

Centre Number	Candidate Number	Name
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

**DESIGN AND TECHNOLOGY**

**0445/04**

Paper 4 Technology

October/November 2005

**1 hour**

Candidates answer on the Question Paper.  
No additional materials are required.

**To be taken together with Paper 1 in one session of 2 hours 45 minutes.**

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.  
Write in dark blue or black pen in the spaces provided on the Question Paper.  
You may use a soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer any **two** questions.  
The number of marks is given in brackets [ ] at the end of each question or part question.  
You may use a calculator.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

For Examiner's Use	
1	
2	
3	
4	
<b>TOTAL</b>	

1 Fig. 1 shows a design for a toy catapult.

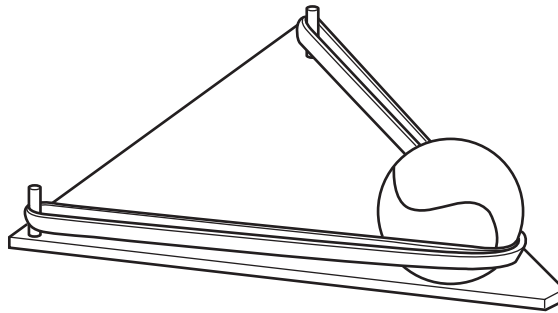


Fig. 1

(a) (i) Complete the block diagram below to show the energy conversion that takes place when the catapult is used.



[2]

(ii) Describe briefly how energy is lost in this design.

.....  
 .....  
 ..... [2]

(iii) Suggest **one** modification that could be made to reduce energy losses.

.....  
 .....  
 ..... [2]

- (iv) During development of the catapult, a student needs to test the strength of a set of elastic bands. Show, using sketches and notes, a suitable test rig for carrying out these tests.

[4]

- (b) Fig. 2 shows a design for catapult using a lever system.

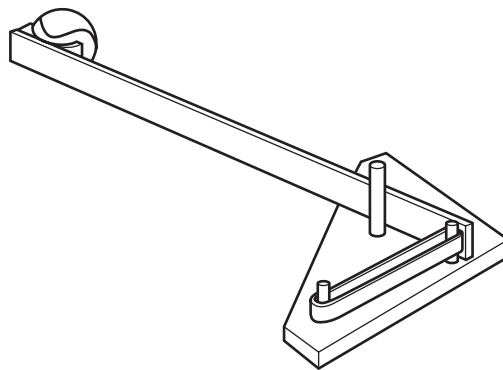


Fig. 2

- (i) Add labels to Fig. 2 to show: pivot; load; effort. [3]

- (ii) The lever works on the Principle of Moments. Explain, briefly the term 'moment'.

.....

.....

.....[2]

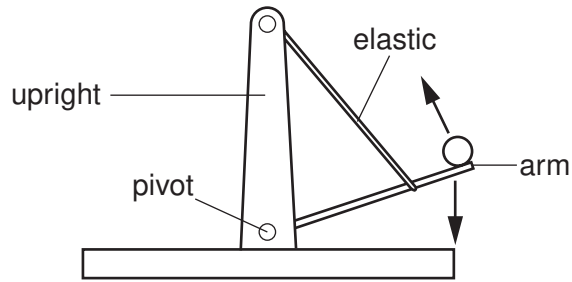
(iii) Explain how the catapult could be modelled before being made from real materials.

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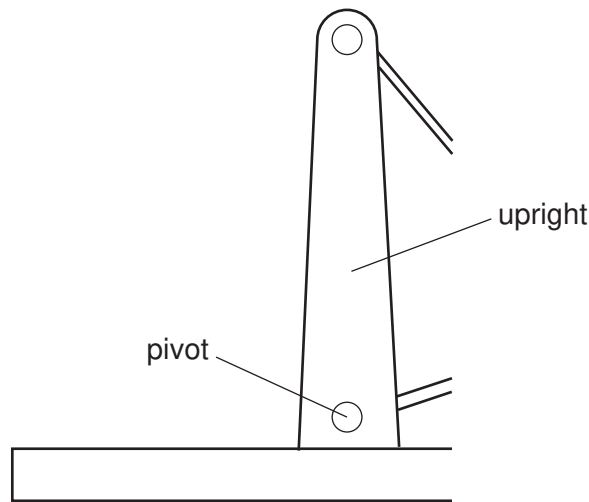
.....[2]

(c) Fig. 3 shows another design for a catapult.



**Fig. 3**

(i) On testing the catapult the upright became loose. Add sketches and notes on Fig. 4 to show how the upright could be reinforced.



**Fig. 4**

[3]

- (ii) During the building of this catapult the student decided to test the deflection of the arm upright. A dial gauge was used to measure the deflection. Add sketches and notes to Fig. 5 to show how the gauge would be set up to measure the deflection.

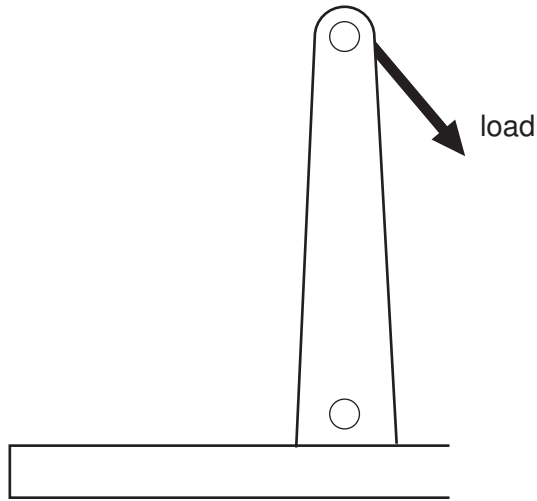


Fig. 5

[3]

- (iii) Name **one** other device that could be used to measure deflection in structures accurately.

.....[1]

- (d) It is decided to control the release of the elastic band using a solenoid.

- (i) A solenoid is an electromagnetic device. Use sketches and notes to show how a solenoid works.

[3]

- (ii) The solenoid is to be controlled by a light-sensitive circuit that will trigger the solenoid when a light beam is broken. Fig. 6 shows a circuit diagram for this system.

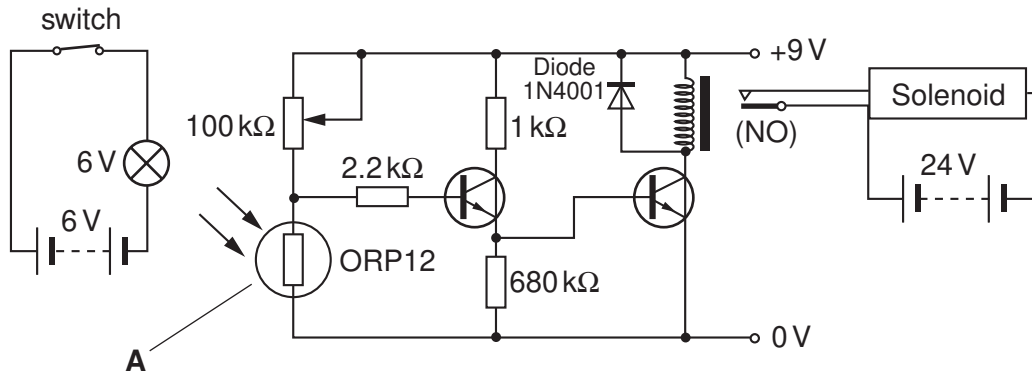


Fig. 6

Name component **A**.

.....  
 .....[1]

- (iii) Explain the purpose of the diode in this circuit.

.....  
 .....[2]

2 (a) Fig. 7 shows a mechanical toy.

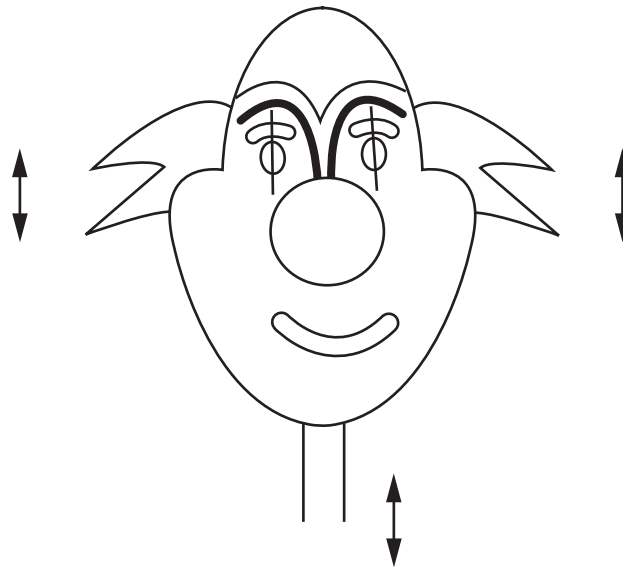


Fig. 7

(i) Use sketches and notes to show a design for a linkage that will enable the motion conversions shown to take place.

[5]

(ii) One form of motion taking place when the toy operates is reciprocating motion. List any **three** other types of motion.

1 .....

2 .....

3 ..... [3]

(iii) Describe **one** way of modelling the linkage during the design stage.

.....

.....

.....

.....[2]

(b) Fig. 8 shows part of a student's design for a mechanical toy.

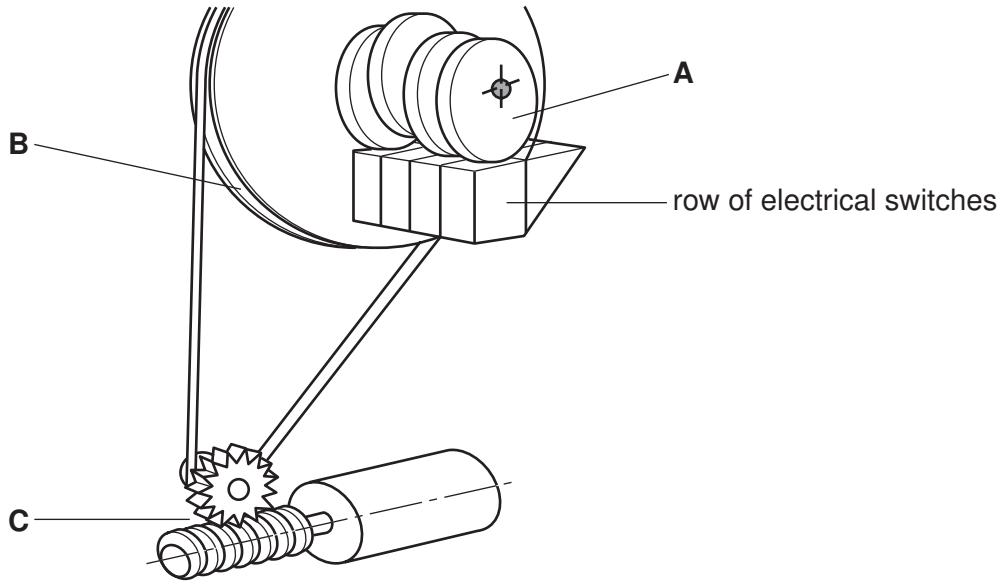


Fig. 8

(i) Name the component **A**.

.....[1]

(ii) Explain how component **A** turns each switch on/off at different times.

.....

.....

.....

.....[3]



(iii) Name component **B**.

.....

(iv) Name component **C**.

.....[1]

(v) Give **one** benefit of using component **C** in this situation.

.....

.....[2]

(c) It is decided to join another shaft to the motor in the toy shown in Fig. 8.

(i) Add sketches and notes to show a simple flexible coupling between the two equally sized shafts shown below.

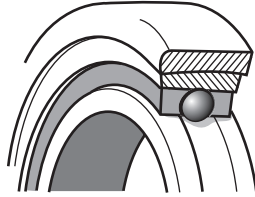
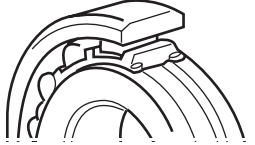


[3]

(ii) For higher loads a universal joint is commonly used as a coupling. Sketch a diagram of a universal joint.

[4]

(iii) A bearing is used to support a shaft. Complete the table below to show bearing types and their applications.

Bearing	Diagram	Application
plain journal bearing		low-speed shaft support
		washing machine drum
roller bearing		

[4]

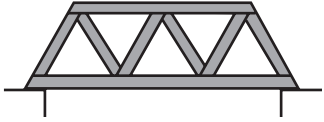
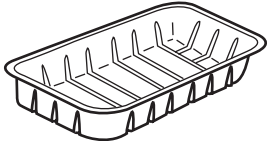
(iv) Lubrication of shafts is very important. Give **one** reason for lubrication.

.....

.....[1]

3 Structures can be classified into two main types.

(a) Complete the table below.

Type of structure	Example	Application
framework		
		

[3]

(b) Fig. 9 shows a model of a simple framework for a stool.

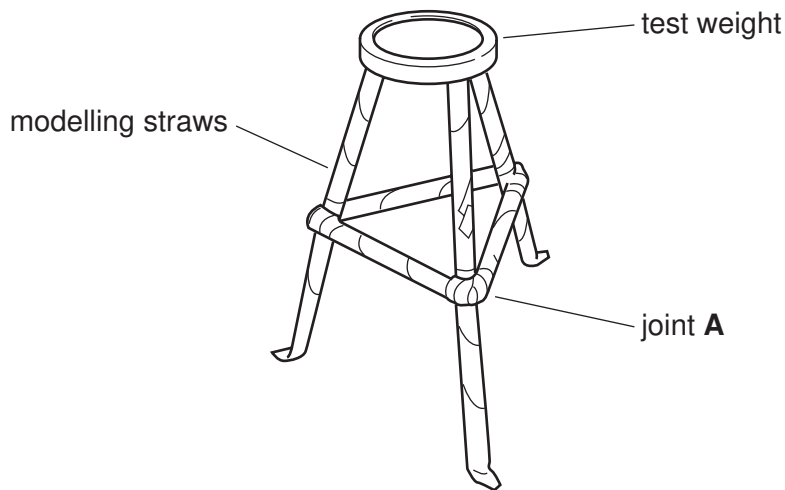


Fig. 9

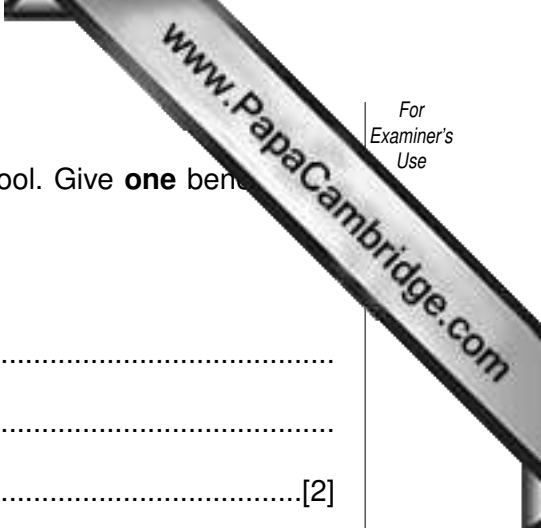
(i) The model is loaded with a static load in Fig. 9. Explain, briefly, the effect of applying dynamic loading to a structure.

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.....

.....

.....[3]



(ii) The student has used modelling straws to model the stool. Give **one** benefit and **one** drawback of using modelling straws.

Benefit

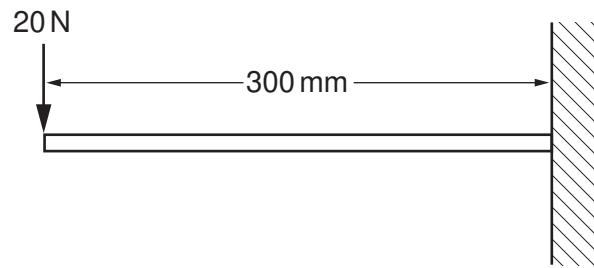
.....  
.....  
.....[2]

Drawback

.....  
.....  
.....[2]

(iii) Describe, using sketches and notes, **one** method of making the joint **A**.

(c) Fig. 10 shows a simple cantilever shelf.



**Fig. 10**

(i) Draw the shear force diagram for the shelf.

[3]

(ii) Draw the bending moment diagram for the shelf.

[3]

(d) Fig. 11 shows a diagram for a roof truss.

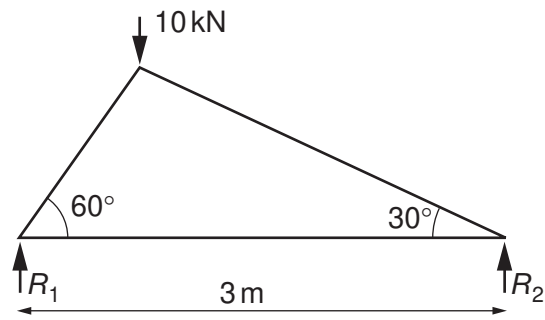


Fig. 11

(i) Determine by either calculation or graphical methods the reactions at  $R_1$  and  $R_2$ .

[4]

(ii) Use graphical methods to determine the values and nature of the forces acting in the members of the roof truss.

[6]

4 Fig. 12 shows a design for an electronic toy.

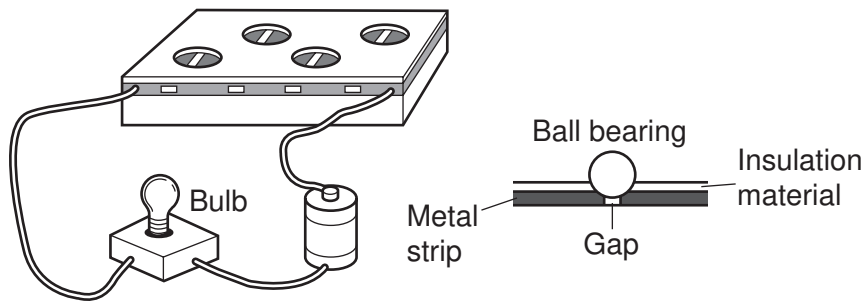


Fig. 12

(a) Each gap in the metal strip acts as a switch to control the bulb.

(i) Draw a circuit diagram to show how the toy would work if the bulb is to be lit whenever the ball bearing rolls into a gap.

[5]

(ii) Draw a circuit diagram for the toy if all gaps need to be connected for the bulb to light up.

[5]

(iii) An on/off switch is needed to control the whole toy. Name a suitable switch for this purpose.

.....[1]

(b) Fig. 13 shows a timer circuit that would, when triggered, light a bulb for a set period of time.

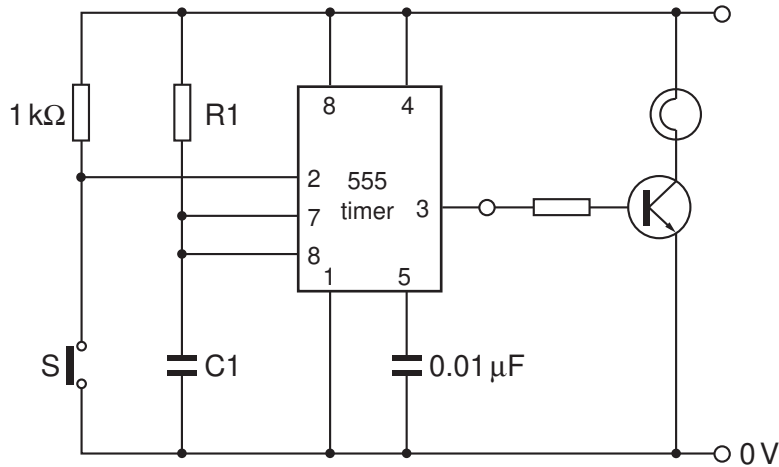


Fig. 13

(i) Explain briefly how the time delay period is set.

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.....

.....

.....[3]

(ii) Explain the purpose of the transistor in this circuit.

.....

.....

.....

.....[3]

(iii) Capacitors come in two main types: ceramic and electrolytic. Briefly explain the difference between the two types of capacitor.

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.....

.....[3]



- (c) An alternative light source is an LED.
  - (i) Sketch and label an LED.  
Clearly show its positive and negative connections.

[3]

- (ii) Fig. 14 shows an LED in a circuit diagram.

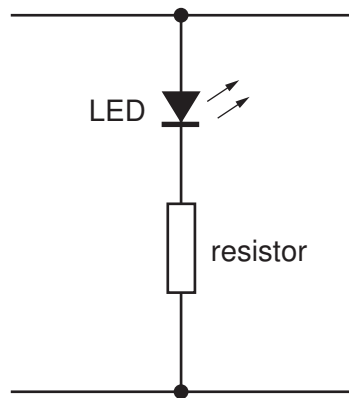


Fig. 14

Explain the purpose of the resistor.

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.....[3]

- (d) Resistors can be used to bias a transistor in a circuit. This is done using an arrangement of resistors known as a potential divider. Fig. 15 shows a potential divider.

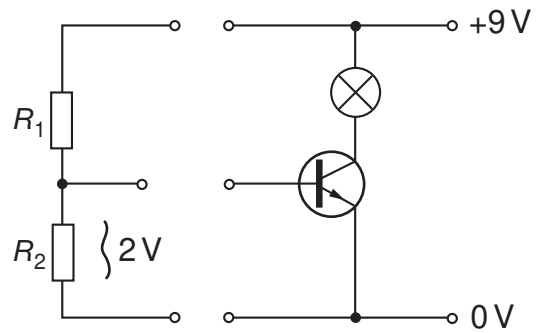


Fig. 15

If the current flowing is 1 mA and the voltage drop across  $R_2$  is 2 V calculate the values of  $R_1$  and  $R_2$ .



