = 106.50 cm^3 - 14.88 cm^3 = 91.62 cm^3 (1 mark) Density = mass / volume Density = 247.37 / 91.62 cm^3 Density = 2.69, accept 2.70 (1 mark) Accept responses using versions of π beyond two decimal places.	

20	**The oil rig rescue boat in** Figure 6 **is constructed from glass reinforced plastic.** **Identify** and **describe** one **property of glass reinforced plastic.** Award one mark for identification and two marks for a description: • corrosion resistant (1), so it doesn't break down (1) when used as a tank lining and the chemicals it contains (1) • high strength to weight ratio (1), means its lightweight (1) yet strong (1) • doesn't conduct electricity (1), so it's safe to use in such electrical environments, as it won't spark and cause a fire (1)	**3** **AO1=1** **AO2=2**

	• impact resistant (1), returning to its set shape (1) when pressure is removed (1) Accept any other suitable responses, including those referring to other related products. Don't accept colour.	

21	**Prosthetics and other medical devices have advanced through the use of technology in engineering.** **Explain how engineering has considerably improved prosthetics for users.**	**9** **AO1=3** **AO2=3** **AO3=3**

Level	Marks	Description
3	7–9	A coherent explanation with reference to specific technological advances and its application in an engineering context. 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 with reference to some technological advances and its application in an engineering 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 technology and its application in an engineering 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 may be inappropriate, and may show 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:

3: Justification or evaluative statements may include the following:

- use of composite materials that provide lightweight strong solutions such as carbon fibre blades for feet which are then easier to move
- use of titanium materials with carbon fibre for strength, improving support for larger/heavier users
- use of various implants which are user moulded that can control an artificial prosthetic such as a hand or skeleton walking frame
- use of robotics with sensory inputs and outputs to sense pressure for example in an artificial hand which can be adapted for any user
- connection to the human bodies nervous system through different means for different people
- adapted for the user with individually moulded limbs
- prosthetics enabling everyday functions/activities, increasing access for less able-bodied person to society
- a range of technology is explained in detail.

2: Reasoned statements with some justification may include the following:

- reference to materials and how theses have been combined to make artificial limbs and aids for a range of people who have different injuries
- use of electronics to operate prosthetics by eye and impulse and any other user input
- use of implants such as hearing to support communication for those that are deaf or hard of hearing

	• reference to athletics for the less abled and advances in technology used • some range of technology is explained. 1: Brief statements with no justification may include the following: • some reference to medical aids, not linked to how it would aid (artificial limbs, stilts) • some reference to examples but limited in context • some range of technology explained. No written material that has any reference to the context of prosthetics. Accept any other suitable response.	

Assessment Objective Grid

Question	AO1	AO2	AO3	Total
1	1			1
2	1			1
3		2		2
4a	1			1
4b	1	2		3
5	2			2
6a	1			1
6b	2		2	4
6c	1			1
7	2			2
8	3	3	3	9
9		2		2
10a	1			1
10b	1			1
10c	1			1
10d	3			3
11	1			1

12	1			1
13	1			1
14	1			1
15			3	3
16a	1			1
16b	1	1		2
16c	1	2		3
17	3	3	3	9
18a	1		1	2
18b		1	1	2
19a		2		2
19b		5		5
20	1	2		3
21	3	3	3	9
Total	**36**	**28**	**16**	**80**