

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 2006

**1 hour**

Candidates answer on the Question Paper.  
No Additional Materials are required.

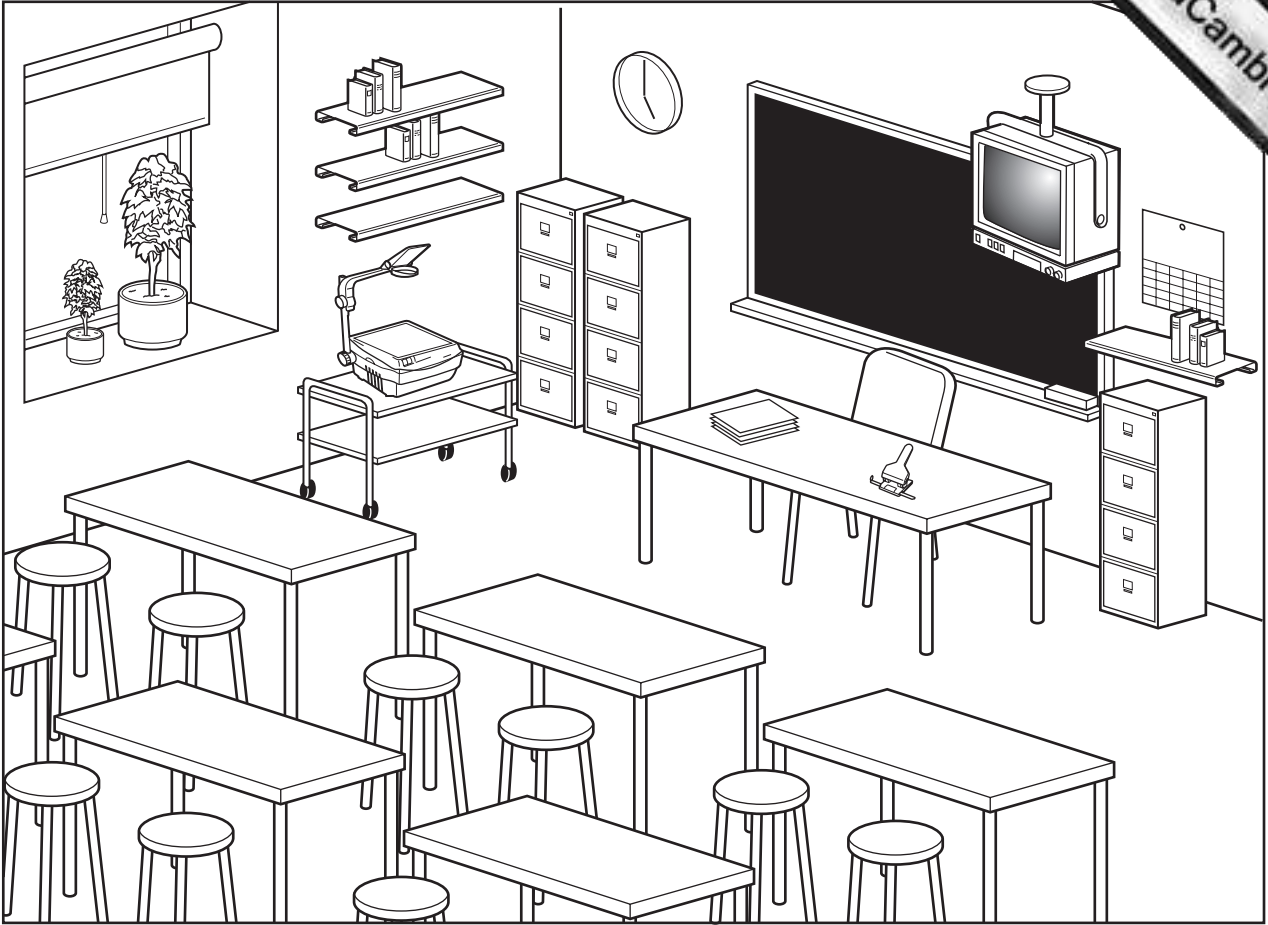
**To be taken together with Paper 1 in one session of 2 hours 45 minutes.**

**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.  
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.  
You may use a calculator.  
At the end of the examination, fasten all your work securely together.  
The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE	
1	
2	
3	
4	
<b>TOTAL</b>	



**Fig.1 shows a classroom**

- 1 Fig.2 shows a pot plant with a moisture sensor fitted so that an alarm is set off when the compost becomes dry and the plant needs to be watered.

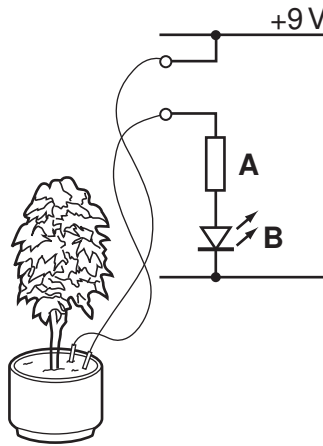


Fig. 2

- (a) (i) Identify components **A** and **B**.

**A** ..... [1]

**B** ..... [1]

- (ii) Explain the purpose of component **A** in this circuit.

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

- (iii) Describe **one** drawback to this circuit.

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

- (iv) Explain how this drawback can be overcome.

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

(b) It is decided to replace this circuit with the circuit shown in Fig. 3.

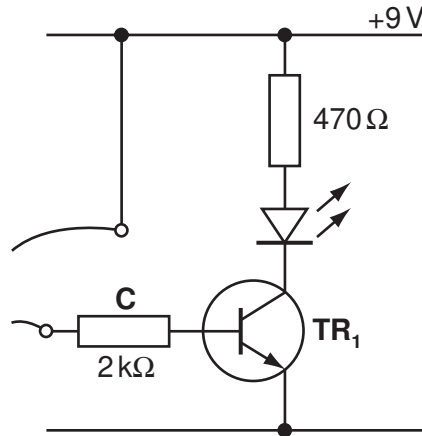


Fig. 3

(i) Explain why the addition of the transistor  $TR_1$  is beneficial to the moisture sensor circuit.

.....

.....

..... [2]

(ii) Use sketches and notes to show the following features of a transistor:

- base;
- collector;
- emitter.

[3]

(iii) Explain the purpose of component **C**.

.....

..... [2]

(iv) Explain how a transistor works.

.....

..... [2]

- (c) It is decided to modify the moisture sensor circuit so that it will automatically control a pump powered by a separate power supply.

Fig. 4 shows the circuit plan for the modified circuit.

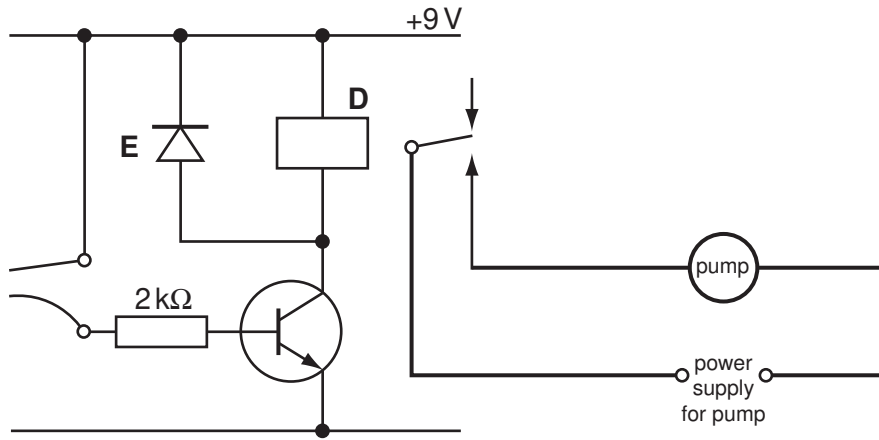


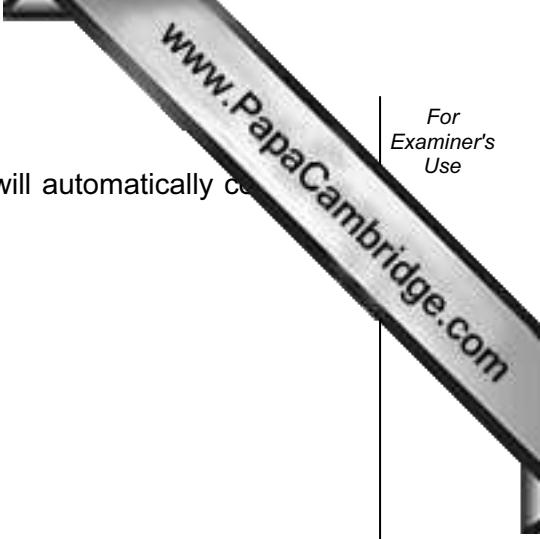
Fig. 4

- (i) Explain the purpose of component D.

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

- (ii) Explain the purpose of component E.

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



(d) It is decided to add an on/off switch to this circuit. A toggle switch is selected.



(i) Draw and label a sketch of a toggle switch.

[3]

(ii) Draw the circuit symbol for the toggle switch.

[2]

(iii) Complete the table below showing switches and their uses.

switch	sketch	uses
slide switch		reverse current flow to electric motors to change their direction of rotation
reed switch		triggered by magnet passing by, e.g. in burglar alarms
		

[4]

2 Fig. 5 shows a television monitor on a ceiling mounted bracket.

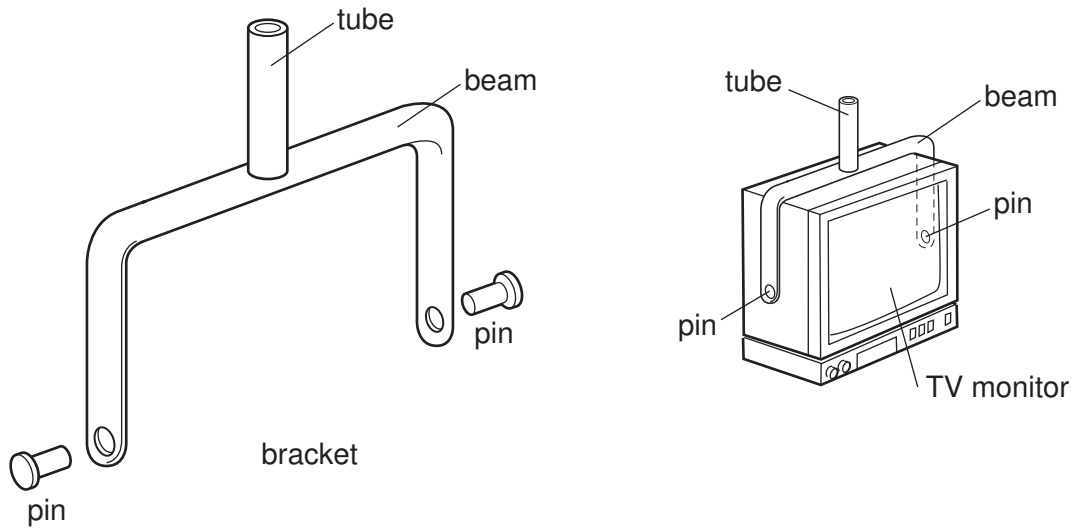


Fig. 5

(a) (i) Name the type of force acting on the pins.

..... [1]

(ii) Describe **one** way of reducing this force in the pins.

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

(iii) When the monitor is adjusted the pins also experience torsion.

Explain, using sketches and notes, what is meant by 'torsion'.

[3]

- (b) (i) The beam of the bracket is in bending.

Use sketches and notes to show the way in which the beam would deflect under loading.

[3]

- (ii) The deflection of the beam could be measured accurately using strain gauges.

Use notes and sketches to show how a strain gauge is used to measure deflection.

[4]

- (iii) The tube of the bracket is subject to tensile loading. This causes the tube to elongate 0.0001 mm over its original length of 400 mm.

Calculate the strain on the tube.

[3]



- (c) There is a lintel above the window of the classroom which is subject to bending moment. Use notes and sketches to show a reinforced concrete lintel.

[3]

- (d) Fig. 6 shows detail of a shelf in the classroom.

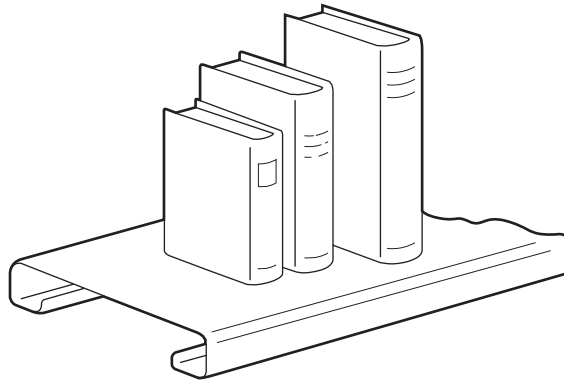


Fig. 6

Explain why the shelf is shaped in this way.

.....

.....

..... [2]

(e) Fig. 7 shows a simplified diagram of a shelf showing loads applied to it.

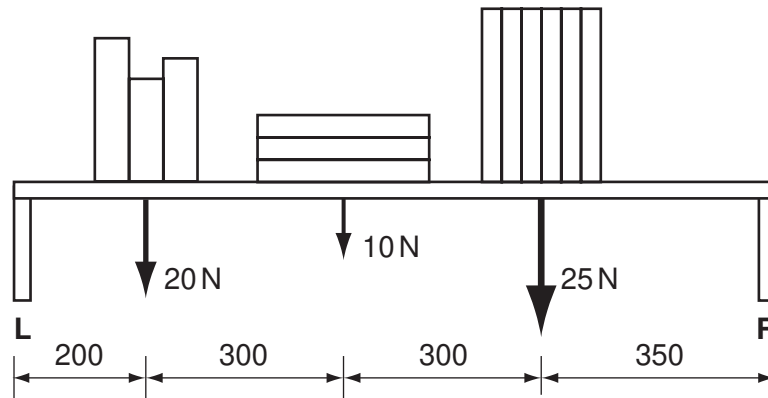


Fig. 7

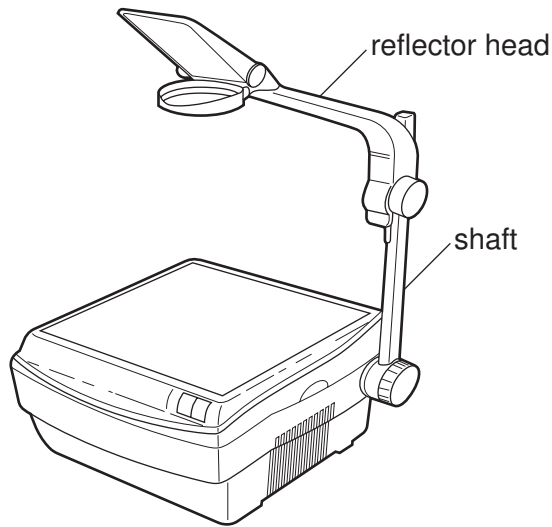
(i) Calculate the values of the reactions at the supports R and L.

[4]

(ii) Draw a shear force diagram for the shelf.

[5]

- 3 Fig. 8 shows an overhead projector.



**Fig. 8**

- (a) Use sketches and notes to explain how the reflector head could be moved up and down the shaft.

[4]

(b) Feet on the overhead projector are height adjustable as shown in Fig. 9.

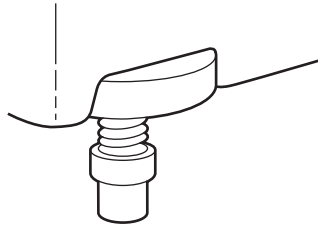


Fig. 9

(i) Identify this mechanism.

..... [1]

(ii) Use sketches and notes to describe the motion conversions that take place when the foot is adjusted.

[3]

(iii) Give **one** other example of the use of this mechanism.

..... [1]

(c) A roller blind in the classroom has a ratchet and pawl mechanism to ensure that once adjusted the blind stays in position.

Use sketches and notes to show how a ratchet and pawl mechanism works.

[4]

(d) Fig.10 shows a pantograph mechanism. It uses a linkage mechanism to reproduce enlarged copies of drawings.

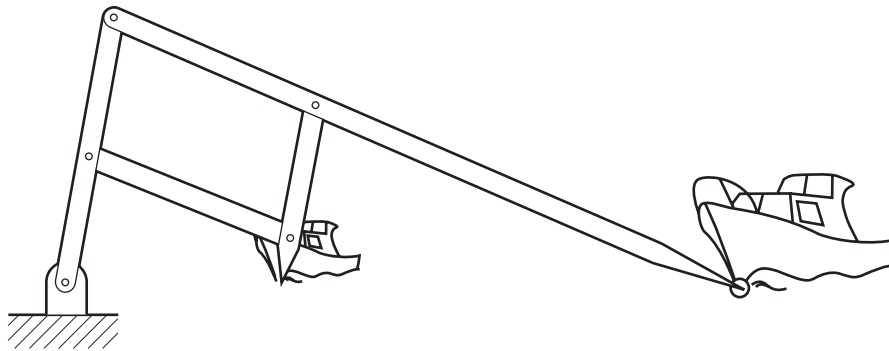


Fig. 10

(i) Add labels to Fig.10 to show:

- fixed pivot;
- moving pivot;
- lever arm.

[3]

(ii) Explain the term linkage.

.....

.....

..... [2]

(iii) Explain how the pantograph works when, as in Fig.10, an enlarged copy is being made.

[4]

(e) Fig.11 shows a diagram of a lever.

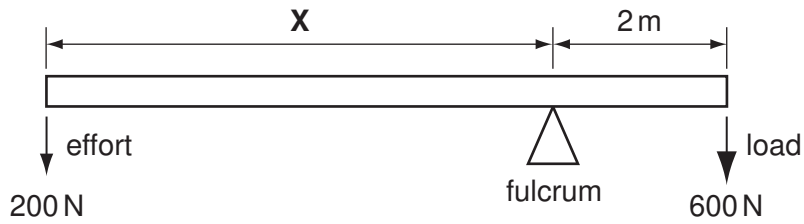


Fig. 11

(i) Name the order (class) of lever shown.

..... [1]

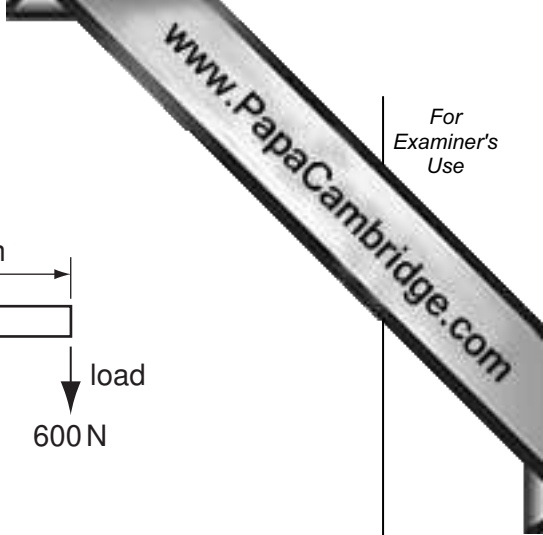
(ii) Calculate the length of **X** for the lever when it is in equilibrium.

[3]

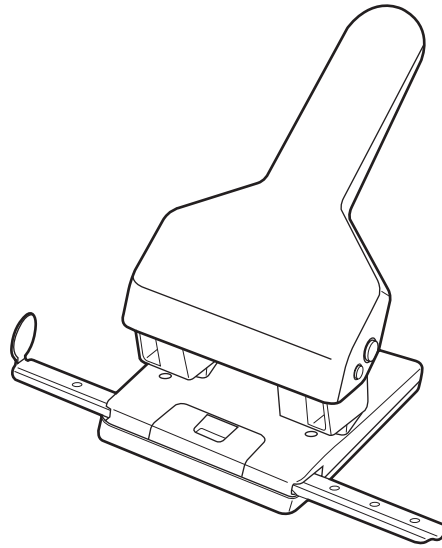
(iii) Complete the following statement.

A moment is the word used to describe the effects of load and

..... from a fulcrum. [1]



(f) Fig.12 shows a hole punch.



**Fig. 12**

Draw a simplified diagram of the hole punch mechanism clearly showing:

- load;
- effort;
- fulcrum.

[3]

4 Fig.13 shows a battery powered stapler.

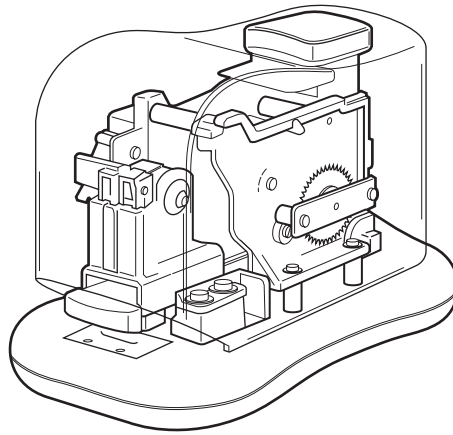
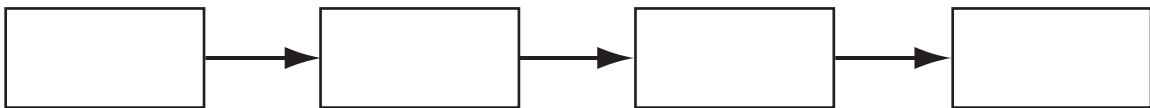


Fig. 13

(a) (i) Complete the block diagram showing the energy conversions that take place when the stapler is in use.



[4]

(ii) Explain what a battery is in terms of energy.

.....

.....

..... [2]

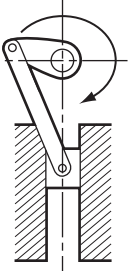
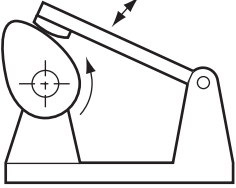
(iii) Give **two** benefits of battery powered staplers.

.....

..... [2]



(b) Complete the table below showing the action of various mechanisms.

mechanism	sketch	action
spur gear		reduction of speed
		converts rotary motion to reciprocating
		

[6]

(c) Fig. 14 shows a hand powered stapler.

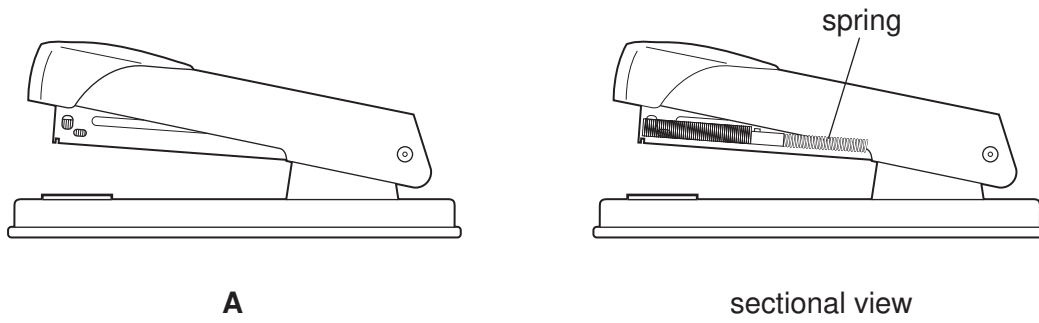


Fig. 14

(i) Explain in terms of energy how the spring provides the power for the stapler.

.....

.....

.....

..... [3]

(ii) Add labels to view **A** to show how the handle acts as a lever.

Show clearly:

- effort;
- load;
- fulcrum.

[3]

(iii) A student is asked to make a demonstration model of the stapler lever mechanism.

Use sketches and notes to show one method of modelling the stapler lever mechanism.

[4]

- (d) A test rig is required to determine the force needed to staple various thicknesses of paper using the hand stapler.

Use notes and sketches to show a design for such a test rig.

Show clearly how the force would be measured.

[6]

