Cambridge Technicals
Engineering

Unit 2: Application of engineering principles

Level 2 Cambridge Technical Certificate/Diploma in Engineering
05887 - 05888

Mark Scheme for June 2019

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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.

Annotations

Annotation	Meaning
	Correct point made
	Incorrect
	Error carried forward in calculation questions
	Seen but attracts no credit / Blank answer space
	Response unclear
	Benefit of doubt given
	No benefit of doubt given
	Correct example or application given
	Identification/knowledge point made
	Understanding shown
Level of response annotations	
	Level 1
	Level 2
	Level 3

Question			Answer	Marks	Guidance
1	(a)		= 80 x 0.1 (radius 0.2/2) = 8 (Nm)	2	Formula given in the question T = Fr Award one mark for 80 x 0.1 8 scores two (unit not required) Award one mark for 16 or 80 x 0.2 seen (Nm)
	(b)		Efficiency = (output power/input power) 100% = (400/500) 100% = 80 (%)	3	Award one mark for recall of Efficiency = (output power/input power) 100% (Seen or implied) Award two marks for (400/500) seen Award three marks for 80 or 0.8
	(c)		P = 2πNT/60 = 2π x (400/60) x 2 = 83.78 W	4	Award one mark for P = 2πNT/60 (seen or implied) Award two marks for 2π x (400/60) x 1 Award three marks for 84 (83.78) Award one mark for 400x2 or 800 Award one mark for W
2	(a)		Methods of material removal include: Filing Grinding Drilling Milling Cutting Turning	3	Award one mark for each correct response up to a maximum of three. Accept other correct responses.

Question			Answer	Marks	Guidance
	(b)		Examples of additive manufacturing are: Sintering Fuse deposition Rapid prototyping	3	Award one mark for each correct response up to a maximum of three. Accept other correct responses (c.f. specification)
	(c)		Material properties: Toughness for cast iron machine base Corrosion resistance for bronze boat propeller Low conductivity of electricity for urea-formaldehyde light switch.	3	Award one mark for each correct response up to a maximum of three. Accept other correct responses.
	(d)		Considerations: Relative cost Relative availability Safety in manufacture Standard forms of supply	3	Award one mark for each correct response up to a maximum of three. Accept other correct responses (eg hardness, strength etc.)

Question			Answer	Marks	Guidance
3	(a)		Switch activation: Toggle Slide Push button Rotary	1	Award one mark for a correct response. Allow action taken to activate – e.g. pull, push etc
	(b)		Solid core cable Fixed installation e.g. household wiring Stranded/ multicore cable Flexible/ moving installations e.g. domestic appliances Ribbon cable Installations requiring many flexible conductors e.g. computer disk drive	4	Award one mark for each correct cable type up to a maximum of two marks. Award one mark for each correct installation type up to a maximum of two marks. Accept other correct responses for applications.

Question			Answer	Marks	Guidance
	(c)		A light dependent resistor (LDR), changes resistance in a circuit based on how much light shines on it. OR In most circuit designs, the LDR acts like an on/off switch based on how much light shines on it. When in full light, the LDR has no resistance and current flows freely. OR In darkness the resistance increases and current flow ceases. LDR applications: Lighting control Camera shutter control Street lamps including solar street lamps Alarm clocks Burglar alarm Light intensity meters	5	Award one mark for reference to 'changes resistance according to light intensity' or acts as an on/off switch for light intensity. Award one mark for specific reference to 'full light LDR no resistance or in darkness resistance increases' Award one mark for each correct application of an LDR up to a maximum of three. Accept other correct responses.
	(d)		A circuit/device is protected by a fuse wire that melts/ breaks/ disconnects if a fault causes too much current flow (or power too high). This causes the circuit/device to disconnect from the supply.	2	One mark for each marking point (max 2) Accept other correct responses.

Question			Answer	Marks	Guidance
4	(a)		Up to three marks for an explanation of the operation of a linear double acting actuator e.g.: A DA Cylinder (Actuator) has two ports and has dual pressure chambers which provide pneumatic power on both extension and retraction, eliminating the need for a spring. The piston rod retracts when air pressure is directed to the rod end of the cylinder. The piston rod is extended by directing air pressure to the blind end of the cylinder. Accept other correct responses.	3	Award one mark for reference to two ports and dual pressure chambers. Award one mark for reference to 'The piston rod retracts when air pressure is directed to the rod end of the cylinder'. Award one mark for reference to 'The piston rod is extended by directing air pressure to the blind end of the cylinder'. Allow answers without reference to components e.g.: A piston rod will extend when fluid power is forced into the cylinder against the face of a piston. To retract, fluid power would be forced into the cylinder at the rod end.
	(b)	(i)	Pilot-operated valves are used in hydraulic equipment. The valves can be pressure regulator valves, solenoid valves or check valves. The pilot valve acts as an open and closed switch. When the switch is open, hydraulic fluid flows into other valves. When the fluid reaches the other valves, each valve completes another part of the hydraulic process. When the switch is closed, hydraulic fluid does not flow.	2	Award one mark for 'The pilot valve acts as an open and closed switch. When the switch is open, hydraulic fluid flows into other valves'. Award one mark for 'When the fluid reaches the other valves, each valve completes another part of the hydraulic process. When the switch is closed, hydraulic fluid does not flow'. Accept other correct responses.

Question			Answer	Marks	Guidance
	(b)	(ii)	Emergency and safety control for high pressure events *Can be set as 'dead man's switch'* Can be set 'push to activate'. Refrigeration plants: Can be an expansion valve which acts as an external thermo element for controlling an injection. Can be an external thermo element to check that temperature does not fall below a prescribed value.	2	Award one mark for each correct response up to a maximum of two. Accept other correct responses. Award max one mark for correct comment on operation if no marks scored in (b)(i)
	(c)		Up to three marks for an explanation of the operation of a dynamic axial pneumatic device e.g.: With an axial dynamic power source i.e. compressor, the air or gas passes along the compressor shaft through rows of rotating and stationary impellers. The air velocity is gradually increased at the same time as the stationary blades convert the kinetic energy to pressure. A balancing drum is often built into the compressor to counterbalance axial thrust. Axial compressors are usually smaller than an equivalent centrifugal compressors and operate at a higher speed. They are used for constant high volume rate of flow at a relatively moderate pressure. Accept other correct responses.	3	Award one mark for each correct operation response up to a maximum of three. Allow explanation of operation (what happens input and output) without identifying specific components.

Question			Answer	Marks	Guidance
	(d)		Applications: Oil refineries Gas pipelines Chemical plants Natural gas processing plants Refrigeration plants Car repair and maintenance Medical and dental tools/machinery Cleaning machine parts Power tools	2	Award one mark for each correct response up to a maximum of two. Accept other correct responses.

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