

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 2004

**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>	

Fig. 1 shows a typical building site.

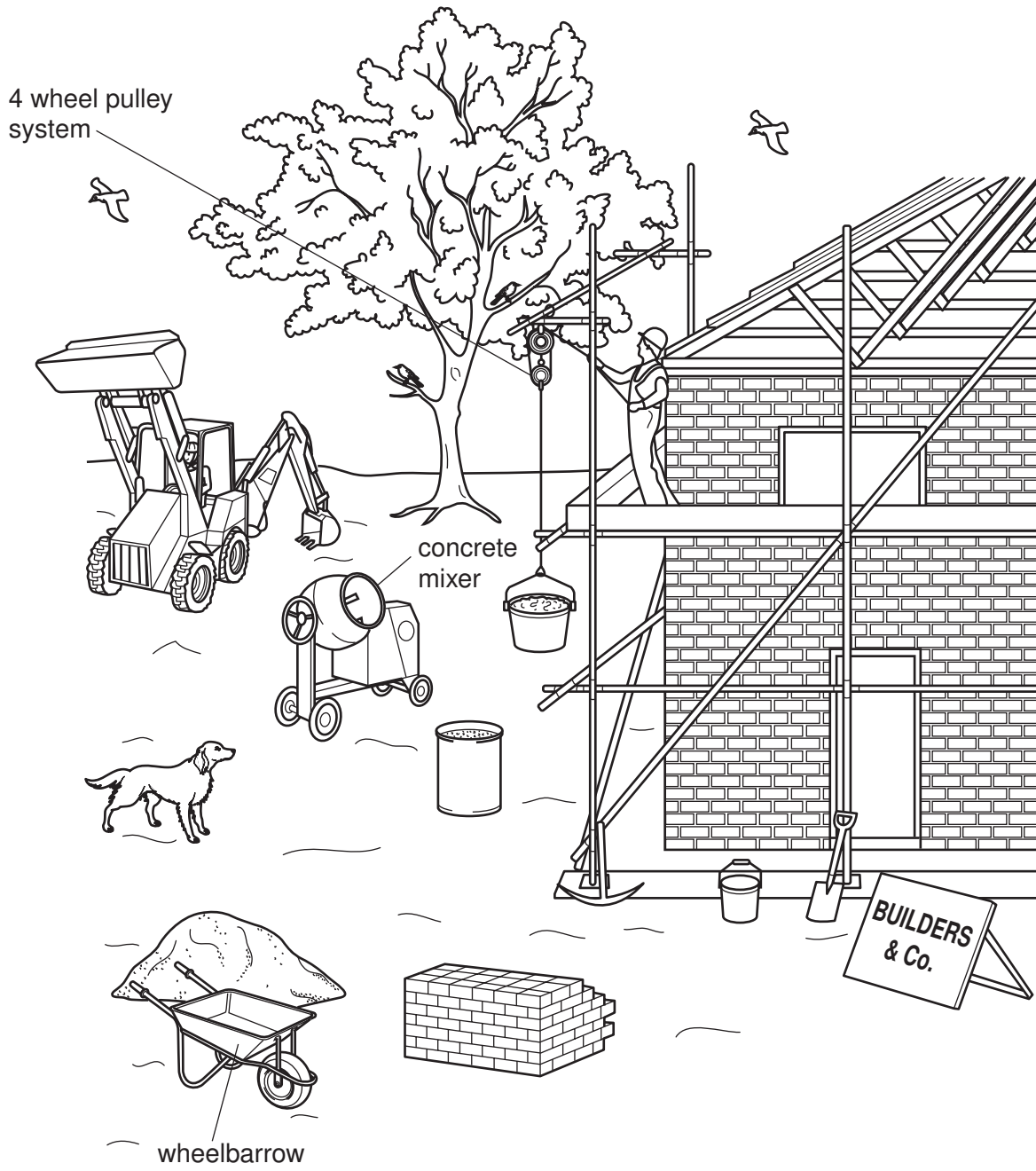


Fig. 1

1 (a) (i) Identify **three** man-made structures seen in Fig. 1.

- 1 ..... [1]
- 2 ..... [1]
- 3 ..... [1]

(ii) Name **three** natural structures seen in Fig. 1.

- 1 ..... [1]
- 2 ..... [1]
- 3 ..... [1]

(b) Fig. 2 shows four cross-sections of material found on the building site.

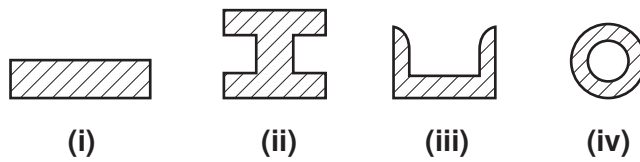


Fig. 2

Complete the table below to show a name, material and use for each cross-section.

	section name	suitable material	use	
(i)			scaffold plank	[2]
(ii)			joist	[2]
(iii)	'U' section			[2]
(iv)		galvanised steel		[2]

(c) Fig. 3 shows an outline of a timber framework from the roof.

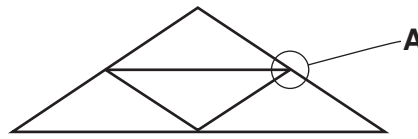


Fig. 3

(i) Explain, in structural terms, why the framework is shaped in this way.

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

(ii) Name **one** method of reinforcing the framework at **A**.

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

(d) Fig. 4 shows a scaffolding plank supporting a stack of blocks.

Calculate the reactions at the supports **L** and **R**. The mass of the blocks is 200 kg. You may ignore the mass of the plank.

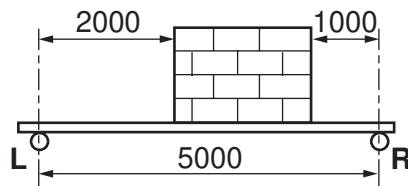
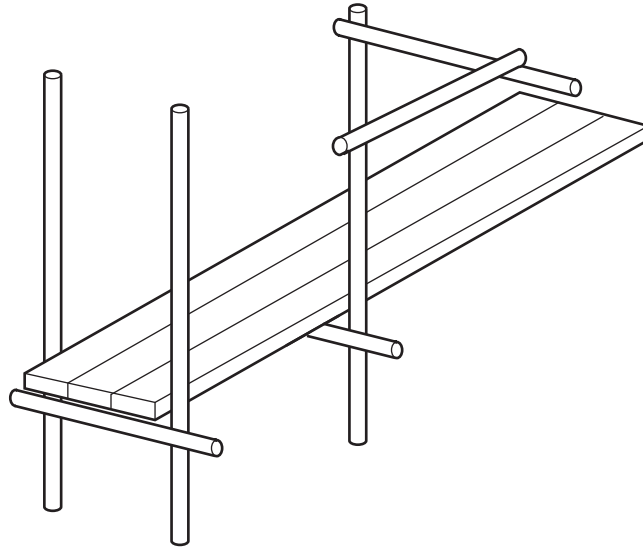


Fig. 4

(e) Fig. 5 shows a hoist cable support structure.

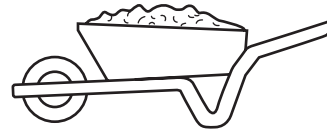
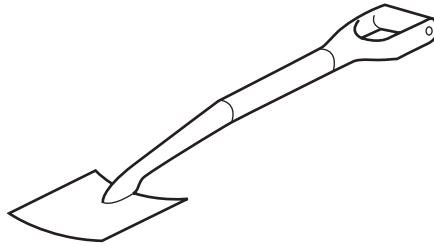
Label on the diagram: a beam, a strut and a tie.



**Fig. 5**

[3]

2 (a) (i) Fig. 6 shows three different examples of tools that use leverage. In the provided indicate the class (order) of the lever for each tool shown.



Class: .....

Class: .....

Class: .....

[3]

Fig. 6

(ii) Explain what is meant by the term 'principle of levers'.

.....  
.....  
.....  
.....

[3]

(iii) Add labels to Fig. 7 to show the positions of:

effort  
load  
fulcrum.

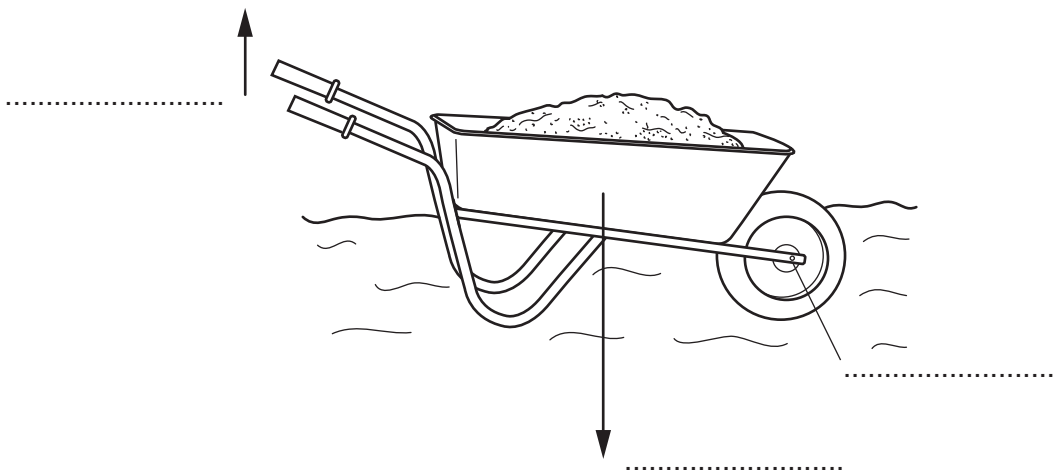


Fig. 7

[3]

(iv) Fig. 8 shows the wheelbarrow full of concrete. It will be hard work to lift and

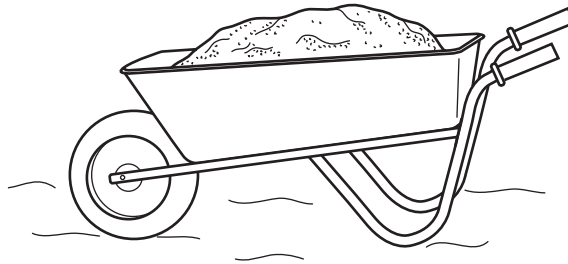


Fig. 8

Add sketches and labels to Fig. 8 to show how the wheelbarrow could be modified to make it easier to lift and move. [3]

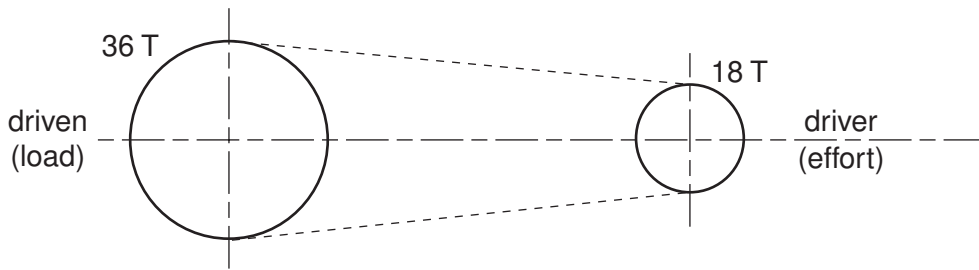
(v) When the wheelbarrow is moved forward, motion is converted from one type to another. Complete the sentence below to show the motion conversion that takes place.

The wheelbarrow converts ..... motion into ..... motion. [2]

(b) The concrete mixer shown in Fig. 1 uses a sprocket and chain drive. Describe briefly, **one** advantage of using a sprocket and chain instead of a belt and pulley drive.

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

(c) Fig. 9 shows a line drawing of a sprocket and chain system.



**Fig. 9**

(i) Calculate the velocity ratio of the system.

[3]

(ii) Calculate the mechanical advantage of the system if the efficiency of the system is 60%.

[3]

(iii) Calculate the effort needed to move a load of 150 N.

[3]

(iv) Give another example of the use of a sprocket and chain drive system.

.....[1]



- (d) The hoist on the scaffold uses a four-wheel pulley system.

Assuming the pulley is 100% efficient, calculate the load a worker could raise with an effort of 850 N.

[4]

- 3 (a) A light is to be used to warn people of protruding scaffolding. Fig. 10 shows a circuit for this purpose.

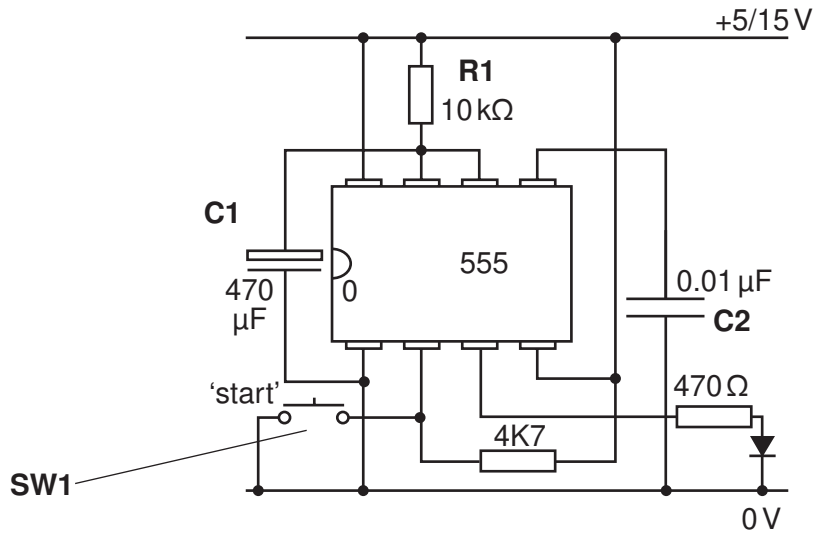


Fig. 10

- (i) Add numbers to Fig. 10 to show the order of the pins on the 555 IC. [2]
- (ii) Explain the effect of changing the value of C1.  
 .....  
 .....  
 .....  
 ..... [3]
- (iii) State the name of the switch SW1.  
 ..... [1]
- (iv) Explain the difference between the capacitors C1 and C2 (apart from their values of capacitance).  
 .....  
 .....  
 ..... [3]
- (v) Describe how you could identify the value of a resistor from its appearance.  
 .....  
 ..... [2]

- (b) The on/off frequency of the light is controlled by closing the start switch. It is desired to modify the circuit to make the light flash at a given frequency.
- (i) Complete the circuit diagram in Fig. 11 to show a suitable circuit to make the light flash on and off automatically. [6]

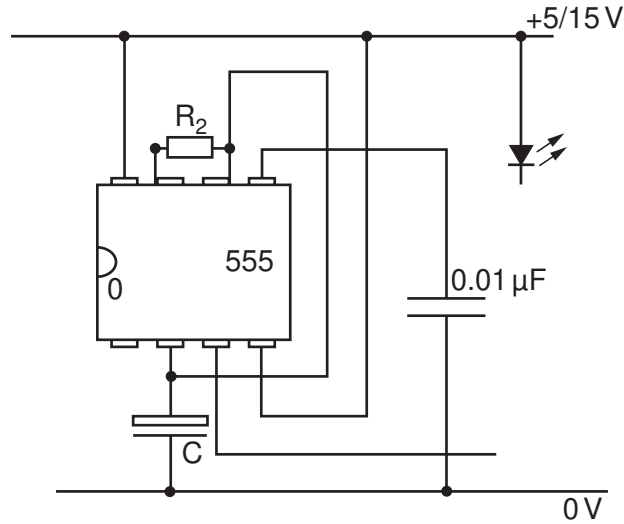


Fig. 11

- (ii) The on/off frequency of the circuit is called the mark space ratio. Draw the mark space ratio for a frequency of 1 hertz. Clearly show the 'mark' and the 'space' features on the diagram you draw.

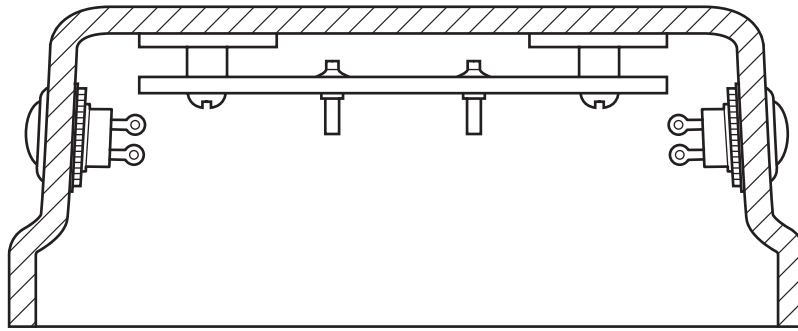


[4]

- (iii) Name the type of light device that is used in the circuit shown in Fig. 11.

.....[1]

(c) Fig. 12 shows a plastics casing for the circuit for the flashing light.



**Fig. 12**

- (i) Add sketches and labels to Fig. 12 to show how a base can be fitted to the casing. [4]
- (ii) Show how a battery could be located in the casing so that it does not touch any parts of the circuit. [2]
- (iii) Suggest a suitable plastics material for the casing.  
.....[1]
- (iv) Name a method for forming the casing.  
.....[1]

4 (a) During construction of a building it is noticed that there is a crack in one wall. In order to measure the rate of growth of the crack a strain gauge is to be used.

(i) Using notes and diagrams describe how a strain gauge works.

[4]

(ii) Complete the circuit diagram in Fig. 13 to show how a 741 Op. Amp can be used as an inverting amplifier to amplify the signal from the strain gauge. [5]

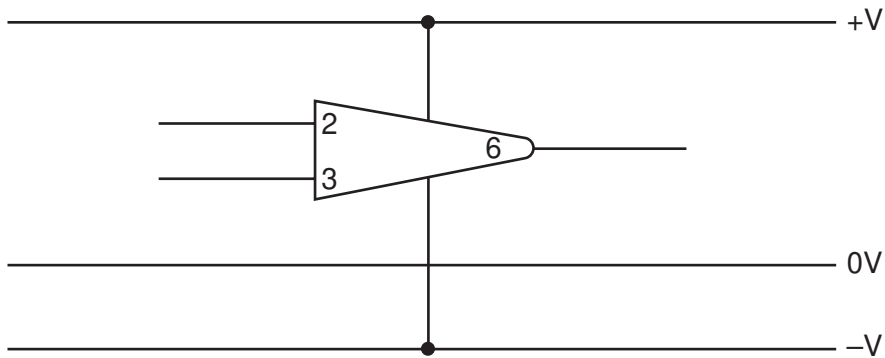


Fig. 13

(b) When designing the roof truss a model could be made to simulate the effects of loading.

Describe **one** way of modelling a roof truss.

.....

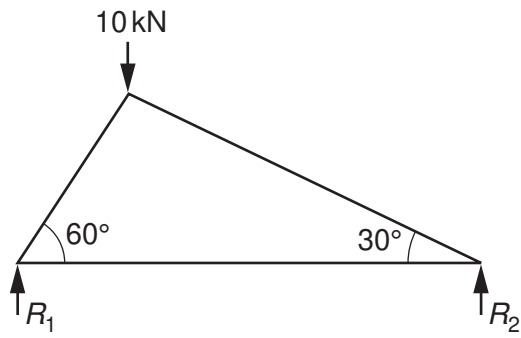
.....

.....

.....

[3]

(c) Fig. 14 shows a simple roof truss.



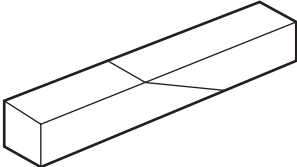
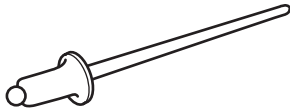
**Fig. 14**

Use graphical methods to find the values and nature of the forces in each member and to find the values of the reactions  $R_1$  and  $R_2$ .

[10]

(d) Joining methods are very important to the structural designer.

(i) Complete the table below showing different joining methods.

method	diagram	typical use
gusset plate		roof truss
scarf joint		
		light tubular frameworks

[6]

(ii) Fig. 15 shows good and bad joints for welded tubes.

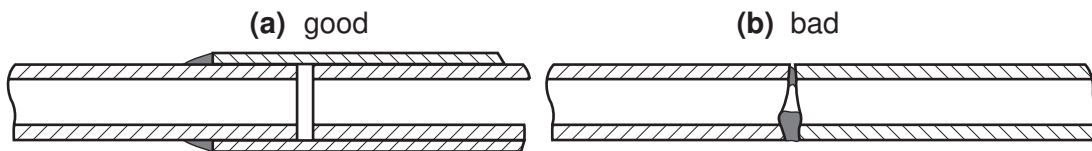


Fig. 15

Explain why joint (a) is better than joint (b).

.....

.....

.....

.....

.....

.....

.....

[2]

16  
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