Cambridge National

Engineering

R101/01: Principles in Engineering and Engineering Business: Engineering principles

Level 1/2 Cambridge National Certificate/Award

Mark Scheme for June 2022

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

PREPARATION FOR MARKING ON-SCREEN

1. Make sure that you have accessed and completed the relevant and training packages for on-screen Marking: *scoris assessor Online Training* and the *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the Instructions for On-Screen Marking and the Mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to scoris and Mark the **required number** of practice responses and the **required number** of standardisation responses.

MARKING INSTRUCTIONS – FOR MARKING ON-SCREEN AND FOR PAPER BASED MARKING

1. Mark strictly to the Mark scheme.

2. Marks awarded must relate directly to the Marking criteria.

3. The schedule of dates is very important. It is essential that you meet the scoris 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the Mark scheme, consult your Team Leader by telephone or the scoris messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of questions across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. (The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)

   Multiple Choice Question Responses

When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate). When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

Contradictory Responses
When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. (The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
    - there is nothing written in the answer space

Award Zero '0' if:
    - anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The scoris **comments box** is used by your team leader to explain the Marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
If you have any questions or comments for your team leader, use the phone, the scoris messaging system, or e-mail.

9. For answers Marked by levels of response:
   a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
   b. **To determine the Mark within the level**, consider the following:

Descriptor	Award Mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of Marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of Marks available)
Consistently meets the criteria for this level	At top of level

10. These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

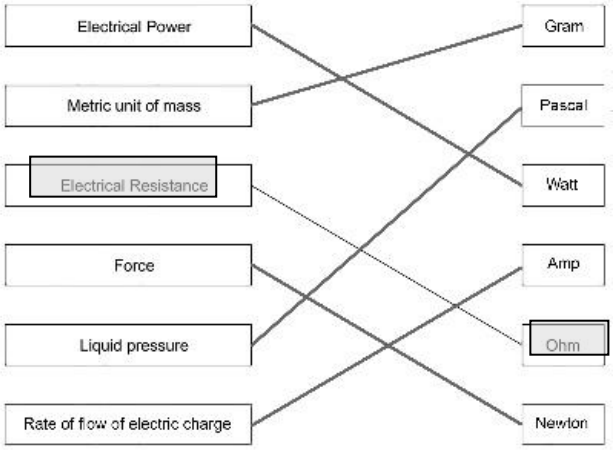
Annotation	Meaning of annotation
	Blank page
	Tick
	Cross
	Noted but no credit given
	Repeat

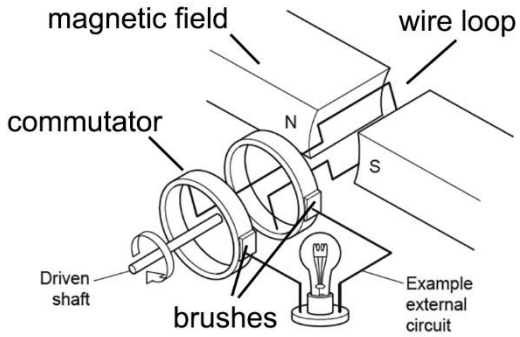
BOD	Benefit of doubt
NBOD	Benefit of doubt not given
ECF	Error carried forward
DEV	Development
EG	Example/Reference
K	Knowledge
L1	Level 1
L2	Level 2
L3	Level 3

11. Here are the subject specific instructions for this question paper

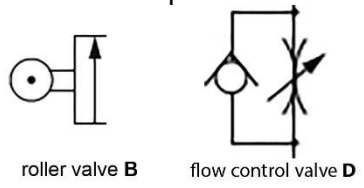
All responses must be visibly marked with ticks or crosses or SEEN. Additional annotation can be used to clarify.

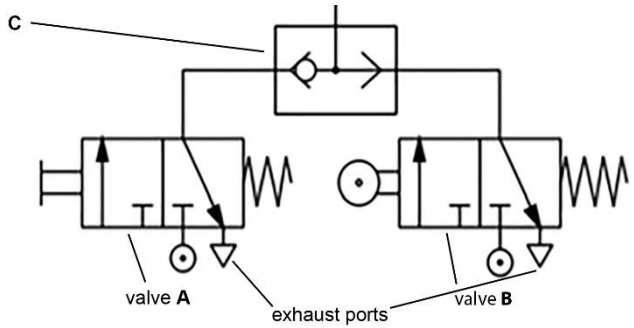
12. Here is the Mark scheme for this question paper.

Question			Answer/Indicative content	Mark	Guidance
1	(a)		 Engineering measurement linked to the correct Unit (4x1)	4	Electrical resistance – Ohm already given. 1 match correct [1] 2 matches correct [2] 3 matches correct [3] 4 or 5 matches correct [4]
	(b)	(i)	$W_{KE} = 1/2mv^2$ Working out, ½ m =1000 x 5^2 1000 x 5 x 5 Answer **25,000** [1] J (Joules) [1] (2x1)	2	No mark for stating formula One mark for correct answer One mark for correct units

Question			Answer/Indicative content	Mark	Guidance
		(ii)	Kinetic Energy (1) (1x1)	**1**	Allow BOD for Gravitational or Gravitational Potential Energy.
	(c)		The mechanical efficiency of an internal combustion engine is found to be 35%. Mechanical efficiency is the ratio of …**work done**… to the **energy supplied** to an engine. Two sources of where efficiency is lost are …**heat**…… and friction. (3x1)	**3**	
			Total	**[10]**	
2	**(a)**	**(i)**	Generator (1) (1x1)	**1**	Accept dynamo.
		(ii)	 Any three correct labelled component parts. (3x1)	**3**	Allow (permanent) magnets or magnetic poles for 'magnetic field'. Allow 'contacts' for 'brushes'. Allow 'coil' for wire loop. Allow slip ring – BOD. No marks for electromagnet.
		(iii)	Description of current being induced into the wire loop /armature. i.e. the shaft is rotated through a magnetic field (1) and current is induced [accept similar terms] into the wire loop/armature (1) which is collected on the commutator (1) through the brushes to the output (1). (3x1)	**3**	Allow two marks for a full explanation of a single point.

Question			Answer/Indicative content	Mark	Guidance
	(b)		Explanation of the generator output with three valid points e.g. The output is direct current (DC) (1) which flows starting from zero at rest (1) and is then a half wave rectified positive voltage (1) There is no negative voltage produced (1), over time/time taken for one cycle. (3x1)	**3**	Allow two marks for a full explanation of a single point.
			Total	**[10]**	
3	**(a)**	**(i)**	Relay (1) Motor (1) Solenoid (1) (1x1)	**1**	Allow any other valid electro mechanical device e.g. servo.
		(ii)	Distance moved by Driven pulley = 160 = 2 2:1, (1) Distance moved by Driver pulley 80 2 x 900 =**1800** rpm, (1)	**2**	Award two marks for correct answer with no working.
		(iii)	The generator will start to charge at lower engine revolutions (1) or Higher output at lower engine rpm. (1) (1x1)	**1**	Only allow reference to the pulley spinning faster when linked to electrical output. Only allow reference to 'increase' if it could refer to electrical output BOD. Only award mark for reference to change in electrical output.
	(b)	**(i)**	Vacuum suction can: • Lift and hold any shape object • Will hold items gently • Will not leave marks or scratches on components • Vacuum can lift light or heavy objects • Can operate in small areas • Clean / hygienic method • Can lift delicate / fragile items • Can operate at high speed. (2x1)	**2**	Allow similar answers.

Question			Answer/Indicative content	Mark	Guidance
		(ii)	Description of how vacuum is created e.g. Vacuum is created by sucking out air from a chamber (1) whilst atmospheric pressure (1) is acting on the object. The reduction in atmospheric pressure in the chamber creates suction (1), which is used to lift the object.(1) (3 x1)	3	Allow appropriate descriptions.
		(iii)	• One mark for a correct application. e.g.: • Vacuum is used in food manufacture to move objects • Vacuum is used to seal packaging air-tight so no contaminants can get in. • Vacuum is used to lift/place glass on cars etc. • Vacuum forming of plastics • Pick and place assembly • Vacuum cleaning / dust extraction.	1	Allow any other valid alternative. Vacuum cleaning must be justified.
			Total	**[10]**	
4	(a)		Component **E** uses a spring as a return spring to return the piston in the actuator (1) Return spring (1) To make the piston reset / instroke(1). (1x1)	1	Award mark for understanding shown.
	(b)		Candidates label the roller on Valve **B** (1) Candidates label component **D** as flow control valve (1)  (2x1)	2	If same label is applied twice it must be clear which is the intended answer.
	(c)		…**3**…… Ports (1) …**2**…… Positions (1) (2x1)	2	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td> 

Candidates correctly either of the two exhaust ports (1)
(1x1)</td><td>1</td><td></td></tr>
<tr><td></td><td>(e)</td><td></td><td>1 mark for each correct stage in the correct order of sequence. (stages U,Q, R, T, P, S) i.e.:
<table>
<tr><td>Sequence</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Stage of operation</td><td>U</td><td>Q</td><td>R</td><td>T</td><td>P</td><td>S</td></tr>
</table>
(4x1)</td><td>4</td><td>4 – T already given

1 stage correct [1]
2 stages correct [2]
3 stages correct [3]
4 or 5 stages correct [4]</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>[10]</td><td></td></tr>
<tr><td>5</td><td>(a)</td><td>(i)</td><td>Shuttle valve (1)</td><td>1</td><td>This is the only acceptable answer</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Description should contain the following points:
• Two possible inputs one output [1]
• Air enters P1 (P2) ball moves and seals opposite side [1]
• Air flows from input P1 (P2) to A [1]
• Air applied to opposite input ball moves to block other input.[1]</td><td>4</td><td></td></tr>
</table>

Question			Answer/Indicative content	Mark	Guidance
	(b)	**(i)**	Award mark for each correct explanation point of how the fluid is controlled e.g. The pump creates pressure in the sealed system. (1) The operator uses the manual control valve to allow hydraulic fluid under pressure (1) to direct flow to the hydraulic cylinder/actuator. (1) Fluid fills one side of the cylinder and forces fluid out of the other cylinder port, back to the reservoir. (1) (4x1)	**4**	Award marks for correct variations.
		(ii)	The filter is there to remove impurities and particles from the hydraulic fluid that could cause damage (1) (4x1)	**1**	Do not accept reference to pneumatic/air related system.
			Total	**[10]**	
6	**(a)**	**(i)**	12V – 2V = 10V 10/560 (1) = **0.0178 A** or **17 mA** (1) (2x1)	**2**	Allow rounding up to **0.018 A** If the voltage drop is not applied: Allow ecf 12/560 = **0.0214 A** or **2 mA** Allow rounding up to **0.02A**. Maximum 1 mark annotate with **ecf.**
		(ii)	Any two valid points made. e.g. • Low current draw / energy efficient • The battery will last longer • If a generator/dynamo is used, very little current will need to be generated • LED will last longer, filament lamps can break or fail through vibration, bumps and uneven road surface could cause the filament to break • Low cost of LEDs compared to filament lamp • LEDs are usually smaller/smaller package/unit • No / very little heat given out • Extremely bright. (2x1)	**2**	No mark for unjustified reference to cost, i.e. cheaper, cost effective.

Question			Guidance	Marks	Answer
	(b)*		Award up to 6 marks for a discussion on how portable energy supply impacts on equipment choice. **Level 3 (5 – 6 Marks)** Detailed discussion showing clear understanding of how portable energy supply impacts on equipment choice. Understanding of different types of power supply, the limitations of each with appropriate examples given. Specialist terms will be used appropriately and correctly. The information will be presented in a structured format. The candidate can demonstrate the accurate use of spelling, punctuation and grammar. **Level 2 (3 – 4 Marks)** Adequate discussion showing an understanding of how portable energy supply impacts on equipment choice. The response may give appropriate example applications. There will be some use of specialist terms, although these may not be used appropriately. The information will be presented for the most part in a structured format. There may be occasional errors in spelling, punctuation and grammar. **Level 1 (0 – 2 Marks)** Basic discussion showing limited understanding of how portable energy supply impacts on equipment choice. There will be little or no specialist terms. Answers may well be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.	**6**	Examples and relevant points could include: • Portable equipment requires its own power supplies to be able to be portable. Examples include portable radios used where there is no mains electricity supply. • A portable energy supply usually is in the form of battery cells, rechargeable and disposable types. Re-chargeable cells are only useful if they are charged before leaving a source of mains power. • Increasingly solar powered power packs are being used for small portable devices such as mobile ‘phones and small tablets which draw relatively low levels of power consumption over long periods. • Illumination using LEDs is another example of how prolonged use can be achieved by using portable devices with low current draw. • Equipment that has higher power consumption will need re-charging more often than low power consumption equipment. This limits the type of equipment suitable for portable usage. Portable heaters need to be mains electricity powered or use

			0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at the end of the response.		fossil fuels. • Handheld portable equipment is usually powered by direct current means such as cells, unless it is connected to a portable generator which can supply alternating current directly to the equipment. • Portable generators can be used to provide sustained power sources for larger equipment used in construction, and road maintenance. • Portable generators can be used to provide power to numerous pieces of equipment at the same time. These are usually powered using piston engines to generate electrical power. Examples include temporary traffic lights, and compressors. • Portable tools used in construction are usually charged or powered by a lower mains voltage of 110V to increase the safety of using portable equipment. DC powered equipment is safer to use than AC powered equipment. AC cannot be stored unlike DC power supplies.
			Total	**[10]**	

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