



GENERAL CERTIFICATE OF SECONDARY EDUCATION
DESIGN AND TECHNOLOGY
ELECTRONICS AND CONTROL SYSTEMS

A514/03

Technical aspects of designing and making
 Mechanisms

Candidates answer on the Question Paper

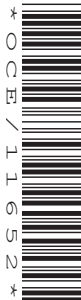
OCR Supplied Materials:
 None

Other Materials Required:

- A calculator may be used

Tuesday 22 June 2010
Morning

Duration: 1 hour 15 minutes



Candidate Forename		Candidate Surname	
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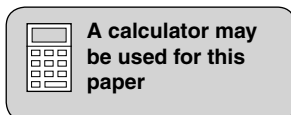
Centre Number						Candidate Number				
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INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).
- Show all your working out for calculations.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- Marks will be awarded for the use of correct conventions.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- Dimensions are in millimetres unless stated otherwise.
- This document consists of **16** pages. Any blank pages are indicated.



Section A

Answer **all** questions.

- 1 (a) Many types of fastener are used when constructing mechanisms. Details of three types of fastener are shown in the table below.

(i) Use notes or sketches to complete the table.

name	fastener	tool used to fasten
cap head screw		
		
		spanner

[4]

- (ii) Washers may be used with all of the fasteners in the table above. Give **one** reason for using a washer with a fastener.

..... [1]

- (iii) With each of the fasteners in the table above conversion of motion is taking place when they are used. Give the types of motion involved.

Frommotion to..... motion [2]

- (b) Fig. 1 shows an adjustable spanner.



Fig. 1

- (i) Give the name of the type of gear that is used to adjust the jaw opening.

..... [1]

(ii) Explain why this type of gear is the most suitable for providing adjustment.

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

(c) Fig. 2 shows a pillar drill that can be used to produce holes.

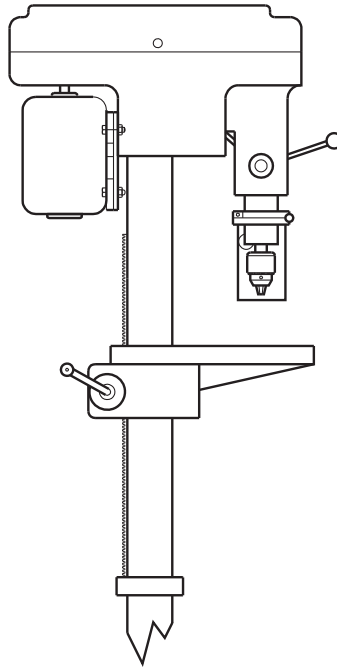


Fig. 2

Before using a pillar drill safety checks have to be carried out.
Give **one** safety check that should be carried out for each of the items mentioned below.

Drill chuck [1]

Work being drilled [1]

[Total: 12]

2 Fig. 3 shows an outline drawing of lawn edge shears which use a lever action.

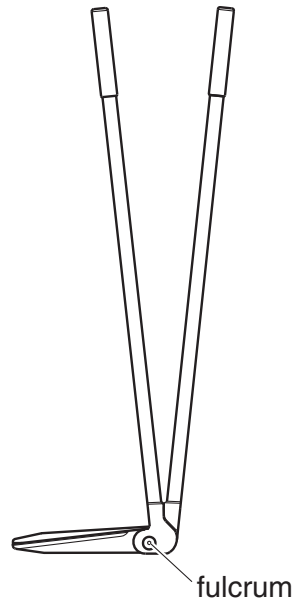


Fig. 3

(a) (i) Indicate on Fig. 3 the position of the **effort** and **load** that will give the **maximum** mechanical advantage. [2]

(ii) State the order of lever that is used in the shears.

..... [1]

(b) An improved version of the shears using a double lever action is shown in Fig. 4.



Fig. 4

(i) Describe how this is an advantage when using the shears.

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

(ii) State **two** areas where ergonomics can be applied in the design of garden shears.

1 [1]

2 [1]

(iii) The metal blades on the shears require several special properties. Give **one** property required by the blades.

..... [1]

(c) Fig. 5 shows two views of a lawnmower. One view shows the cover removed from the side.

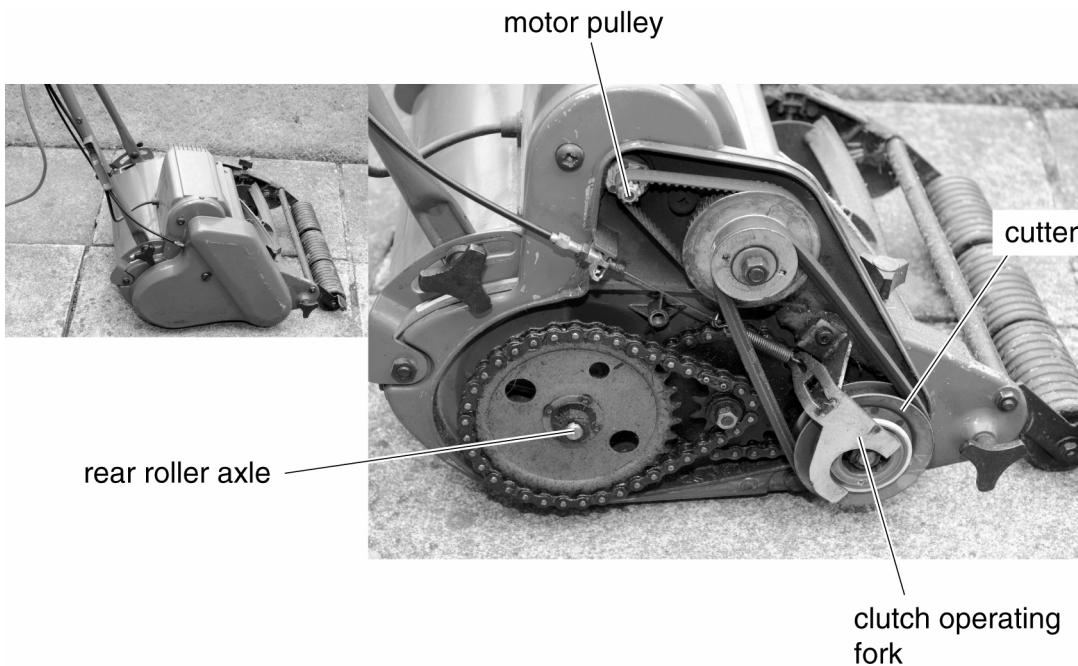


Fig. 5

(i) The mower blades are driven by a belt and pulley system which provides a speed reduction from the electric motor. Torque at the blades is increased.

State what is meant by torque.

..... [1]

- (ii) The rear roller has a chain drive that is attached to the cutter pulley through a clutch. Use notes and sketches to describe the principle of a simple clutch drive.

[3]

[Total: 12]

- 3 Details of a salad spinner are shown in Fig. 6. When the handle is rotated centrifugal force causes water to move to the outside of the spinner basket, drying the salad leaves.

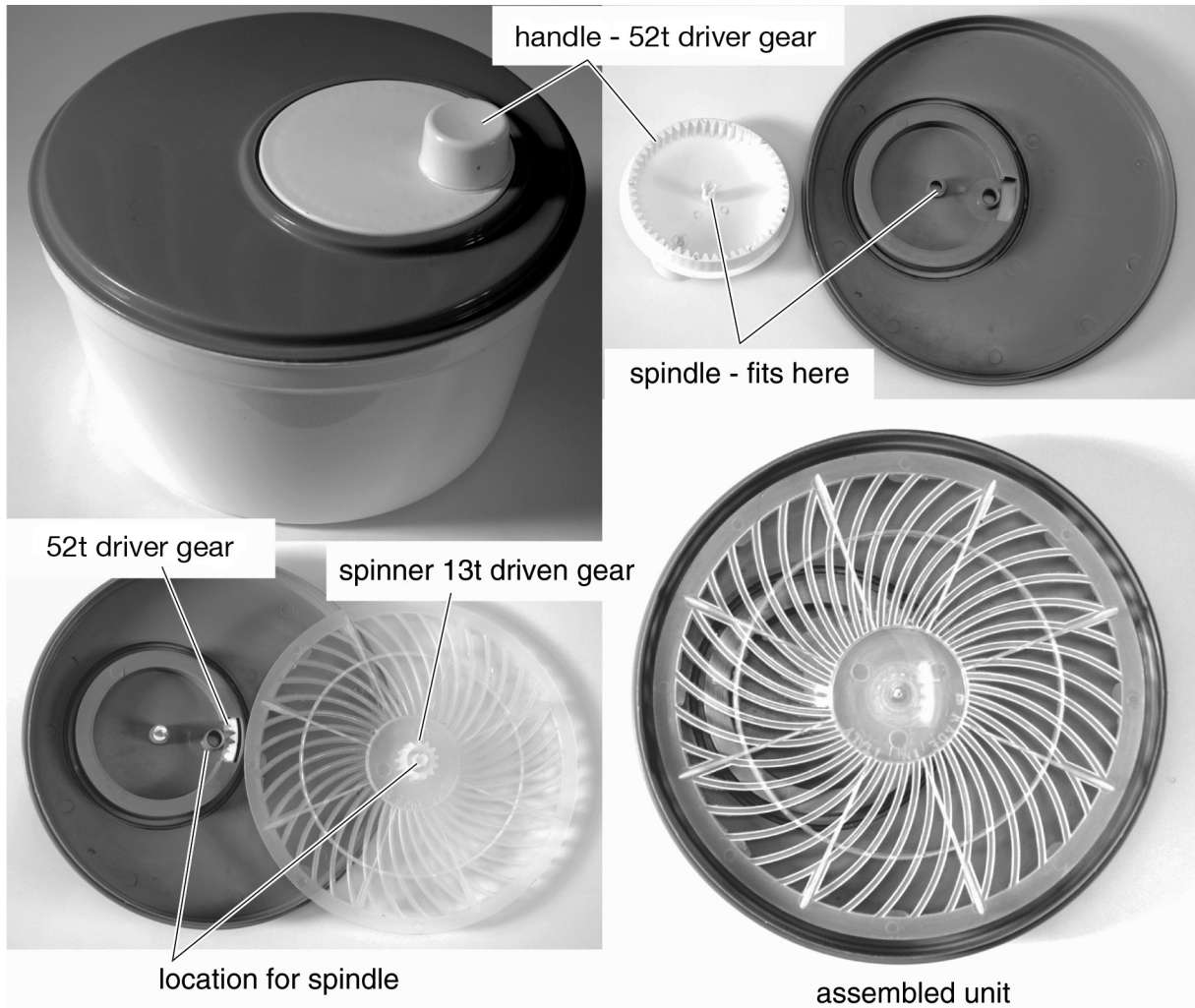


Fig. 6

- (a) The handle is attached to a 52t driver gear which engages with a 13t driven gear at the centre of the spinner.

- (i) Calculate the velocity ratio of the system.

Use the formula $VR = \text{number of teeth on driver} / \text{number of teeth on driven}$.

..... [1]

- (ii) Calculate the speed in rpm of the spinner basket when the handle is rotated at 60 rpm.

.....
 [2]

- (iii) The salad spinner gears are injection moulded in nylon for economy and hygiene. Give **one** other benefit of using nylon for moving parts in a mechanism.

..... [1]

- (b) In a mechanical system a change in direction of rotation is often needed. Fig. 7a shows two methods of direct drive. Complete Fig. 7b to show how direction of rotation can be changed in each case.

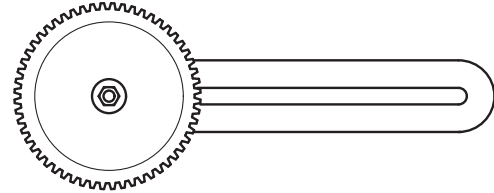
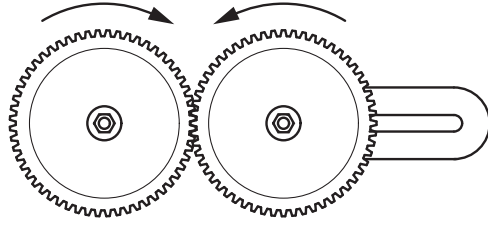
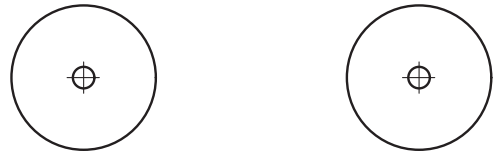
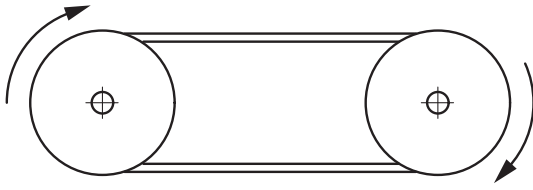


Fig. 7a

Fig. 7b

[2]

Section B

Answer **all** questions.

- 4 (a) Fig. 8 shows part of a treadle mechanism. This is a traditional method of producing rotary motion. The system is foot operated and relies on momentum of the flywheel to complete each rotation.

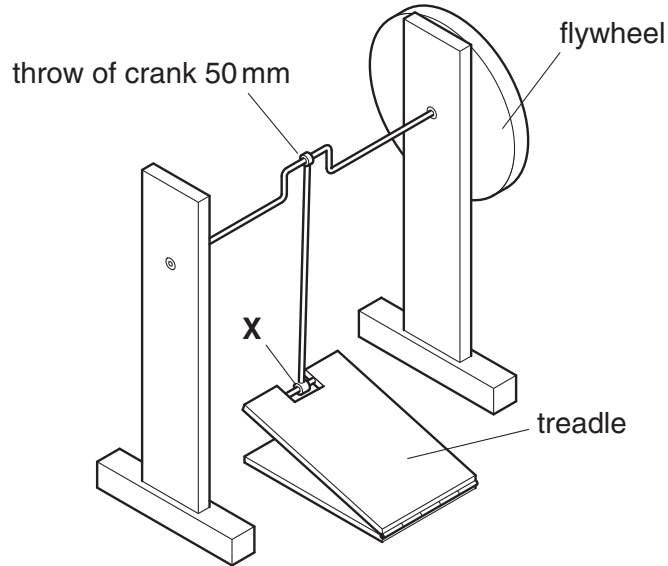


Fig. 8

- (i) State the vertical distance moved at point X during a full rotation of the flywheel.

..... [1]

- (ii) Describe **one** important property of the flywheel.

..... [1]

- (b) (i) Complete Fig. 9 to show how a second treadle could be used to increase the power of the mechanism.

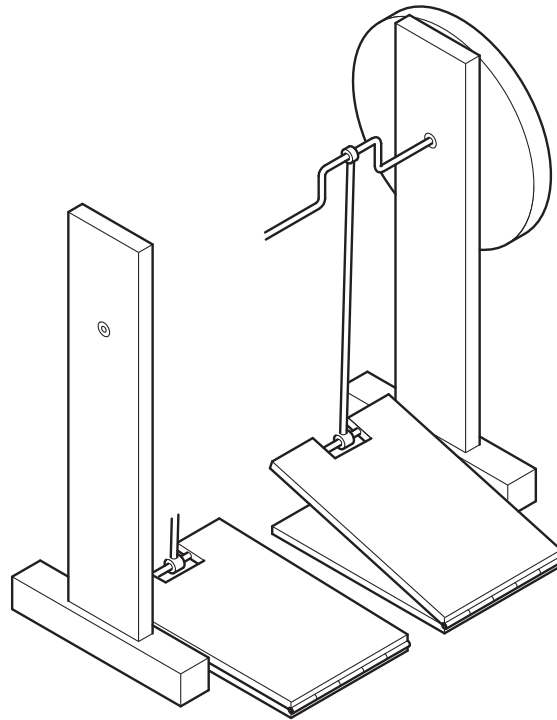


Fig. 9

[3]

- (ii) Give **one** disadvantage of using a system with two treadles to power a machine.

..... [1]

(c*) The treadle mechanism shown in Fig. 10 is used in developing countries to power water pumps. The pump has two cylinders; each treadle is attached to a piston moving in the cylinder. A rope and pulley mechanism joins the treadles.

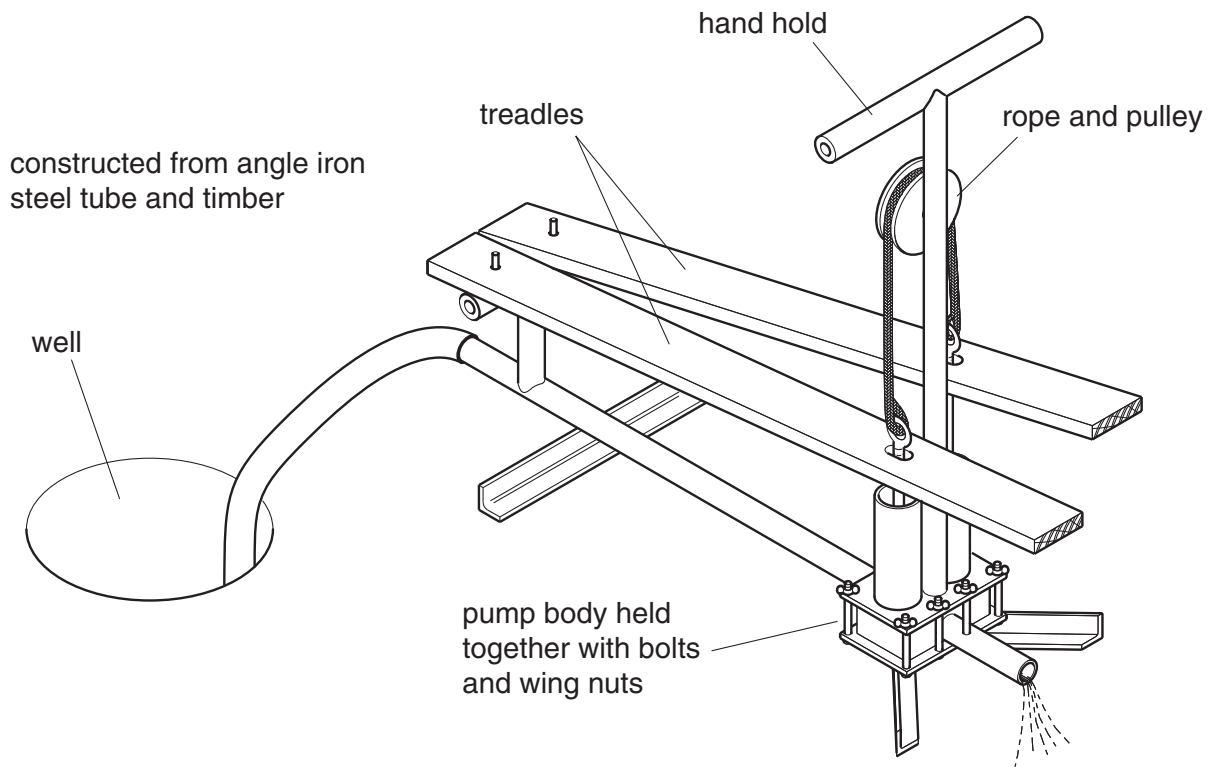


Fig. 10

- 5 (a) Fig. 11 shows the profile of an elephant that is to be developed into a push along toy. A circular cam will make the head of the elephant move as the toy is pushed.

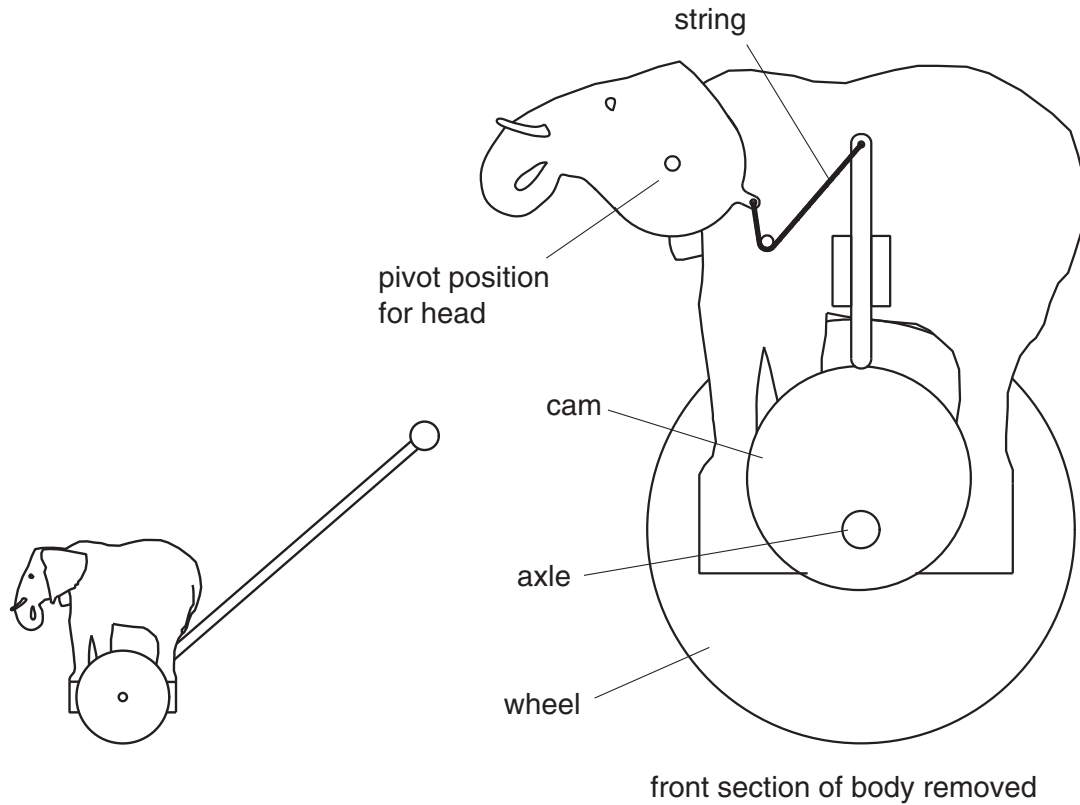


Fig. 11

- (i) Describe what will happen when the toy is pushed along.

.....

 [2]

- (ii) Give **one** benefit to the manufacturer of making the toy from plastics.

.....
 [1]

- (iii) Give **one** reason for making the toy from wood.

.....
 [1]

- (b) The cam is based on a circle.
Give **one** reason for using this shape of cam for batch production of the toy.

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

- (c) (i) When designing toys for young children safety of the user is vital.

Give **two** important safety features to be considered on a push along toy.

1 [1]

2 [1]

- (ii) Anthropometric data is important when designing for children.

Give **two** anthropometric measurements that will be needed for this toy.

1 [1]

2 [1]

- (d) A pictorial view of the main components of the push along toy is shown in Fig. 12.
The head must pivot smoothly at point **X** when the toy has been assembled.
Use notes and sketches to show details of how this can be achieved.
Include any additional parts necessary.

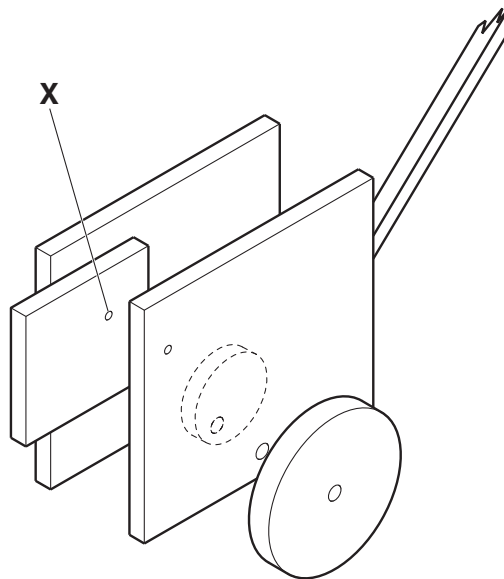


Fig. 12

[3]

[Total: 12]

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