Cambridge Assessment

O Level

Physics

Session: 1974 June
Type: Question paper
Code: 532

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PHYSICS

532/1

ORDINARY LEVEL

PAPER 1

(Two hours)

This question paper contains two parts: Part I is allotted 60 marks, Part II is allotted 30 marks. Candidates are advised not to spend more than about 80 minutes on Part I.

Answer 15 questions from Part I and the question in Part II. Answers to Part I must be written on the question paper, and are to be handed in with the answers to Part II.

Mathematical tables and squared paper are provided.

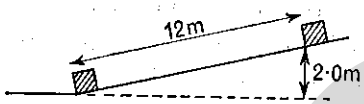
All *working must be shown.*

In Part II the marks shown indicate the relative credit given for each part of the question.

* PART I [4 marks per question]

Answer **fifteen** *questions. You may use any convenient space on this question paper for diagrams.*

1



A block of mass 30 kg is pulled up a slope by the action of a force of 70 N acting parallel to the slope. The block is moved 12 m along the slope, and becomes raised through a vertical height of 2·0 m, as shown in the diagram. Assuming the earth's gravity to exert a force of 10 N on a kilogramme, calculate

(*a*) the work done by the force of 70 N,

..... (2)

(*b*) the increase in the potential energy of the block.

..... (2)

2 A small solid sphere falls freely from rest, in air, with an acceleration of 10 m/s². How far does it fall in 5·0 seconds?

..... (2)

Explain why there would be a difference in the distance fallen by a large hollow sphere, of the same mass, in the same time.

.....

..... (2)

* Candidates in the Caribbean take Part I only.

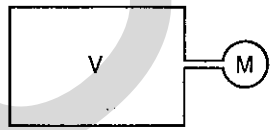
3 A pole AB of length 10·0 m and weight 800 N has its centre of gravity 4·0 m from the end A, and lies on horizontal ground. The end B is to be lifted by a vertical force applied at B. Calculate the least force required to do this.

(2)

Why would this force, applied at the end A, not be sufficient to lift the end A?

(2)

4



A quantity of volatile liquid, such as ether, is introduced into a closed evacuated vessel V, which is connected to a pressure gauge M. Some of the liquid evaporates, but when the pressure gauge gives a steady reading there is still some liquid in V.

State, giving a reason for each statement, the effect on the reading of the pressure gauge

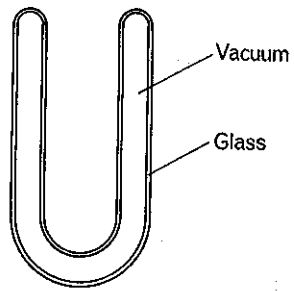
(*a*) if the volume of the vessel is reduced at constant temperature,

..... (2)

(*b*) if the temperature of the vessel and contents is reduced.

..... (2)

5



The diagram illustrates a double-walled vacuum flask used for keeping its contents hot.

(*a*) Why is a vacuum required between the two walls?

..... (2)

(*b*) How is heat transfer due to radiation greatly reduced? Illustrate your answer by labelling the diagram.

..... (2)

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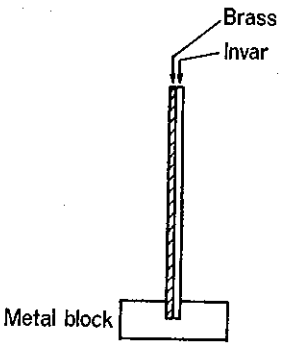
6 Draw a labelled diagram of a clinical thermometer, such as is used for finding a person's temperature. (3)

State any **one** feature of its design which results in a quick action.

.....(1)

7



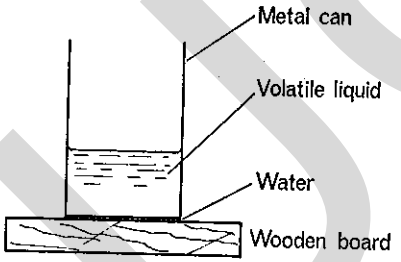
The compound bar of brass and invar shown in the diagram is firmly secured to a metal block at its lower end.

Show, on the diagram, the change which occurs when the temperature rises. Indicate, by completing the diagram, how this bar could be used to operate an alarm system when a particular temperature is reached. (3)

What adjustment would you make for the alarm to begin to operate at a higher temperature?

.....(1)

8

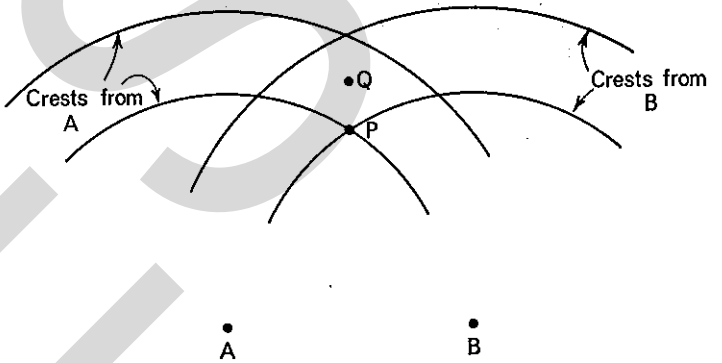


A metal can containing a volatile liquid, such as ether, stands on a wooden board with a layer of water between its base and the board. When a jet of air is blown through the liquid, the water freezes. Explain why this happens. (4)

9 A jet aircraft climbs at an increasing speed, using a large amount of fuel to provide energy. Write *brief* notes on the energy transformations which occur.

.....(4)

10



The diagram shows (actual size) the positions of successive crests of water ripples which have come from the point sources A and B, each source having a frequency of 15 Hz. The height of each crest is 3 mm above the normal water-level.

(*a*) From a measurement made on the diagram, find the wavelength of the wave-motion.

.....(1)

(*b*) Calculate the speed of travel of the wave-motion.

.....(1)

(*c*) State how the level of the water at Q compares with the level of the water at P, at the moment when the crests are in the positions shown in the diagram.

.....(2)

11 The spectra of two stars A and B appear as follows:

A. A continuous spectrum showing mainly red, orange and yellow.

B. A line emission spectrum ranging from red to violet.

State what you can deduce concerning

(*a*) the nature and the temperature of A, ...(2)

(*b*) the nature and the temperature of B. .....(2)

.....

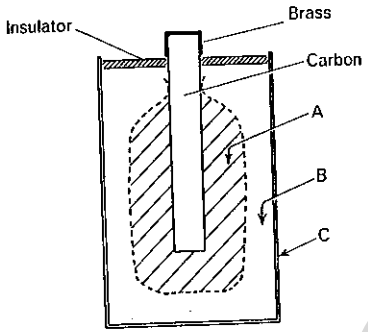
[Use terms such as red-hot, yellow-hot, etc. to express temperatures.]

JOLES

12

The above diagram represents a cross-section of the wires of a solenoid carrying a current so that the right-hand end has the same polarity as the N pole of a magnet. The lower diagram shows a cross-section of two such solenoids, carrying equal currents, with the right-hand end of each having the same polarity as the N pole of a magnet. Show, on each diagram, the magnetic lines of force due to the flow of current. (1)

13



Name the materials labelled A, B and C in the diagram, which shows a section of a dry cell. (2)

A .....

B .....

C .....

How do A and C change when the cell is supplying a current? (1)

Change in A .....

Change in C ..... (1)

14 Draw labelled circuit diagrams to show how two 6 V 12 W lamps can be lit to their normal brightness when they are connected (*a*) in parallel, (*b*) in series. Show, on each diagram, the required applied voltage and a suitable current-rating for a fuse put in the supply line. (2,2)

(*a*) Parallel (*b*) Series

15 What do you understand by 'an alternating current of frequency 50 Hz and peak value 2 A'? Answer this by means of a labelled sketch-graph.

Sketch graph:

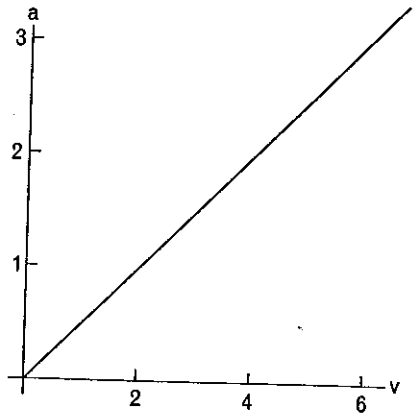
(2)

If this current is passed through an a.c. ammeter, correctly calibrated, the ammeter reads less than 2 A. Give a reason for this. (2)

.....

.....

16



The above graph shows the relation between a, the current in amperes, and v, the potential difference in volts, for a fixed resistor. What is the resistance of the resistor?

..... (2)

Show, on the above axes, a likely graph for the filament of an electric lamp, whose resistance when cold is the same as that of the fixed resistor and whose resistance is 3 times greater at a potential difference of 6 volts. (2)

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17 Lithium 7 ($^{7}_{3}$Li) and lithium 8 ($^{8}_{3}$Li) are isotopes of lithium. Put a tick √ against any of the following *statements* which are correct; put a cross × against any which are wrong.

Statements

The chemical properties of these isotopes are the same. .....

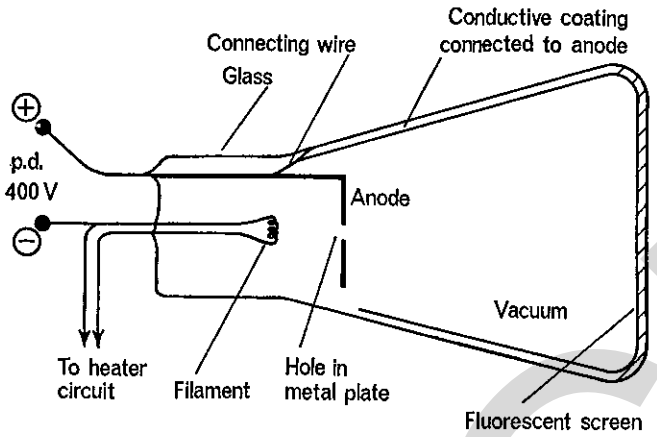
The physical properties (e.g. density) of these isotopes are the same. .....

The number of neutrons in the nucleus of each isotope is the same. .....

The number of electrons in the atom of each isotope is the same. .....

The mass number of each isotope is the same. ..... (4)

18



The diagram shows a section through an apparatus for producing an electron beam from a heated filament to a fluorescent screen.

(*a*) Explain the fact that the electrons are accelerated between the filament and the anode.

.....

..... (2)

(*b*) Explain the fact that the electrons travel at constant speed between the anode and the screen.

.....

..... (2)

PART II [15 marks per part of the question]

Answer two *of the parts* (*a*), (*b*), (*c*).

(*a*) A simple pendulum consisting of a small spherical metal bob on a thin cord is set up. Timings are carried out from which the time T of a complete small-angle oscillation is deduced for various lengths L of the pendulum. T^2 is calculated in each case, giving these results:

L in m	0·578	0·650	0·705	0·748	0·800	0·864	0·895
T^2 in s^2	2·37	2·62	2·82	3·03	3·24	3·46	3·65

Plot the graph of T^2 against L using scales which start from zero on both axes, and deduce the slope of the best line you can draw. **[8]**

(*i*) L is to be measured from the point of suspension to the centre of gravity of the bob. Suggest a suitable method of securing the upper end of the thread and state precisely how you would obtain an accurate value of L. **[3]**

(*ii*) Give details of how you would obtain an accurate value of T. State clearly at which point of the oscillations you would begin and end the timing. **[4]**

(*b*) Different currents were sent through a dilute solution of sulphuric acid, using carbon electrodes. The following table shows how, in the experiment, the potential difference V between the electrodes varied with the current I.

V in volt	1·20	1·24	1·31	1·37	1·42	1·49	1·54	1·61
I in ampere	0·10	0·20	0·30	0·40	0·50	0·60	0·70	0·80

(*i*) Draw a labelled circuit diagram to show the apparatus you would use for doing this experiment. **[4]**

(*ii*) From the information in the above table, plot a graph of V against I. **[4]**

(*iii*) Estimate, from the graph, a value of V when the current is 0·01 A. What steps would you take to check this value of V experimentally? **[3]**

(*iv*) Deduce, from the graph, the resistance R between the electrodes given that

$$R = (\text{change in } V) \div (\text{change in } I).$$ **[4]**

(*c*) A flexible metal sheet has the following approximate dimensions: length 6·0 cm, breadth 4·0 cm, thickness 0·1 cm. The density of the metal can be determined from measurements of its mass and its linear dimensions.

(*i*) State the instruments you would use for each of these measurements. **[3]**

(*ii*) Enumerate the steps you would take in each case in order to reduce errors in the use of these instruments. **[4]**

(*iii*) Show how you would calculate a value for the density; indicate the units of your result. **[2]**

(*iv*) Describe an alternative method of measuring the volume of the metal, and discuss whether you consider this will give a more accurate value than would a determination from the linear dimensions. **[6]**

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PHYSICS

532/2

ORDINARY LEVEL

PAPER 2

(Two hours and a half)

Answer **five** *questions, including at least* **one** *from each of the Sections* A *and* B, *and at least* **two** *from Section* C.

Mathematical tables and squared paper are provided.

The marks shown indicate the relative credit given for the various parts of the questions.

SECTION A

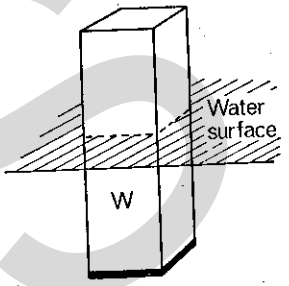
1 A motor car moves from rest with a constant acceleration of 2·5 m/s² for the first 4·0 s. It then changes gear and the acceleration becomes 1·5 m/s² for the next 6·0 s.

Draw a graph of *speed* against *time* to illustrate the motion during the 10 seconds, and deduce the total distance travelled in this time. **[7]**

Calculate the resultant force required to produce the acceleration of 2·5 m/s² when the car has a mass of 1200 kg. How much work is done by this force in the first 4 seconds? **[6]**

If you were travelling in a motor-car, how would you (i) test whether the acceleration in the first half-minute of the journey were uniform and (ii) obtain an estimate of the average acceleration in the first half-minute? **[7]**

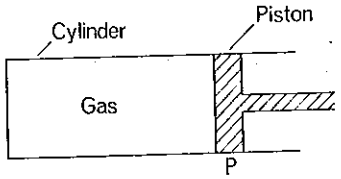
2 The diagram shows a loaded block W floating in water. The block has a weight of 1·20 N and an area of cross-section of 5·0 cm². Describe in detail how it could be used in an experiment to measure the pressure due to the water at various depths below the surface. **[8]**



How would the fluid pressure in a liquid of density 1·5 g/cm³ compare with that in water (density 1·0 g/cm³) at the same depth? **[2]**

Explain how liquid pressure is used in a mercury barometer for the measurement of atmospheric pressure. Explain, with reference to any **two** of its properties, why mercury is a suitable liquid for use in a barometer. **[10]**

3



The diagram shows a gas enclosed in a cylinder by a piston P. Account for the pressure exerted on the piston P by the molecules of the gas.

State the changes which occur in this pressure when

(*a*) the piston is pushed to the left, so that the gas now occupies only half the volume it occupied originally, but the temperature of the gas remains unaltered,

(*b*) the piston remains fixed in position, but the temperature of the gas is increased.

Account for these changes in the pressure exerted by the molecules of the gas. **[11]**

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Draw a fully labelled diagram of an apparatus which could be used to investigate how the volume of a mass of gas changes with temperature at constant pressure. Indicate clearly how the constancy of pressure is achieved. **[6]**

A mass of gas which is initially at a pressure of 760 mmHg has its volume halved, and at the same time its temperature increases from 300 K to 400 K. What does the pressure become? **[3]**

4 What do you understand by *specific latent heat*? **[4]**

By considering the molecular nature of matter, explain what happens to the latent heat of fusion of ice and to the latent heat of evaporation of water, when each is supplied to cause the corresponding change of state. **[6]**

A jet of dry steam (at 100 °C), flowing at the rate of 0·30 g per second, is directed on to crushed ice at 0 °C in a copper can which has a hole in its base. 2·80 g of water at 0 °C flows out through the hole per second. If the specific latent heat of condensation of steam is 2260 J/g and the specific heat capacity of water is 4·20 J/g °C, calculate the heat per second given out by the steam in condensing and cooling to 0 °C. Use this result to estimate a value for the specific latent heat of fusion of ice, and explain whether you would expect this value to be larger or smaller than the correct value. **[10]**

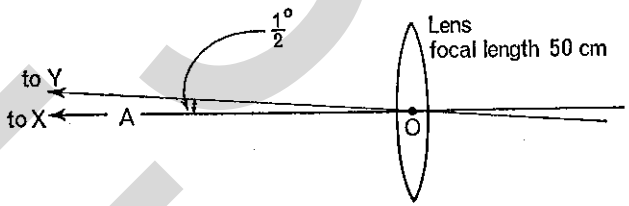
Section B

5 Describe how you would attempt to show that a material medium is essential for the transmission of sound. **[7]**

A source of sound S produces vibrations of constant frequency in the air. Describe for some point in the air, e.g. A in the following diagram, (i) the *motion* of the air at the point, (ii) the *pressure changes* occurring at the point. How would the pressure changes at that point alter if the source of sound were (*a*) louder, (*b*) of higher pitch? **[10]**

In the above diagram, B is the point nearest to A at which the motion and pressure changes are at all instants identical with those at A when the frequency of the source is 1360 Hz. Given that AB = 25·0 cm, calculate the speed of sound in the air. **[3]**

6 (i)



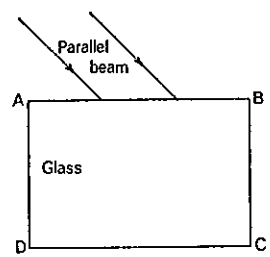
Rays of light from a point X on the edge of the sun's disc are effectively parallel. The lens in the diagram, which has a focal length of 50 cm, is arranged so that its principal axis OA points towards X. Where will the rays from X come to a focus after passing through the lens? **[2]**

The point Y, at the opposite end of the sun's diameter to X, is in a direction OY where $Y\hat{O}A = \frac{1}{2}°$. At what point will rays from Y come to a focus after passing through the lens? Where should a screen be placed in order to obtain the most clearly focused image of the sun's disc? Calculate the diameter of this image. **[8]**

(ii) Describe how you would determine, experimentally, the focal length of a converging lens. **[6]**

(iii) Explain, with the aid of a ray diagram, how a lens of focal length 5 cm can be used to enable a person to see an erect magnified image of a small object. **[4]**

7 (i)



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The diagram shows a parallel beam of monochromatic light incident at 45° on the surface AB of the glass block ABCD. Copy the diagram, about twice the size shown above, and complete it to show some of the *wave-fronts* of the light

(*a*) approaching AB,

(*b*) travelling in the glass,

(*c*) after emergence from CD.

Explain why the direction of travel of a *wave-front* changes on entering the glass.

If the refractive index of the glass is 1·55, what angle do the wave-fronts in the glass make with AB? **[12]**

(ii) Calculate the *critical angle* for light emerging from glass, of refractive index 1·55, into air. Would the critical angle be greater or less than this if the light were emerging from the glass into water? Give your reasoning. **[4]**

Draw a diagram to show how a right-angled isosceles glass prism can be used to turn a ray of light through 90°. What are the advantages of using a prism, rather than a silvered mirror, for this purpose? **[4]**

Section C

8 Given an unmagnetised steel bar, how would you test experimentally that it is unmagnetised? Describe how you would then use a solenoid, a d.c. supply, and other apparatus

(i) to test that there is a limit to the strength of the magnet that can be made by magnetising the steel bar,

(ii) to find a relation between the direction of the current in the turns of the solenoid and the polarity of the magnetised steel. **[12]**

A steel bar is inside a solenoid which carries a current sufficient to magnetise the steel fully. State the effect, on the magnetism of the bar, of switching off the current and then gradually increasing the current to its previous value but in the opposite direction. **[4]**

Describe briefly any **one** method of demagnetising a magnetised steel bar. **[4]**

9 An accumulator battery of electromotive force 24·0 V and internal resistance 4·0 Ω is to be connected to a coil of resistance wire for use as a heater of output about 30 W. Given two such coils A and B, of resistance 4·0 Ω and 8·0 Ω respectively, find by calculation, for each coil separately connected to the accumulator

(*a*) the power provided by the heater,

(*b*) the efficiency (power provided by the heater ÷ power expended by the battery). **[7]**

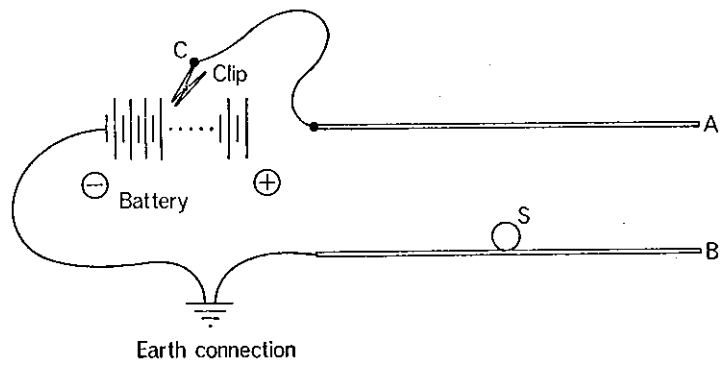
Tabulate your answers; give brief comments on the results. **[3]**

Draw a labelled circuit diagram to show how you would re-charge a 24 V accumulator battery, at 5 A, from a 240 V a.c. main, given a transformer with a turns-ratio of 6 : 1 and any other necessary accessories. How could you tell when the charging process was complete? **[10]**

10 Draw a labelled diagram to show the apparatus and the electric circuit you would use for copper-plating a sheet of brass on both sides. What conditions are needed to ensure a firm and uniform deposit of copper? **[8]**

Give a brief account of what happens at the electrodes, and of the movement of electric charges in the electrolyte. Explain how an increase in the potential difference between the electrodes affects what happens in the electrolyte and at the electrodes. **[7, 5]**

11



The diagram shows a section through two horizontal metal plates A and B; B is earthed, and A can be given a potential V by using the movable clip C to connect it to a terminal on a high-voltage battery. S is a small sphere of conducting material, resting on B.

Give an explanation of each of the following:

(*a*) When C is connected to the battery, S becomes charged. **[3]**

(*b*) When V is steadily increased, a stage is reached at which S moves upwards. **[3]**

(*c*) A value of V greater than that in (*b*) results in a continuous movement of S up and down from one plate to the other. **[8]**

Make reference, in your explanation of this movement, to the differing accelerations of S as it moves up and down.

(*d*) If A becomes isolated from the battery while S is moving between the plates, the up and down motion of S continues, becomes slower, and soon ceases. **[6]**

12 Name the particles emitted in (i) *thermionic emission*, (ii) *radioactive decay*. **[4]**

How do the processes by which particles are emitted differ in *thermionic emission* and in *radioactive decay*? How, if at all, do the processes affect the atomic structure of the emitter in each case? **[11]**

Thoron is a radioactive gas with a half-life of the order of 1 minute. When some of the gas is put in a cloud chamber, tracks of the emitted particles can be seen. If, on first observing tracks in the chamber, there were 15 tracks visible, what further observations would you make, and how would you use them, in order to determine the half-life of thoron as accurately as you can? **[5]**

PHYSICS PRACTICAL A

[CARIBBEAN CENTRES ONLY]

ORDINARY LEVEL **532/3 Caribbean**

(Two hours and a quarter)

Answer Question 1 *and* **one** *other question. You will not be allowed to start work with the apparatus for the first quarter of an hour.*

Candidates are recommended to record their observations as soon as these observations are made. These observations and any arithmetical working of the answers from them should be written on the answer sheets: scrap paper should not be used. The record may be in pencil provided it is sufficiently neat to be intelligible. A fair copy is **not** *wanted.*

An account of the method of carrying out the experiments is **not** *required; but candidates should record any precautions they have taken, and it must be clear (by diagrams or otherwise) how the readings were obtained. The theory of the experiments is* **not** *required.*

Mathematical tables and squared paper are provided.

1 Determine the mass M of the given glass microscope-slide. Then, from measurements of its dimensions, find the density of the glass.

Notes on procedure

(i) Adjust the given simple balance so that its beam is horizontal; a small pellet of plasticine can be stuck to the beam if it is not already horizontal.

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