



# Cambridge International AS & A Level

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## PHYSICS

9702/32

Paper 3 Advanced Practical Skills 2

May/June 2026

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

### INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You will be allowed to work with the apparatus for a maximum of 1 hour for each question.
- You should record all your observations in the spaces provided in the question paper as soon as these observations are made.
- You may use a calculator.
- You should show all your working and use appropriate units.

### INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

#### For Examiner's Use

|       |  |
|-------|--|
| 1     |  |
| 2     |  |
| Total |  |

This document has **16** pages. Any blank pages are indicated.

You may not need to use all of the materials provided.

1 In this experiment, you will investigate the equilibrium of forces.

- (a)
- Assemble the apparatus as shown in Figure 1.1.
  - Adjust the bosses so that both nails are 55.0 cm above the bench.
  - Hang a mass D of 300 g from the loop of the short string.
  - Adjust the distance between the stands so that the section of string between points A and B is perpendicular to the section of string between points B and C.

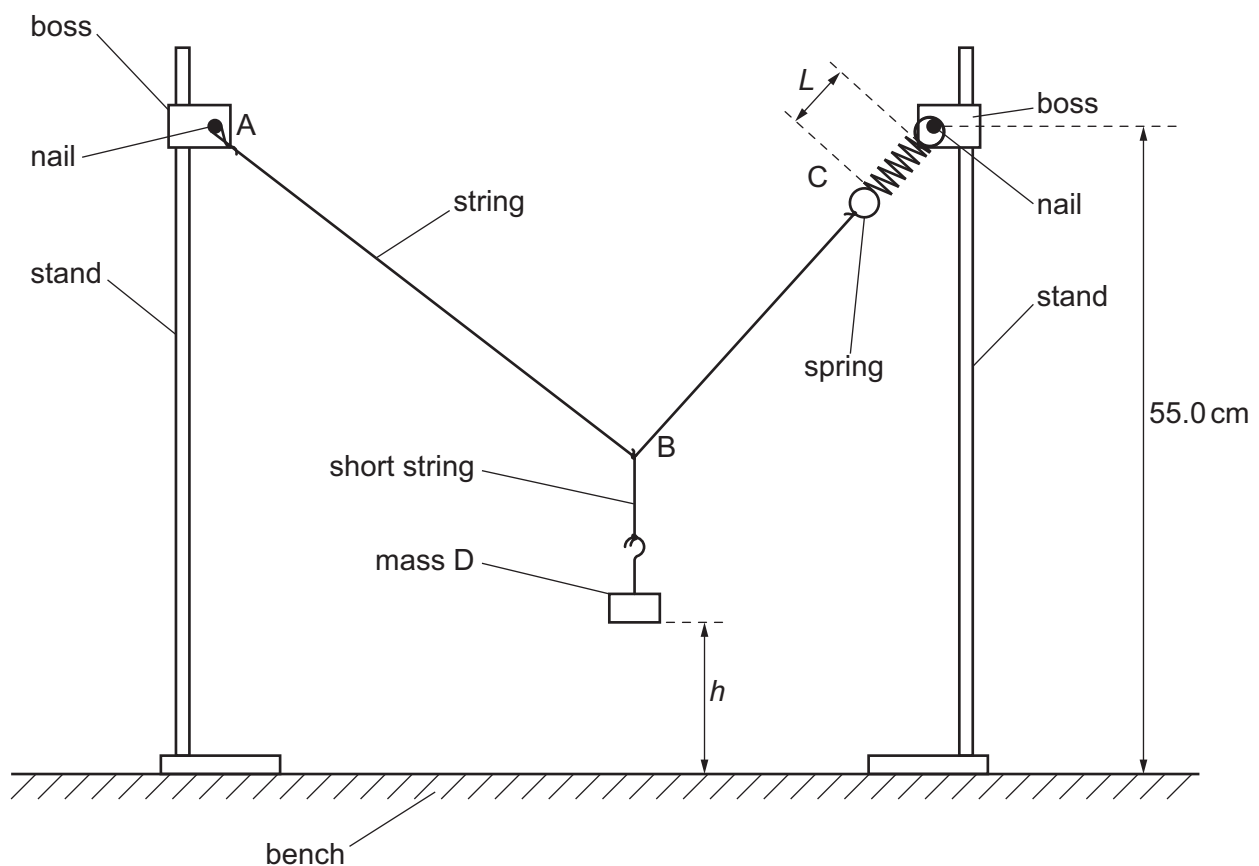


Figure 1.1



- The mass of D is  $m$ . Record  $m$ .

 $m = \dots\dots\dots$ 

- The length of the coiled part of the spring is  $L$ .

The distance between the bottom of D and the bench is  $h$ .

Measure and record  $L$  and  $h$ .

 $L = \dots\dots\dots$  $h = \dots\dots\dots$ 

- Calculate  $T$ , where  $T = L + h$ .

 $T = \dots\dots\dots$ 

[2]



- (b) Change  $m$  and adjust the distance between the stands so that the section of string between points A and B is perpendicular to the section of string between points B and C. Measure and record  $L$  and  $h$ . Repeat until you have six sets of values of  $m$ ,  $L$  and  $h$ .

Record your results in a table. Include values of  $T$  in your table.

[10]

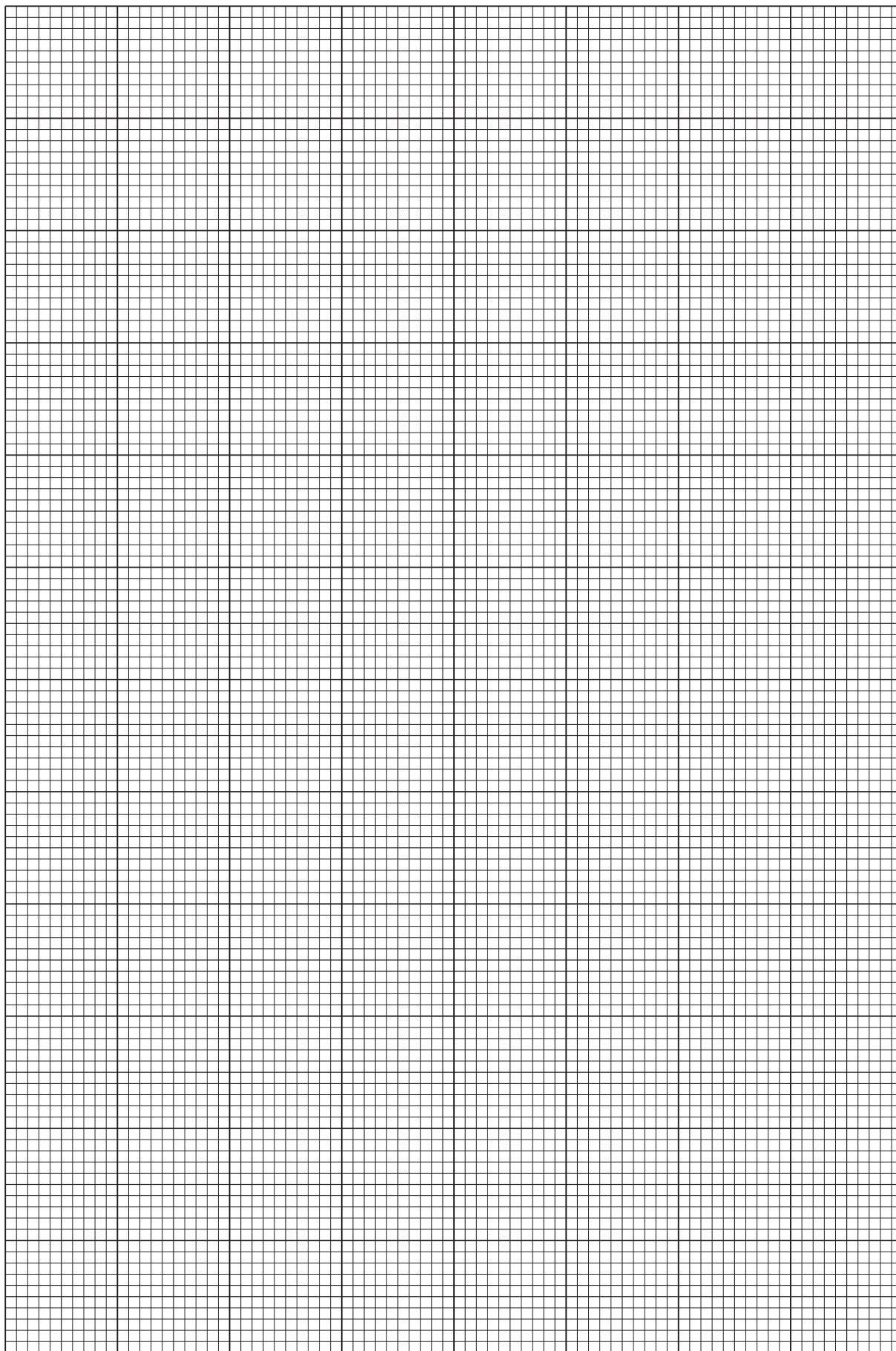
- (c) (i) Plot a graph of  $T$  on the  $y$ -axis against  $m$  on the  $x$ -axis. [3]
- (ii) Draw the straight line of best fit. [1]
- (iii) Determine the gradient and  $y$ -intercept of this line.

gradient = .....

$y$ -intercept = .....

[2]







(d) It is suggested that the quantities  $T$  and  $m$  are related by the equation

$$T = pm + q$$

where  $p$  and  $q$  are constants.

Use your answers in **1(c)(iii)** to determine the values of  $p$  and  $q$ .

Give appropriate units.

$p =$  .....

$q =$  .....

[2]

[Total: 20]

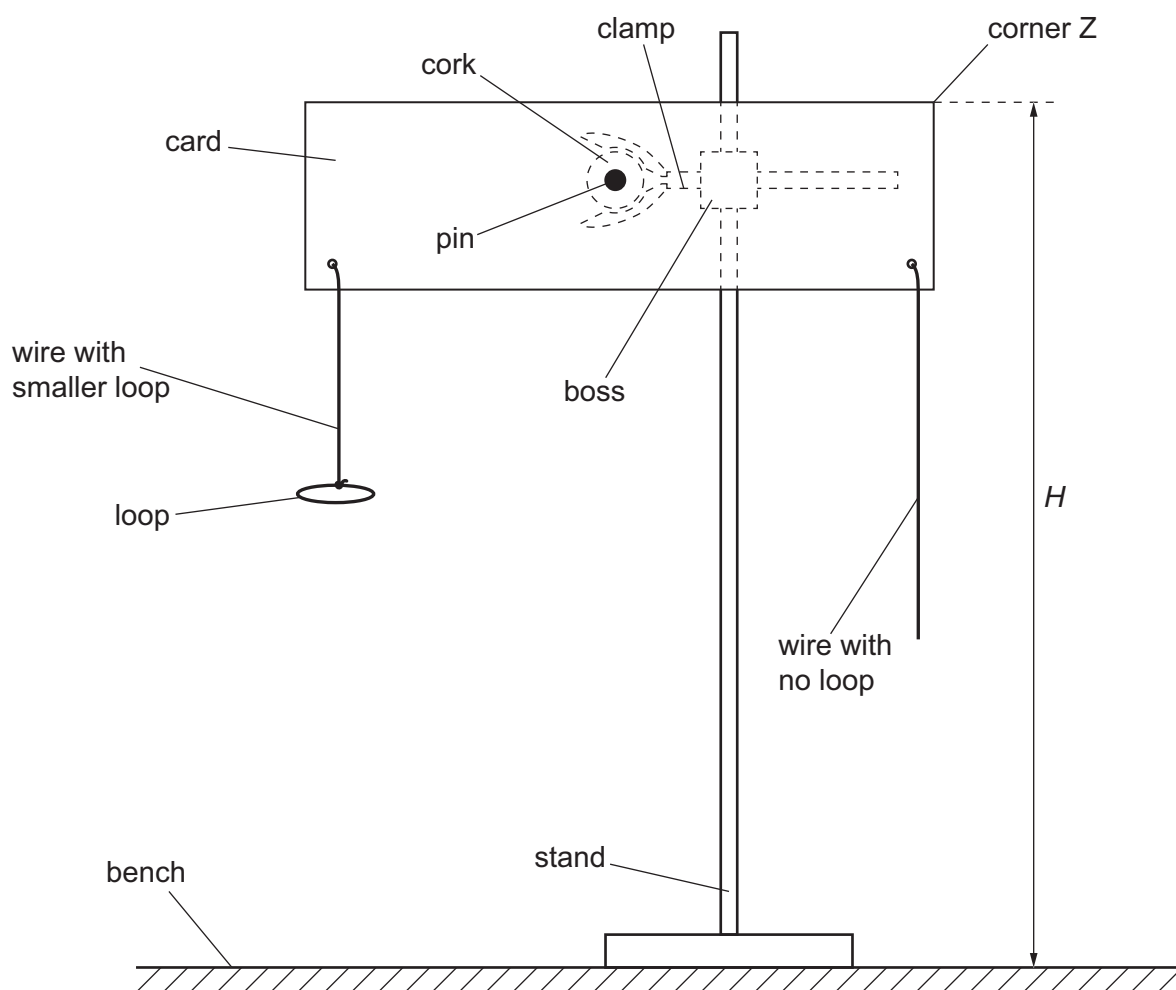


**You may not need to use all of the materials provided.**

**2** In this experiment, you will investigate the force applied by water on a copper wire loop.

**(a)** You have been provided with three copper wires. Each wire has a hook at one end. Two of the wires have a loop at the other end. The loops have different diameters.

- Using the wire with the loop of the **smaller** diameter, assemble the apparatus as shown in Figure 2.1.
- The pin passes through the central hole in the card and is pushed into the cork, which is held in the clamp.



**Figure 2.1**

- Adjust the height of the boss holding the clamp so that the pin is approximately 40 cm above the bench.
- Check that the card pivots freely on the pin.

- The height of corner Z above the bench is  $H$ , as shown in Figure 2.1.

Measure and record  $H$ .

$H = \dots\dots\dots$  cm

- In Table 2.1, record this value of  $H$  in the row  $n = 0$ .

[1]

- (b) • You have been provided with four paper clips.

Attach **one** paper clip onto the loop of the wire hanging from the card. The card will tilt.

- The number of paper clips attached onto the loop of the wire is  $n$ .

Measure  $H$  and record this value in Table 2.1.

**Table 2.1**

| $n$ | $H/\text{cm}$ |
|-----|---------------|
| 0   |               |
| 1   |               |
| 2   |               |
| 3   |               |
| 4   |               |

- Add more paper clips, and record the corresponding values of  $H$  in Table 2.1.
- Remove the paper clips from the loop.
- On Figure 2.2, plot a graph of  $H$  on the  $y$ -axis against  $n$  on the  $x$ -axis.
- Draw the curved line of best fit.



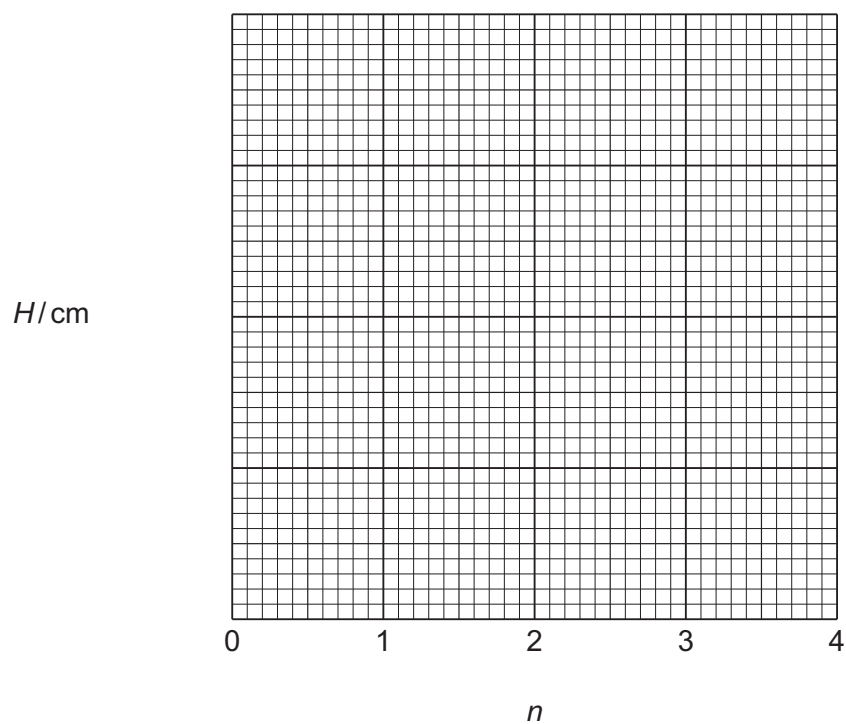


Figure 2.2

[1]

- (c) (i) • Lift up the beaker of water so that the loop just touches the water surface.
- Slowly lower the beaker so that the card tilts, as shown in Figure 2.3.

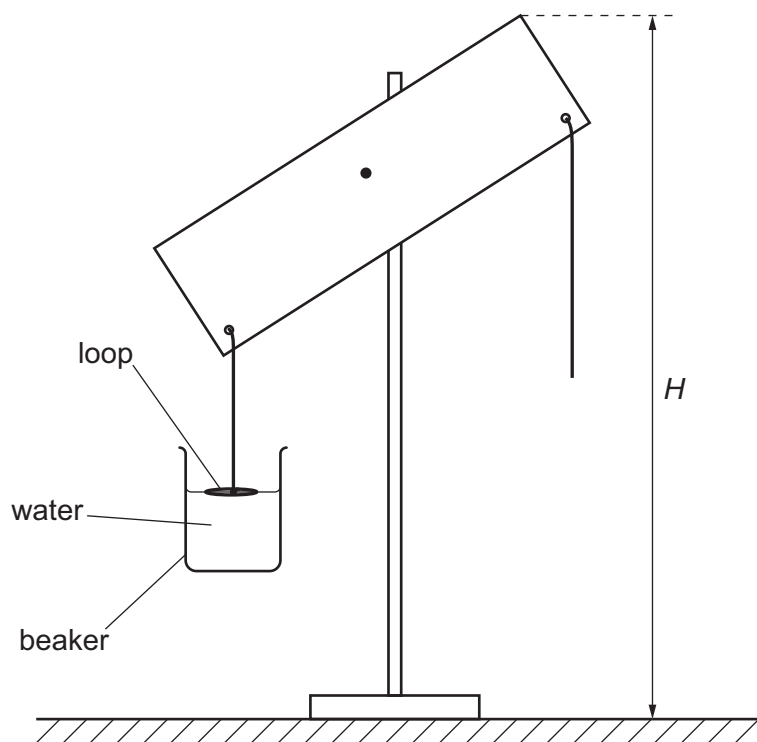


Figure 2.3



- Continue to lower the beaker until the loop breaks away from the water surface.
- Measure and record the value of  $H$  at the instant when the loop breaks away from the water surface.

$H = \dots\dots\dots$  cm [2]

- (ii) Estimate the percentage uncertainty in this value of  $H$ . Show your working.

percentage uncertainty =  $\dots\dots\dots$  % [1]

- (iii) • Use Figure 2.2 to determine the value of  $n$ , to the nearest 0.1, that corresponds to this value of  $H$ .

$n = \dots\dots\dots$

- The force  $F$  applied by the water is given by

$$F = nW$$

where  $W$  has the value 0.0032 N.

Calculate  $F$ .

$F = \dots\dots\dots$  N  
[1]

- (d) • Remove the wire with the loop from the card.
- Measure and record the diameter  $d$  of the loop.

$d = \dots\dots\dots$  [1]



- (e) • Hang the wire with the **larger** loop from the card.
- Repeat **2(c)(i)**, **2(c)(iii)** and **2(d)** using the wire with the larger loop.

$H =$  ..... cm

$n =$  .....

$F =$  ..... N

$d =$  ..... [2]

- (f) It is suggested that  $F$  and  $d$  are related by

$$F = 2\pi dk$$

where  $k$  is a constant.

- (i) Using your data, calculate **two** values of  $k$ .

first value of  $k =$  .....

second value of  $k =$  ..... [1]

- (ii) Justify the number of significant figures that you have given for your values of  $k$ .

.....

.....

..... [1]



(g) It is suggested that the uncertainty in the values of  $k$  is 10%.

Using this uncertainty, explain whether your results support the relationship in **2(f)**.

.....

.....

.....

..... [1]

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- (h) (i) Describe **four** sources of uncertainty or limitations of the procedure for this experiment.

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

- 1 .....
- 2 .....
- 3 .....
- 4 .....
- [4]

- (ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

- 1 .....
- 2 .....
- 3 .....
- 4 .....
- [4]

[Total: 20]







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