



SPECIMEN

LEVEL 1/2 CAMBRIDGE NATIONAL AWARD/CERTIFICATE IN PRINCIPLES IN ENGINEERING AND ENGINEERING BUSINESS

R101: Engineering Principles

Candidates answer on the Question Paper

OCR Supplied Materials:

- None

Other Materials Required:

- None

Duration: 1 hour



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

1. Use black ink. HB pencil may be used for graphs and diagrams only.
2. Complete the boxes above with your name, centre number and candidate number.
3. Answer **all** the questions.
4. Write your answer to each question in the space provided.
5. Do **not** write in bar codes.

INFORMATION FOR CANDIDATES

1. The total number of marks for this paper is **60**.
2. The number of marks for each question is given in brackets [] at the end of the question or part question.
3. Dimensions are in millimetres unless stated otherwise.
4. This document consists of **12** pages. Any blank pages are indicated.



Answer **all** questions.

1 **Fig.1** shows a simple lever used to lift a load.

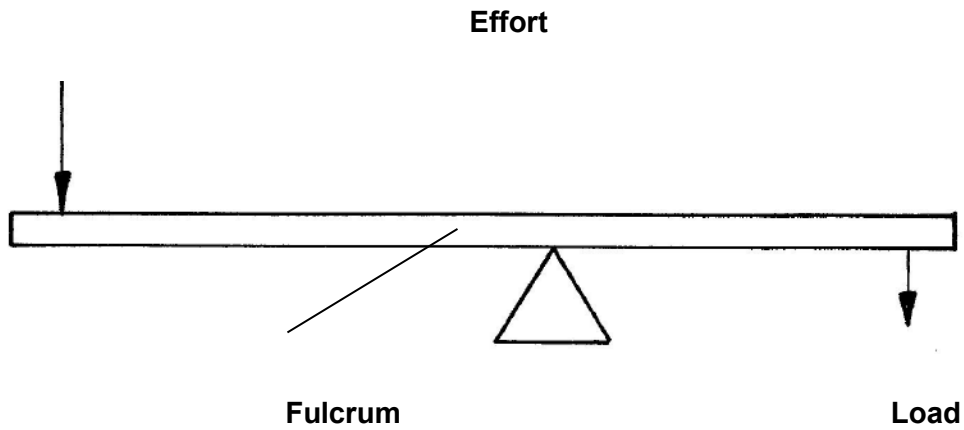


Fig. 1

(a) (i) Describe how the effort required to lift the load could be reduced.

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..... [2]

(ii) What type of force is acting on the pivot in **Fig.1**?

..... [1]

(b) Explain what is meant by the term 'torque.'

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..... [2]

(c) Energy can be defined as ‘the capacity to do work.’

State the basic unit of energy.

.....[1]

(ii) Complete the following table. One row has been completed for you.

Form of energy	Definition	Example
Electrical	Electrical energy is a form of energy that is made available by the flow of electric charge through a conductor.	Lamp
Mechanical		
Sound		

[4]

(iii) Describe the energy conversion that takes place to produce light in a simple hand held torch that uses a battery as its energy source.

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.....[4]

2 (a) Power can be defined as the 'rate at which work is done.'

State the basic unit of power[1]

(b) Fig. 2 shows a simple gear train.

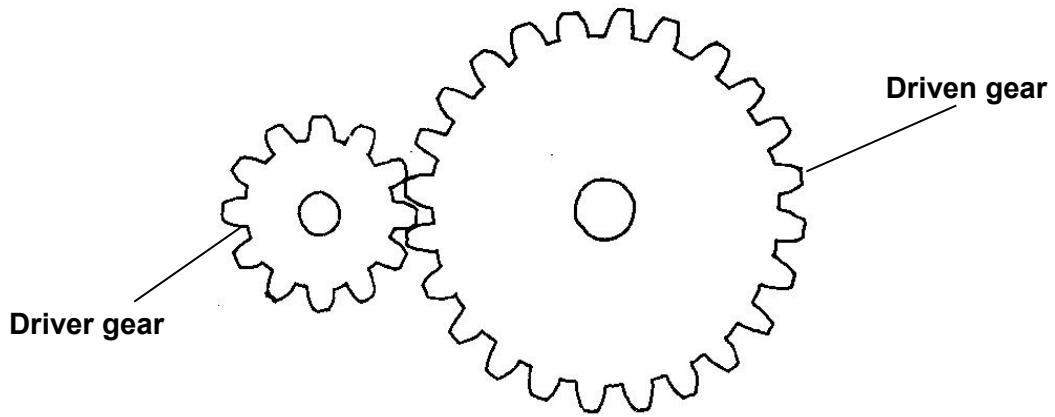


Fig. 2

(i) Give **two** ways of increasing the speed of the driven gear.

- 1
- 2[2]

(ii) Calculate the speed of the driven gear when the driver gear is turning at 100 revolutions per minute.

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.....[3]

- 3 (a) Explain using an example, **one** effect of current passing through an electric circuit.

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..... [3]

- (b) Calculate the power used in an electric fire which has a current of 10 amps flowing an element of 20 ohms resistance.

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..... [4]

- (c) Explain the simple operation of an electrically operated relay used as a switch.

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..... [3]

- 4 (a) Explain why the voltage across each of the identical lamps L1 and L2 in Fig.3 is 6 volts.

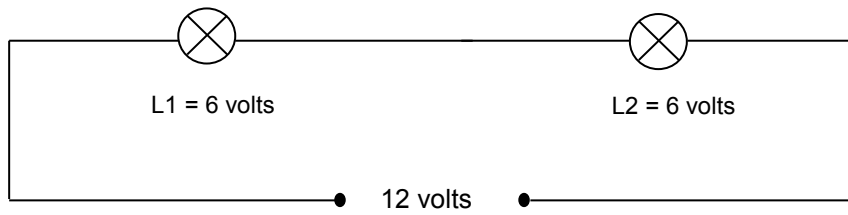


Fig .3

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..... [2]

- (b) Modern decorative lights are often connected in parallel. Give **two** advantages of this type of connection.

Advantage 1

..... [1]

Advantage 2

..... [1]

(c) State **three** advantages of using an alternating current (AC) system for supplying electricity rather than a direct current (DC) system.

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[3]

(d) Multi-meters are used to measure the values of current, voltage and resistance in electrical circuits.

Explain the procedure that should be carried out in order to accurately measure the resistance of a component in an electrical circuit.

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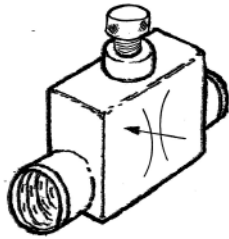
[3]

5 Fluid power systems operate on pressure produced by compressed air or hydraulic fluid.

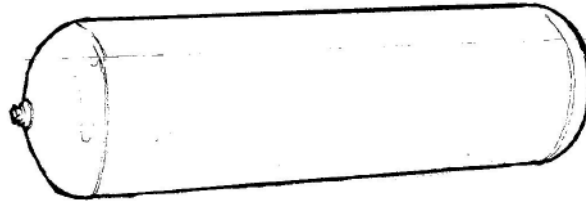
(a) Define the term 'pressure' in relation to power systems.

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..... [1]

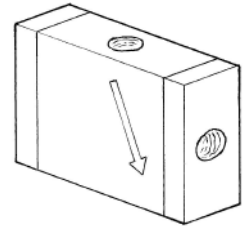
(b) Fig. 4 shows three fluid power components.



Pressure Regulator



Air reservoir



Directional Switch

Fig. 4

State the function of each component.

Pressure regulator

Function

..... [1]

Air reservoir

Function

..... [1]

Directional switch

Function

..... [1]

(c) Fig. 5 below shows a linear actuator.

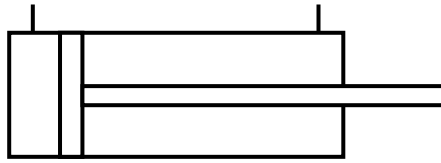


Fig. 5

Describe the operation of the linear actuator shown in Fig.5.

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[3]

6 (a) Describe how pneumatic power could be used in a production line.

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.....[2]

(b) Fig.6 shows a fork lift truck powered by batteries which drive the wheels through a gearbox.



Fig. 6

(i) State the integrated power system used in the forklift truck.

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(ii) The lifting mechanism of the fork lift truck in shown Fig.6 uses a 'hydro mechanical' system comprising of a hydraulic ram and mechanical pulleys.

Describe how the load lifting capacity could be improved by increasing the hydraulic ram size or mechanical pulleys of the system.

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[4]

*(c) Discuss the advantages of using pneumatics rather than hydraulics in engineering applications.

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[6]

END OF QUESTION PAPER

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SPECIMEN

Sample Assessment Material

LEVEL 1/2 CAMBRIDGE NATIONAL AWARD/CERTIFICATE/DIPLOMA IN PRINCIPLES IN ENGINEERING AND ENGINEERING BUSINESS

R101: Engineering Principles

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 60

SPECIMEN

This document consists of 8 pages

Question			Answer	Marks	Guidance												
1	(a)	(i)	Up to two marks for a clear description. Description to include moving effort away from fulcrum increasing effort or extending the length of the lever (1) moving load closer to fulcrum or reducing the distance between the load and fulcrum (1) (2 x 1)	2													
		(ii)	Compression	1													
	(b)		Up to two marks for a clear description. Description to include moving effort away from fulcrum increasing effort or extending the length of the lever (1) moving load closer to fulcrum or reducing the distance between the load and fulcrum (1) (2 x 1)	2													
	(c)	(i)	The Joule	1													
		(ii)	<table border="1"> <thead> <tr> <th>Form of energy</th> <th>Definition</th> <th>Example</th> </tr> </thead> <tbody> <tr> <td>Electrical</td> <td>Electric energy is a form of energy that is made available by the flow of electric charge through a conductor.</td> <td>Lamp</td> </tr> <tr> <td>Mechanical</td> <td>Energy associated with the motion and position of an object.</td> <td>Flywheel</td> </tr> <tr> <td>Sound</td> <td>Energy associated with the vibration or disturbance of matter, a mechanical wave which requires a medium to travel through</td> <td>Bell</td> </tr> </tbody> </table> (4 x 1)	Form of energy	Definition	Example	Electrical	Electric energy is a form of energy that is made available by the flow of electric charge through a conductor.	Lamp	Mechanical	Energy associated with the motion and position of an object.	Flywheel	Sound	Energy associated with the vibration or disturbance of matter, a mechanical wave which requires a medium to travel through	Bell	4	Accept other suitable examples for mechanical and sound energy.
Form of energy	Definition	Example															
Electrical	Electric energy is a form of energy that is made available by the flow of electric charge through a conductor.	Lamp															
Mechanical	Energy associated with the motion and position of an object.	Flywheel															
Sound	Energy associated with the vibration or disturbance of matter, a mechanical wave which requires a medium to travel through	Bell															

Question			Answer	Marks	Guidance
		(iii)	Up to four marks for a clear description. Chemical energy (1) from the battery is converted through chemical action into electrical energy (1) which passes through the conductive circuit and into the bulb filament converting electrical energy into heat energy (1) which is then converted into light energy (1)	4	
2	(a)		Watt or Joules per sec	1	
	(b)	(i)	One mark for each valid way of increasing the speed of the driven gear. Reduce size of driven gear Increase size of driver gear		Allow reference to increasing the speed of the driver gear
		(ii)	Selecting the correct formula as driven/driver (1) Counting the number of teeth on each wheel and applying to the formula in the correct sequence 100/50 (1) Correct ratio give as 2:1 or 50rpm (1) (3 x 1)	3	Accept 50 as an answer. Award full marks if correct answer is shown without workings
3	(a)		Up to three marks for a valid explanation. Electro magnetism (1) A magnetic field surrounds the wire when current flows (1). The intensity of the field is proportional to the amount of current (1) Heat (1) is generate in a conductor dependent on the current flowing through a resistor (1) which can be destructive (overload) of useful (light) (1)	3	

Question		Answer	Marks	Guidance
	(b)	$V = I \times R$ (1) then $P = I \times V$ (1) $200 = 10 \times 20$ (1) 2000w = 10×200 (1)	4	Award full marks for correct answer without workings But must contain w or watts (three mark without)
	(c)	<p>Up to three marks for a valid explanation.</p> <p>A relay is an electrically operated switch which uses an electromagnet to operate a switching mechanism (1)</p> <p>Relay consists of a coil of wire wrapped around a soft iron core which isn magnetised when current is passed through it. (1) A movable arm is hinged to the body and linked to a set of contacts so that when the relay is energized contact is made (1)</p>	3	
4	(a)	<p>Up to two marks for a clear explanation.</p> <p>As the lamps are identical and connected in series (1) then the applied voltage is shared equally(1) across each lamp.</p> <p style="text-align: right;">(2 x 1)</p>	2	
	(b)	<p>One mark for each advantage.</p> <p>If one lamp were to fail then the other lamps are not affected (1)</p> <p>All lamps operate at the same brilliance (1)</p> <p>The addition of further similar lamps doesn't affect the brightness of the other lamps (1)</p> <p>Easier fault finding.(1)</p> <p style="text-align: right;">(2 x 1)</p>	2	
	(c)	<p>One mark for each valid advantage:</p> <p>Response could include reference to:</p> <p>Can be transported over large distances (1)</p> <p>easier and cheaper to generate (1)</p> <p>voltage levels can be increased or decreased by transformers (1)</p> <p>Reduced voltage drop over large distances (1)</p> <p>Can be reduced in domestic applications (1)</p> <p style="text-align: right;">(3 x 1)</p>	3	

Question		Answer	Marks	Guidance
	(d)	<p>Up to three marks for a valid explanation.</p> <p>Procedure should be logical and may include reference to:</p> <p>Disconnect the circuit from the supply (1) Remove or isolate the component (1)</p> <p>Make sure that the multi-meter is correctly set to measure resistance (1) Zero the instrument before starting measurement (1).</p> <p>Safety procedures when removing components to include damage and de-soldering</p> <p style="text-align: right;">(3 x 1)</p>	3	
5	(a)	<p>Definition to include reference to force and surface area</p> <p>Pressure (the symbol: p) is the ratio of force to the area (1) over which that force is distributed.(1)</p>	1	
	(b)	<p>One mark for correctly stating the function of:</p> <p>A – pressure regulator – used to control the pressure in a circuit B – Air reservoir – used to hold supply of air/maintain pressure in system C –Directional switch – used to direct pressure to parts of a circuit</p>	3	
	(c)	<p>Up to three marks for a clear description of the operation.</p> <p>The piston is connected via a connecting rod to an external stimulus (1) at one end only (1). It is double acting since pressure can be applied at either end of the piston (1)</p> <p>Double acting means it must be returned by pressure (1)</p>	3	

Question		Answer	Marks	Guidance	
6	(a)	<p>Up to two marks for a clear description.</p> <p>Compressed air operate linear cylinders (1) can be operated by fully or semi-automatic means (1) to push, pull, lift, lower, open close or clamp (1).</p> <p>Applications can perform tasks in a certain order, in sequence or together (1) to pick and place, move, stop or redirect components (1).</p> <p>Two or more cylinders could work together to complete the task (1) and can speed up or slow down production depending on production flow (1).</p>	2		
	(b)	(i)	Electro-mechanical	1	
		(ii)	<p>Up to four marks for a clear description.</p> <p>Description should include references to both hydraulic and mechanical components</p> <p>Increasing the ram size thus increasing the surface area (1)</p> <p>Increasing the pressure of the ram(1)</p> <p>Relocating the ram so that it is further away from the pivot (increased mechanical effort (1)</p> <p>Decrease the size of the pulleys increasing leverage (1)</p> <p>Increase the number of pulleys increasing ratios (1)</p>	4	

Question	Answer	Marks	Guidance
(c)*	<p>Up to six marks for a discussion or detailed explanation of the advantages of using pneumatics. rather than hydraulics</p> <p>Level 3 (5–6 marks) Detailed discussion showing a clear understanding of the advantages of using pneumatics rather than hydraulics. 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 advantages of using pneumatics rather than hydraulics. There will be some use of specialist terms, although these may not always 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 (1–2 marks) Basic discussion showing limited understanding of the advantages of pneumatics rather than hydraulics. There will be little or no use of specialist terms. Answers may 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 end of response.</p>	6	<p>Pneumatic control systems are widely used in the industrial sectors for the driving of automatic machines.</p> <p>Very effective and little mess, many factories have equipped their production lines with compressed air supplies and movable compressors. It is difficult to transmit and transport fluid in the same way.</p> <p>There is an unlimited supply of air to produce compressed air. The use of compressed air is not restricted by distance, as it can easily be transported through pipes and does cause big problems if a small amount of air escapes in the system.</p> <p>After use, compressed air can be released directly into the atmosphere without the need of processing and does not cause environmental issues.</p> <p>Pneumatic components are durable and are not easily damaged when compared to electromotive hydraulic components; pneumatic components are reliable and usually lighter</p> <p>Simple design, the designs of pneumatic components are relatively simple. They are thus more suitable for use in simple automatic control systems.</p>
Total marks for paper		60	

Learning Outcomes (LO) Grid

			Content Area				
Question Number			LO1	LO2	LO3	LO4	
1	a	i	2				Section A
1	a	ii	1				
1	b		2				
1	c	i	1				
1	c	ii	4				
1	c	iii	4				
2	a		1				
2	b	i	2				
2	b	ii	3				
3	a			3			
3	b			4			
3	c			3			
4	a			2			
4	b			2			
4	c			3			Section B
4	d			3			
5	a				1		
5	b				2		
5	c				3		
6	a					2	
6	b	i				1	
6	b	ii				4	
6	c*					6	
Total Marks							