Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						7	5	4	0	/	0	2	Signature	

Paper Reference(s)

7540/02

London Examinations GCE

Physics

Ordinary Level

Paper 2

Monday 29 January 2007 – Afternoon

Time: 2 hours

Materials required for examination

Four-figure mathematical tables may be issued to candidates requesting them

Items included with question papers

Nil

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Total	

Instructions to Candidates

Answer ALL the questions in the spaces provided in this question paper.
In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.

Information for Candidates

Calculators may be used.
Where necessary, assume the acceleration of free fall, $g = 10\ \text{m/s}^2$.
The total mark for this paper is 100. The marks for parts of questions are shown in round brackets: e.g. (**2**).
This paper has five questions.

Advice to Candidates

Write your answers neatly and in good English.
In calculations, show **all** the steps in your working.

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Answer all the questions.

1. This question is about energy and momentum.

(a) In the ancient Olympic games long jumpers carried a mass of 5.0 kg in each hand. In one particular jump the increase in height of a mass of 5.0 kg was 3.2 m and its velocity was 6.2 m/s.

For this 5.0 kg mass calculate:

(i) the momentum;

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(2)

(ii) the increase in gravitational potential energy;

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(2)

(iii) the kinetic energy.

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(2)

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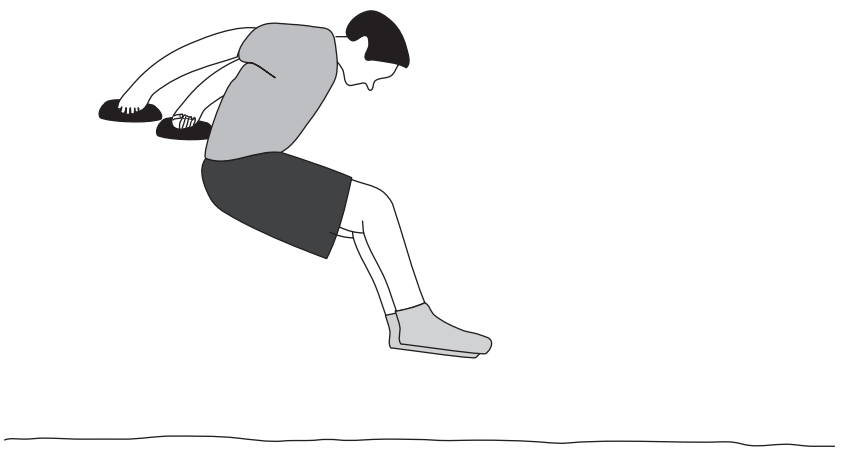
(b) During the jump the long jumper holds the masses above his head.



The drawing shows the long jumper landing. He has moved the masses to alter the position of his centre of gravity.

(i) What is meant by **centre of gravity**?

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(2)

(ii) How has the position of the centre of gravity of the jumper been changed by this movement of the masses?

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(2)

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(c) Describe an experiment to investigate the conservation of linear momentum during a collision using dynamics trolleys.

In your account:

(i) draw a labelled diagram;

(3)

(ii) list the measurements made;

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(3)

(iii) describe the method used;

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(3)

(iv) write down the equation you would use to show that momentum is conserved.

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(1)

Q1

(Total 20 marks)

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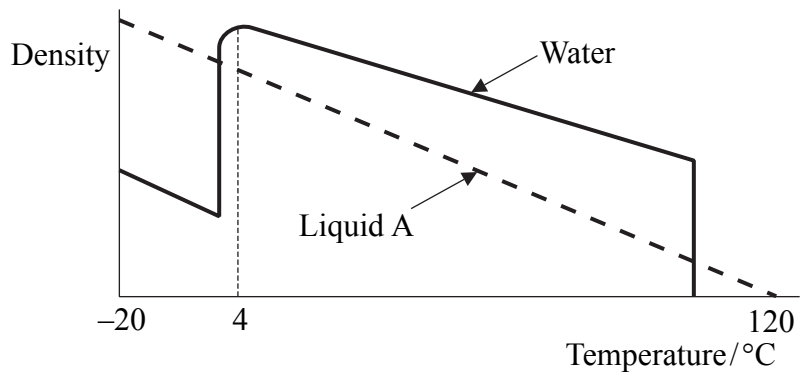
2. This question is about density and pressure.

(a) The graphs below show how the density of two different substances varies with temperature between –20 °C and 120 °C.



(i) Describe how the density of water changes when it is heated from –20 °C to 120 °C.

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(3)

(ii) Describe how the density of liquid A changes when it is heated from –20 °C to 120 °C.

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(1)

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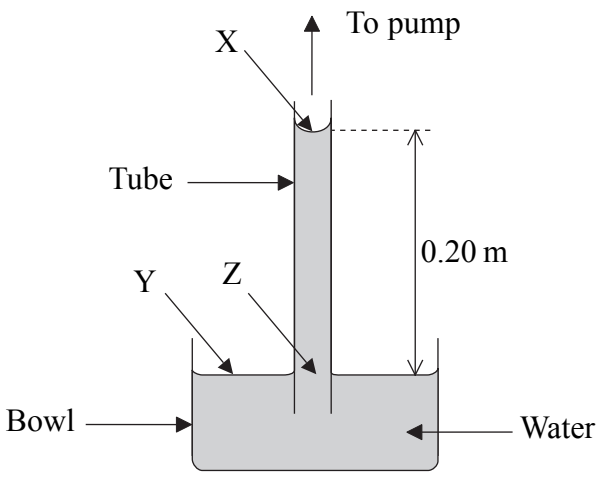
(b) The diagram shows a tube dipped into a bowl of water. Water has been drawn up the tube by a pump.



(i) Three points are labelled X, Y and Z. Which point or points is/are at atmospheric pressure?

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(1)

(ii) What is the pressure due to the column of water XZ?
(Density of water = 1000 kg/m^3)

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(2)

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(iii) What is the pressure at X when the atmospheric pressure is 100 kPa?

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(2)

(iv) The cross-sectional area of the tube is 0.000050 m^2. Calculate the mass of water in the 0.20 m length of the tube.

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(4)

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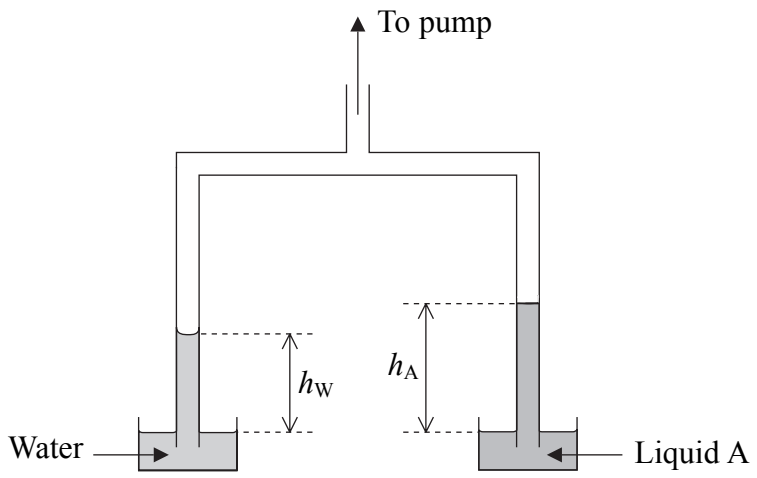
(c) The apparatus below can be used to measure the density of liquid A.



(i) Explain how the diagram shows that liquid A has a lower density than water.

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(3)

(ii) By making actual measurements of h_W and h_A, calculate the density of liquid A.

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(2)

(iii) Explain why it is more difficult to measure h_W than h_A.

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(1)

(iv) Explain why it is important to note the temperature.

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(1)

Q2

(Total 20 marks)

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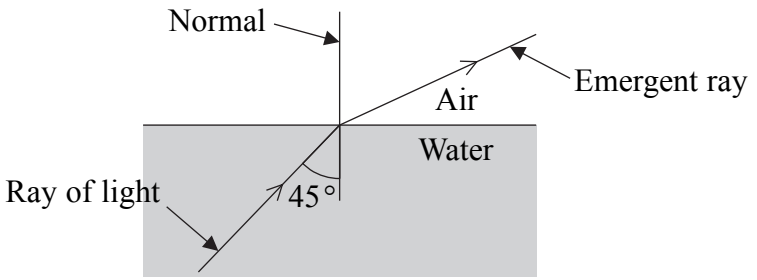
3. This question is about the refraction of light.

(a) The diagram shows a ray of light passing through water into air.



(i) Explain, in terms of the properties of light, why the light changes its direction as shown.

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(2)

(ii) If the refractive index of the water is 1.35, calculate the angle made by the emergent ray with the normal.

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(3)

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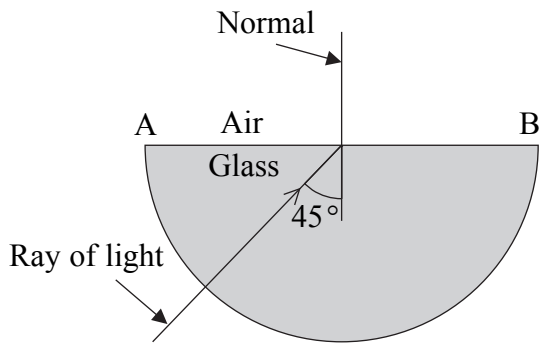
(b) The experiment is repeated using a semicircular glass block.



(i) State why the light does not change direction as it enters the glass.

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(1)

(ii) How does the light change as it passes from air to glass?

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(1)

(iii) Explain why the light does not emerge from the straight edge AB of the glass block.

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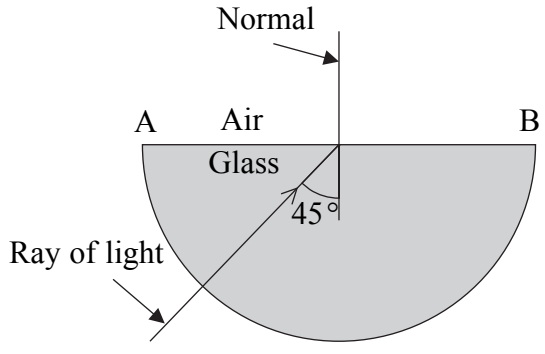
(2)

(iv) Sketch on the diagram below to show the complete path followed by this ray of light.



(2)

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(v) The glass has a refractive index of 1.60. Calculate the largest angle that the ray would need to make with the normal to allow the light to emerge from the straight edge AB of the glass block.

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(3)

(vi) The speed of light in air is 3.00×10^8 m/s. Calculate the speed of light in glass of refractive index 1.60.

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(3)

(c) When the experiment in (b) is repeated with the glass block immersed in water instead of air, the light emerges from the straight edge AB. Explain why this happens.

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(3)

Q3

(Total 20 marks)

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4. This question is about waves.

The males of insects called cicadas produce a very loud and shrill ‘song’. The insects produce the sound by vibrating a small plate called a tymbal. The sound is amplified by making a thin membrane vibrate at its resonant frequency.

(a) (i) State what is meant by resonance.

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(2)

(ii) Explain why the sound produced by the tymbal is amplified by the thin membrane.

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(2)

(b) Researchers have shown that the wavelength of the cicada’s song varies with body length. The results are shown in the table.

Wavelength of song/mm	31	43	53	64	81
Average body length/mm	16.2	22.7	28.8	35.0	45.3

(i) On the grid opposite, plot a graph of wavelength of song (y-axis) against average body length (x-axis). Start the x-axis at 15 mm and use a suitable scale that makes best use of the graph paper.

Draw the best straight line through your points.

(5)

(ii) Use the graph to find the wavelength of the song produced by a cicada with a body length of 20 mm. Show how you used the graph to obtain your value.

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(2)

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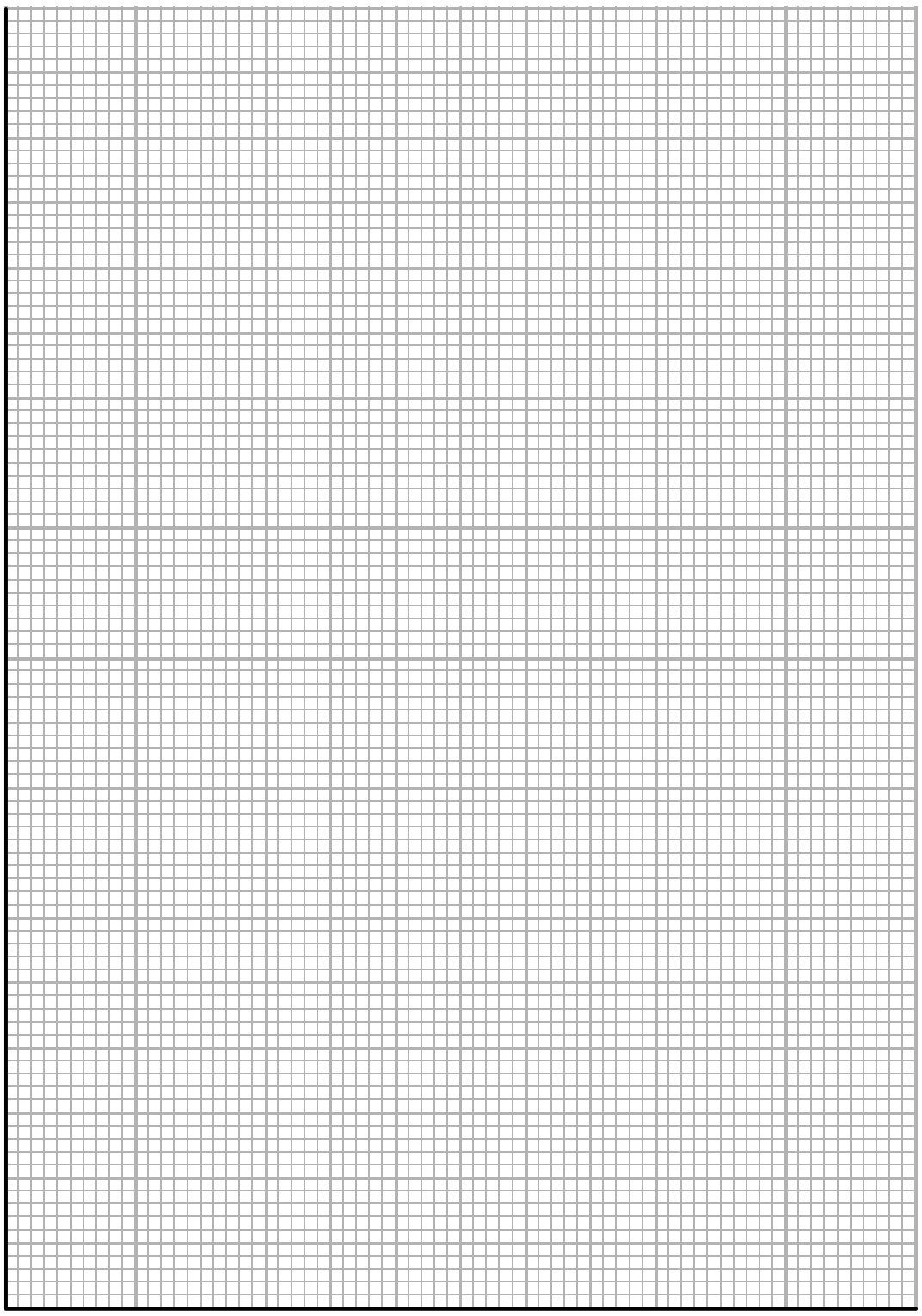

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(c) A cicada with a body length of 35 mm produces a song with a wavelength of 0.064 m and a frequency of 5.3 kHz. Calculate the speed of sound in air.

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(3)

(d) On a very hot day the speed of sound in air is 350 m/s.

(i) What effect, if any, does this have on the pitch and wavelength of the song heard?

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(2)

(ii) Explain your answers in (d)(i).

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(4)

Q4

(Total 20 marks)

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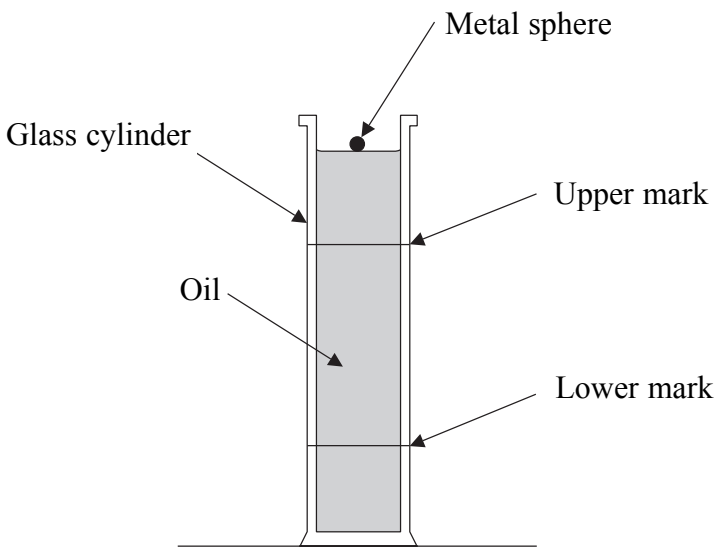
5. This question is about motion and the design of an experiment.



(a) The diagram shows a glass cylinder containing oil. A student holds a metal sphere at the surface of the oil and then releases it. The sphere accelerates at the start and then reaches a constant speed before reaching the upper mark on the cylinder. It then continues at this speed until it reaches the bottom of the cylinder.

(i) Name two vertical forces that act on the sphere as it falls through the oil.

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(2)

(ii) Sketch a graph showing how the speed of the sphere varies as it falls from the surface to the bottom of the oil.

(2)

Leave blank

(b) Describe how the student would investigate the relationship between the mass of the sphere and the constant speed at which it falls through the oil. Your description should include:

(i) a list of three essential items of measuring equipment;

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3 .....

(3)

(ii) a statement of how the student would change the mass of the metal sphere;

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(1)

(iii) a description of the method the student would use, including any measurements made;

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(6)

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(iv) a statement of how the student would ensure that the results obtained were as accurate as possible.

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(2)

(c) Name two other factors which would affect the constant speed at which a metal sphere would fall through oil. For each factor, say how it would affect the speed.

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(4) **Q5**

(Total 20 marks)

TOTAL FOR PAPER: 100 MARKS

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