

Cambridge National

**PRINCIPLES IN ENGINEERING AND ENGINEERING
BUSINESS**

Level 1/2 CAMBRIDGE NATIONALS IN PRINCIPLES IN ENGINEERING AND
ENGINEERING BUSINESS

R101/01 Engineering principles

Mark Scheme for Jan 2020

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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.

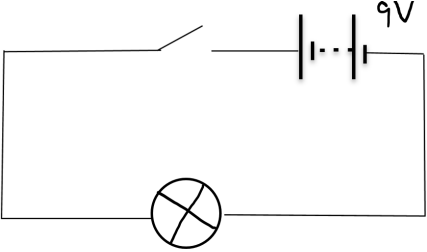
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10. These are the annotations, (including abbreviations), including those used in scoris, which are used when Marking

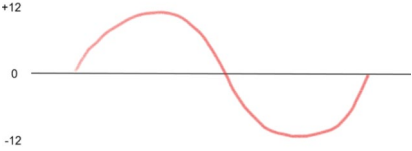
Annotation	Meaning of annotation
	Blank page
	Vague
	Tick
	Noted but no credit given
	Unclear
	Repeat
	Benefit of doubt
	Cross
	Development
	Example/Reference
	Knowledge
	Level 1
	Level 2
	Level 3

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

Question			Answer/Indicative content	Mark	Guidance
1	(a)	(i)	<p style="text-align: right;">(4x1)</p>	4	
		(ii)	Any suitable mechanical application e.g. Gearbox (1) Wheelbarrow (1) Jack (1) Engine (1)	1	Allow any other valid example. Pulley, Bike, Hand tools, Wind up clock torch, Foot switch etc.
	(b)		Valid combinations i.e. Chemical to Kinetic/Mechanical (2) Chemical to Heat/Sound (2) Mechanical/kinetic to Sound (2)	4	Answers must be in the correct order to award the marks i.e. (Sound or Heat could not come first as it is a secondary action).
	(c)		Kinetic energy of an object is the that it possesses due to its motion (1) Moving object having energy (1)	1	Look for reference to movement/motion/moving. Do Not award "Friction"
			Total	[10]	

2	(a)	(i)	<p>1 mark for each correct component</p>  <p style="text-align: right;">(2x1)</p>	2	<p>Allow a single cell or a symbol for a filament lamp.</p> <p>Location of the symbol is not important</p> <p>Allow 1 mark per symbol but the circuit must work</p> <p>Symbol must closely match the corrects symbol.</p>
		(ii)	<p>$I = P/V$ (1)</p> <p>$3/9 = 0.33A$ or $330mA$ (2)</p> <p style="text-align: right;">(2x1)</p>	2	<p>Formula only but incorrect answer = 1 mark</p> <p>Look for $I=P/V$ or in triangle for 1 mark</p> <p>Correct answer with no working = 2 marks</p> <p>Allow rounding up to .3A</p> <p>Do not award marks for $9 / 3$ [9 divided by 3]</p>
		(iii)	<p>1 mark for each valid answer i.e.</p> <p>The circuit will draw more current (1)</p> <p>The lamp will be brighter (1)</p> <p>The 9v battery will not last as long (1)</p> <p style="text-align: right;">(2x1)</p>	2	<p>Do NOT award – “take more energy”, “Increases of resistance”, “Need more power” or similar.</p>
	(b)		<p>Correctly completed statement; 1 mark for each correct term in the correct position i.e.</p> <p>The potential difference in a circuit can be measured by placing a voltmeter in parallel with a component. The current can be measured by placing an ammeter in series with a component.</p>	4	

			(4x1)		
			Total	[10]	

3	(a)	(i)	<p>Generator (1) Alternator (1)</p> <p style="text-align: right;">(1x1)</p>	1	Do not award motor.
		(ii)	 <p>Candidate draws a sinewave (1) Sinewave goes from + through 0v to -V (1) Sinewave is only 1 cycle as shown (1)</p> <p style="text-align: right;">(3x1)</p>	3	
		(iii)	<p>The magnetic field spins inside the generator field coil (1) winding to induce a current (1) into the field coils to produce a current, collected at the brushes (1). A motor uses a spinning coil (1) which is supplied with a current inside a magnetic field, the stator (1)</p> <p style="text-align: center;"><i>or</i></p> <p>Motor converts electrical energy into mechanical energy (1), where the armature is supplied with as current (1). The generator uses mechanical energy to produce an electrical current (1).</p> <p style="text-align: right;">(3x1)</p>	3	Accept valid combinations to a maximum of 3 marks.
		(iv)	<p>The generator could be mounted on to the engine, (1) and driven with a belt and pulley, (1) from the crank shaft to the generator. If the generator has a smaller pulley than the engine, (1) the generator will rotate faster than the engine rpm, (1).</p> <p style="text-align: right;">(3x1)</p>	3	Accept valid combinations to a maximum of 3 marks. Answer MUST include smaller pulley on generator than engine for full marks, or driven faster than engine rpm.

			Total	[10]	
4	(a)	(i)	Hydraulics can be controlled to operate slowly/smoothly (1) The hydraulic system is sealed so the lift cannot collapse without the control to allow the fluid to the other side of the rams. (1) The lift can carry heavy loads (1) Portable (1) (2x1)	2	Allow: Hydraulic fluid cannot be compressed (1) Powerful/Strong (1) – BOD Not spongy, less bounce
		(ii)	1 mark for each valid symptom (operational or physical) The lift may be unresponsive/ very slow to operate or may not function (1) There will be leaking fluid (1) Low pressure (1) (1x1)	1	
	(b)	(i)	Hydraulic systems are sealed systems where the hydraulic fluid cannot escape (1). The system uses a pump to supply fluid to each side of the cylinder/actuator (1) The hydraulic fluid is stored in a reservoir and held under pressure in the system (1). (3x1)	3	
	(b)	(ii)	Valid description of hydraulic control system. 1 mark for each correctly used term given. i.e. The digger engine provides mechanical power to drive the compressor pump . (1) The pump supplies the control valve with hydraulic fluid under pressure.(1) The control valve is used to release the fluid from one side of the double acting cylinder to control the movement of the digger bucket. (1) When the fluid is released from one side of the cylinder, it flows back to the receiver .(1) (4x1)	4	
			Total	[10]	

5	(a)	(i)	'electro pneumatic' means an electric current is used to control air pressure (1) to move an object such as an actuator or open and close a compressed air valve. (1) (2x1)	2	
		(ii)	Electrical signals can be used to control pneumatics at a distance from the operator (1) Electricals signals can be used to control the pneumatics automatically /be programmed.(1) Less air line length required (1) (1x1)	1	Answers should relate to remote application
		(iii)	An assembly line to assemble products (1) In any PLC application (1) Automated machinery (1) Types of lift (1) Suspension (1), Opening bus doors, bus lowering systems (1) (1x1)	1	Accept suitable examples. Electric Pump – BOD
		(iv)	DC power supply (1) Control valves/input switches/relay (1) Output solenoid valve (1) Limit switches (1) Sensors /feedback/signal processing/timer (1) (3x1)	3	Pumps, Compressors, Batteries, Double acting cylinders BOD
	(b)	(i)	Make sure the air supply is off before removing compressed air pipes (1) Compressed air can contain harmful particles (1) Actuators/cylinders can cause hazards as the extend or contract (1) High air pressures (1) Compressed air can be dangerous (1) (2x1)	2	Burst/Split pipes not awarded unless qualified Air leaks not awarded unless qualified

	(c)		Any one correct electrical - mechanical application e.g. Electrical motor (1) Electrical pump (1) Electric vehicles (1) Electric Tail lift (1) Electric gearbox (1) (2x1)	1	Lathe, drill, watch, winch – BOD
			Total	[10]	
6	(a)	(i)	Using two pulleys nearly halves the effort (1) required by the operator, as the load is shared (1) across the two pulleys. Each pulley has an anchored point. (1) (3x1)	3	
		(ii)	1 mark for correct methods to reduce the effort, e.g. Increase the diameter of the bottom pulley (1) Add another pulley (1) (1x1)	1	Allow “Add more wheels” Do NOT award longer/increase length of rope

Question	Guidance	Marks	Answer
(b)*	<p>Level 3 (5 – 6 Marks) Detailed discussion showing clear understanding of the differences in using pulley drive systems compared to gear driven mechanisms.</p> <p>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.</p> <p>Level 2 (3 – 4 Marks) Adequate discussion showing an understanding of the differences in using pulley drive systems compared to gear driven mechanisms. Understanding of the how the choice of mechanical drive system may be influenced such as maintenance and or torque energy requirements.</p> <p>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.</p> <p>Level 1 (0 – 2 Marks) Basic discussion showing limited understanding of the differences in using pulley drive systems compared to gear driven mechanisms.</p> <p>There will be little or no specialist terms. Answers may well be ambiguous or disorganised. Errors of spelling, punctuation and grammar may be intrusive.</p> <p>0 = a response that is irrelevant and/or not worthy of a mark. Annotate with 'Seen' at the end of the response.</p>	6	<p>Examples and relevant points could include:</p> <ul style="list-style-type: none"> • Pulley systems and gear drive systems are used in a wide range of applications and in some low torque applications such as automotive, either can be used to drive ancillary components such as pumps for power steering and air conditioning. A geared output can be used to drive a pulley system in some cases. • Pulley and belts can be used where the driven components are a distance away from the drive output where it would be expensive and impracticable to use a gear train. Pulley and belt systems can be used for applications where slippage is a requirement to prevent damage i.e. in case of seizure but can also be used where slippage would be very damaging, such as with timing belts. • Like gears, there are various types of pulleys and belts including toothed drive and ribbed types to prevent slipping. • Belts can be used to change direction i.e. 90 degrees however this is not very common. • Belts used with pulleys require regular inspection and maintenance to prevent slipping and deterioration leading to failure. • Geared drives provide quiet and relatively maintenance free drive systems capable of driving high torque and high speed outputs such as gearboxes, and drive shafts. Gears can be used to produce an output at any ratio at almost any angle which makes them very versatile. • Gears cannot slip when used in a gear train or in compound gears for example, but do require lubrication. Gears can be used in similar applications to pulley and belt systems using a chain drive.
	Total	[10]	

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