OCR
Oxford Cambridge and RSA

Cambridge National

Engineering

Unit **R101:** Engineering Principles

Level 1/2 Cambridge National Award/Certificate in Principles in Engineering and Engineering Business

Mark Scheme for January 2016

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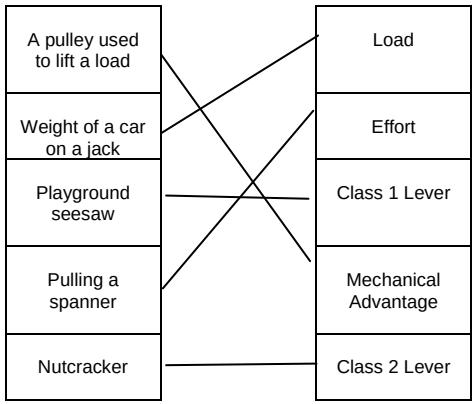
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

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.

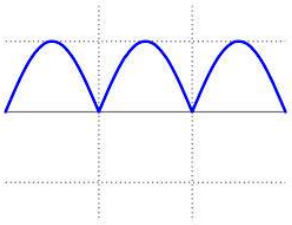
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Question			Answer/Indicative content	Mark	Guidance
1	(a)	(i)	Candidates match the correct term with the correct example;  (1x 4)	4	
		(ii)	Examples of mechanical advantage such as/e.g.; 1mark for example, 1 mark for description of use. Hammer(1) used to pull out nails using leverage (1) Pallet lift truck(1) using mechanical effort and hydraulics(1) Wheel barrow (1) to assist in carrying heavy loads (1) Fishing rod and reel (1) to pull in the load (1) Spanner (1) used to tighten a bolt as a lever (1) Pulley systems (1) (2x1)	2	Allow other valid examples.
		(iii)	Correct example e.g. BBQ tongs (1) Tweezers (1) Hair Straighteners (1) (1x1)	1	

Question			Answer/Indicative content	Mark	Guidance
	(b)		Fulcrum is found between the load (1) and the effort /force (1) in a class 1 lever or Before/in front of the applied force in a 3rd class lever. A pivot point (1) around which a lever turns (1) (2x1)	**2**	
2	**(a)**	**i**	Arrow drawn on gear B going in a clockwise direction (1) (1x1)	**1**	
		ii	The output direction is the same as the input. (1) The idler gear allows the output (driven) gear to travel in the same direction as the input (driver) (1) Join two gears without affecting rotation (1) (1x1)	**1**	Do NOT accept 'change direction' unless exemplified by stating 'both gears rotate in the same direction.'
		iii	Work done = force x distance (1) = 300N x 3m = 900Nm or joules (1) (2x1)	**2**	1 mark for correct formula and/or workings 1 mark for correct answer with or without units 2 marks for correct answer
	(b)		Up to 2 marks for clear description. Long handles of the wheel barrow allow the user's effort (1) to lift the load pivoting on the wheel as the fulcrum (1). Or The wheel barrow is a class 2 lever/type of lever. (1) The handles enable less effort to be used to lift the load. (1) The wheel acts a fulcrum (or pivot) (1). Designed to put load as close (or over) fulcrum (1) (2x1)	**2**	

Question			Answer/Indicative content	Mark	Guidance
	(c)		Generators and alternators use **kinetic** energy in a rotating motion to produce **electrical** energy which is stored in a battery in the form of **Chemical** energy. This energy is used by the flow of **electrons** through a conductor to power lamps, relays, motors, and other electrical devices. (4x1)	4	
3	(a)	(i)	Parallel (1x1)	1	
		(ii)	The Ohmmeter would be positioned across/in parallel with the R3 resistor (1). The value shown would then be compared to the resistor value (1).	2	
		(iii)	$R_1 = 15\ \Omega$ $R_2 = 12\ \Omega$ $R_3 = 10\ \Omega$ $1/R_T = 1/R_1 + 1/R_2 + 1/R_3$ $1/R_T = 1/15 + 1/12 + 1/10$ $1/R_T = 4/60 + 5/60 + 6/60$ $1/R_T = 15/60$ (1) $R_T = 60 / 15$ (1) $R_T = 4\ \Omega$ The total resistance is 4 Ω. (1) (3x1)	3	1 mark for correct use of formula 1 mark for transposition 1 mark for correct answer (units not necessary) Allow 3 marks for correct answer with no workings.

Question			Answer/Indicative content	Mark	Guidance
	(b)	**(i)**	Component D is a diode (1)	**1**	Accept 'to rectify the current' (1)
		(ii)	To provide half-wave rectification (1) To only allow current to flow in one direction (1)	**1**	Accept description of the correct function of a diode i.e. to only allow current to flow in one direction.
		(iii)	Indication that wave is repeated (1) Half sine wave (1) Correct position on axis (1) (3x1)	**3**	
4	**(a)**	**(i)**	Permanent magnet / DC motor (1x1)	**1**	Accept 'magnetic motor.'
		(ii)	When the current is applied the coil spins (1) due to magnetic attraction pulls the current carrying conductor around (1) (2x1)	**2**	No marks awarded for 'creates a magnetic field.'
		(iii)	By reversing the polarity of the input / supply voltage	**1**	
		(iv)	The motor will rotate in the opposite direction. (1x1)	**1**	
		(v)	Any type of permanent magnet motor application; e.g. • Windscreen wiper motor • Electric window winder • Toy car • Fan (1x1)	**1**	Accept other valid response.

Question			Answer/Indicative content	Mark	Guidance
4	(b)		Relay (1x1)	1	
	(c)	(i)	Between points **A** and **B** Use ohm meter : To test continuity (1) to check continuity of relay windings (1) To check resistance (1) Current measurement (1) using ammeter or multimeter (1) Voltage measurement (1) using a voltmeter across A&B (1)	2	
		(ii)	Between points **C** and **D**. To test continuity (1) across the contacts (1) Resistance test (1), using ohm meter or multimeter (1) Connect a device (LED/LAMP) on one contact (1) and connect a power source to the other. When the contacts meet the device will operate. (1) (2x1)	2	Do NOT accept responses related to voltage/voltmeter
5	(a)	(i)	Push button (1) valves (1) 3/2 valves (2) Pushbutton 3/2 valves (2) Pushbutton valves (2) 3 port valve (1) (2x1)	2	'3 port valve' 1 mark. Must have '3/2 valve' for 2 marks
		(ii)	Valves A and B are both required to be pressed to operate the cylinder (1) for safety (1). The cylinder will only actuate when both A & B have been pressed.(1) (2x1)	2	

Question			Answer/Indicative content	Mark	Guidance
		(iii)	When both 3/2 valves A & B are pressed the air flows to the cylinder causing it to outstroke/actuate (1). The cylinder uses a return spring to return to the in stroke position (1). (2x1)	**2**	
	(b)		Pressure = Force/Cross-sectional area. 20/0.01 (1) =2000kN m^{-2} (1) (2x1)	**2**	No marks for stating the formula BOD for correct answer without units.
	(c)	**(i)**	Hydraulic (1) (1x1)	**1**	
		(ii)	Great amount of force produced to lift the platform (1) Quickly, and accurately/ controllable. (1) Hydraulic fluid cannot be compressed (1) so the platform will not bounce. (1) (1x1)	**1**	Do not accept 'strong/stronger' unless exemplified e.g. 'hydraulics are stronger than pneumatics.' Or 'hydraulics are able to lift heavy loads.'

Question			Answer/Indicative content	Mark	Guidance
6	(a)		Up to 2 marks for a clear description demonstrating understanding. With pneumatics the exhaust air can be vented into the atmosphere (1) and does not use a sealed system (1) Hydraulics used a sealed system, and the hydraulic oil will not compress. (1) unlike pneumatics which use air (1) The hydraulic piston can be stopped and held anywhere along the linear stroke. (1) whereas pneumatic cannot be stopped along the stroke (1) The pneumatic cylinder can be used in high speed applications (1) and can use a spring to return the original position. (1) Pnuematic use air, hydraulic use liquid (1) Hydraulic systems can be used to lift greater loads than pneumatics. (1) (2x1)	**2**	Any 2 relevant points.
		b	Automated production lines Gearbox (operation) Braking systems. Air-ride suspension Bus door / door opening systems (1x1)	**1**	Accept other suitable relevant answers.

Question			Guidance	Marks	Answer
					Vacuum is increasingly used for industrial lifting in construction and manufacturing engineering, to allow lifting of heavy materials. Vacuum systems are quiet and can equally be used in automation. Vacuum lifting devices removes the time spent rigging and de-rigging. Vacuum can be used to slowly and meticulously move heavy objects without the use of ropes, slings and chains. Vacuum can be used to allow accurate placement of materials including hot or awkward shaped materials. Mechanical methods usually use some form of attachment to hold materials that can get in the way of placement, where as vacuum attaches directly to the material. Mechanical methods can leave marks or present risk of damage to materials. Using vacuum lifting equipment can reduce any damage caused by manual handling.
6*	**(c)**		Award up to six Marks for a discussion or detailed explanation of the advantages of using vacuum, with some comparison to mechanical handling equipment methods, relevant to meet the needs of users/applications. **Level 3 (5 – 6 Marks)** Detailed discussion showing clear understanding of the advantages of using vacuum rather than mechanical methods. 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 the advantages of using vacuum rather than mechanical methods. 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 the advantages of using vacuum rather than mechanical methods. There will be little or no specialist terms. Answers may well be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive. 0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at the end of the response.	**[6]**	
			Total	**60**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Facsimile: 01223 552553