Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Secondary Education
Higher Tier
January 2012

Additional Science

Unit Physics P2

Physics

Unit Physics P2

PHY2H

H

Monday 30 January 2012 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

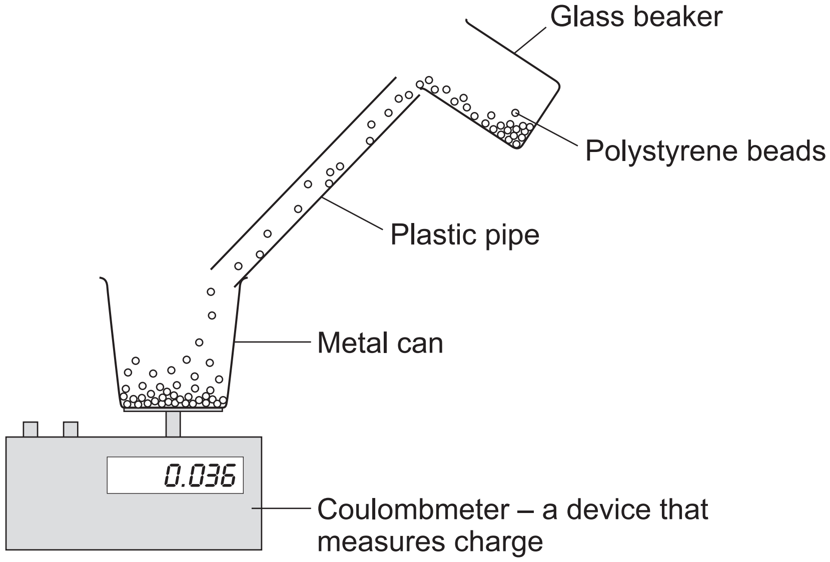
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

Answer **all** questions in the spaces provided.

1 (a) Fine powders poured through a pipe can become charged. The diagram shows the apparatus used by a student to investigate this effect.



The student poured 75 cm^3 of polystyrene beads down the pipe. The beads fell into a metal can and the charge on them was measured directly using a coulombmeter.

The student repeated this twice more, but each time used 75 cm^3 of beads of a different size.

1 (a) (i) When they fell through the pipe, the polystyrene beads became negatively charged.

Explain how this happened.

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(3 marks)

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1 (a) (ii) Give **one** control variable in the student's investigation.

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(1 mark)

1 (b) The results obtained by the student are shown in the table.

Diameter of polystyrene beads in mm	**Charge in microcoulombs**
1.0	0.080
2.0	0.044
3.0	0.012

(1 000 000 microcoulombs = 1 coulomb)

1 (b) (i) Describe the connection between the size of the polystyrene beads and the total charge on the beads.

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(1 mark)

1 (b) (ii) Explain how these results might be different if the student had used a shorter pipe.

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(2 marks)

Question 1 continues on the next page

Do not write outside the box

1 (c) In industry, powders are often pumped through pipes. If the static charge caused a spark, the powder could ignite and cause an explosion.

1 (c) (i) Is an explosion more likely to happen when pumping very fine powders or when pumping powders that consist of much larger particles?

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Give a reason for your answer.

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(1 mark)

1 (c) (ii) Suggest **one** way that the risk of an explosion could be reduced.

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(1 mark)

1 (d) The table gives the minimum ignition energy (MIE) value for a number of fine powders. The MIE is the minimum amount of energy required to cause a fine powder to ignite.

Type of powder	**MIE in millijoules**
Coal dust	60.00
Aluminium powder	10.00
Cornstarch dust	0.30
Iron powder	0.12

The MIE values for different substances are all measured in the same way and under the same conditions of pressure and temperature.

Why is this important?

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(1 mark)

10

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2 (a) Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

2 (a) (i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

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(2 marks)

2 (a) (ii) What is released during both nuclear fission and nuclear fusion?

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(1 mark)

2 (b) Plutonium-239 is used as a fuel in some nuclear reactors.

2 (b) (i) Name another substance used as a fuel in some nuclear reactors.

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(1 mark)

2 (b) (ii) There are many isotopes of plutonium.

What do the nuclei of different plutonium isotopes have in common?

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(1 mark)

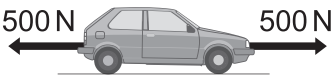
5

Turn over for the next question

Do not write outside the box

3 (a) A car is being driven along a straight road. The diagrams, **A**, **B** and **C**, show the horizontal forces acting on the moving car at three different points along the road.

Describe the motion of the car at each of the points, **A**, **B** and **C**.



A

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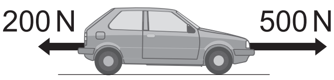

B

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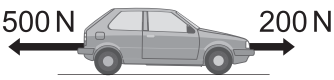

C

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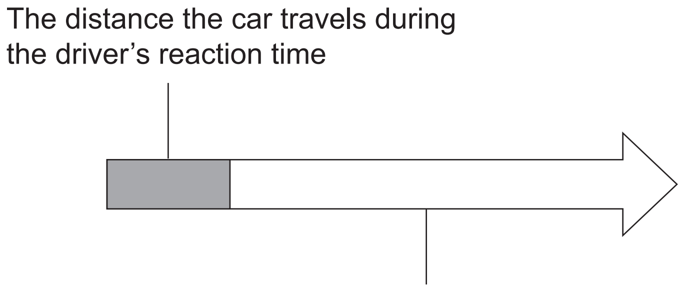
(3 marks)

3 (b) The diagram below shows the stopping distance for a family car, in good condition, driven at 22 m/s on a dry road. The stopping distance has two parts.

3 (b) (i) Complete the diagram below by adding an appropriate label to the second part of the stopping distance.

(1 mark)



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3 (b) (ii) State **one** factor that changes both the first part **and** the second part of the stopping distance.

....

(1 mark)

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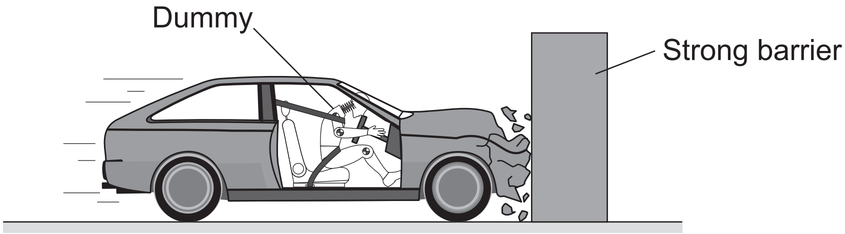
3 (c) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to the dummy inside the car.



3 (c) (i) At the point of collision, the car exerts a force of 5000 N on the barrier.

State the size and direction of the force exerted by the barrier on the car.

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(1 mark)

3 (c) (ii) Suggest why the dummy is fitted with electronic sensors.

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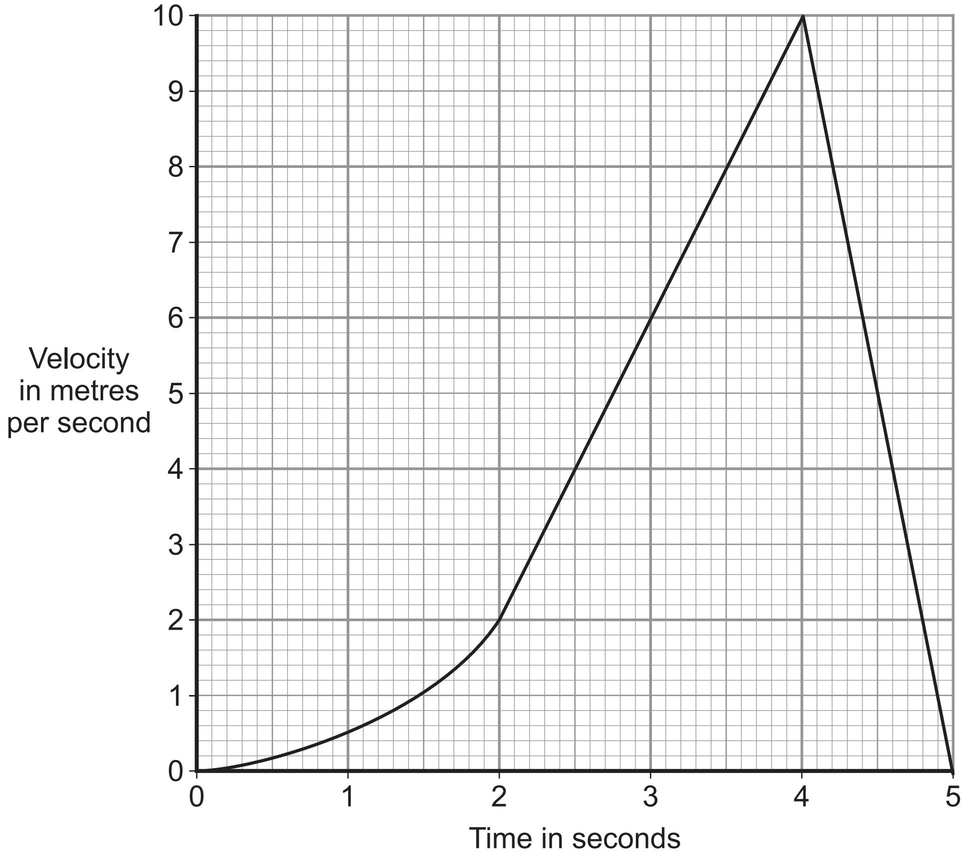
(1 mark)

Question 3 continues on the next page

3 (c) (iii) The graph shows how the velocity of the car changes during the test.



Use the graph to calculate the acceleration of the car just before the collision with the barrier.

Show clearly how you work out your answer, including how you use the graph, and give the unit.

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Acceleration = ...

(3 marks)

10

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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4 (a) The resistance of a 24 W, 12 V filament lamp depends on the current flowing through the lamp. For currents up to 0.8 A, the resistance has a constant value of 2.5 Ω.

4 (a) (i) Use the equation in the box to calculate the potential difference across the lamp when a current of 0.8 A flows through the lamp.

potential difference = current × resistance

Show clearly how you work out your answer.

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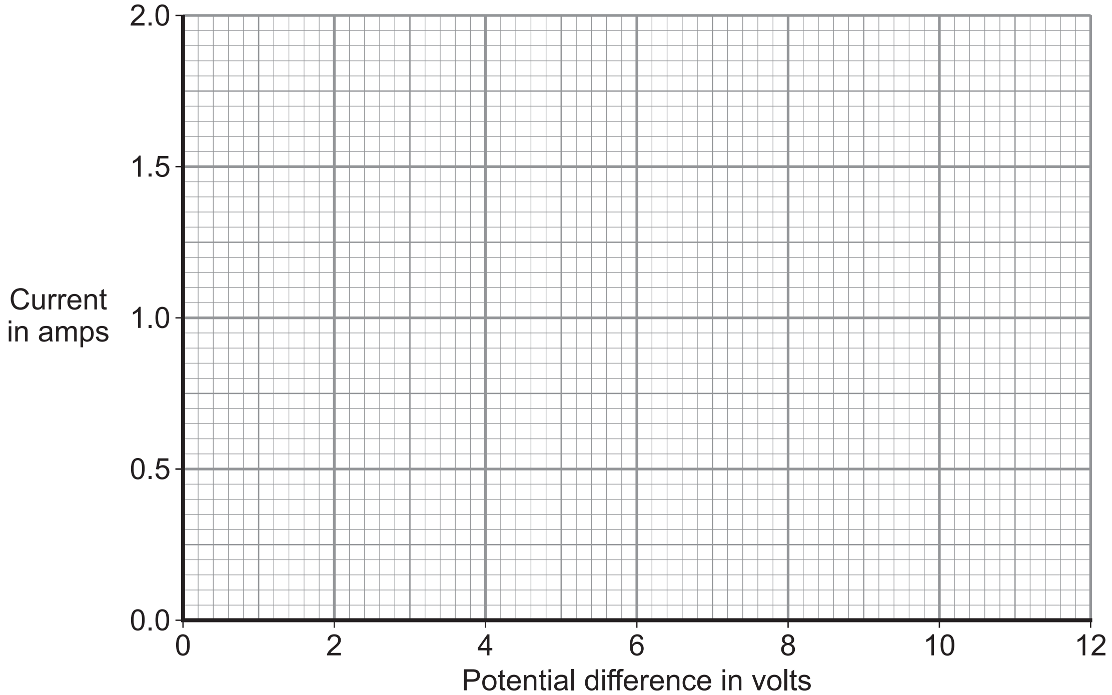
Potential difference = ... V

(2 marks)

4 (a) (ii) When the potential difference across the lamp is 12 V, the current through the lamp is 2 A.

On the axes below, draw a current – potential difference graph for the filament lamp over the range of potential difference from 0 to 12 volts.



(2 marks)

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4 (a) (iii) Why does the resistance of the lamp change when the current through the lamp exceeds 0.8 A?

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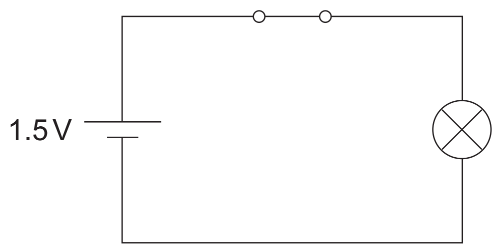
(1 mark)

4 (b) The lamp is now included in a circuit. The circuit is switched on for 2 minutes. During this time, 72 coulombs of charge pass through the lamp.



Use the equation in the box to calculate the energy transformed by the lamp while the circuit is switched on.

energy transformed = potential difference × charge

Show clearly how you work out your answer.

....

....

Energy transformed = ... J

(2 marks)

7

Turn over for the next question

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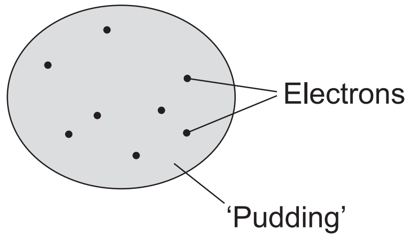
5 The 'plum pudding' model of the atom was used by scientists in the early part of the 20th century to explain atomic structure.



5 (a) Those scientists knew that atoms contained electrons and that the electrons had a negative charge. They also knew that an atom was electrically neutral overall.

What did this allow the scientists to deduce about the 'pudding' part of the atom?

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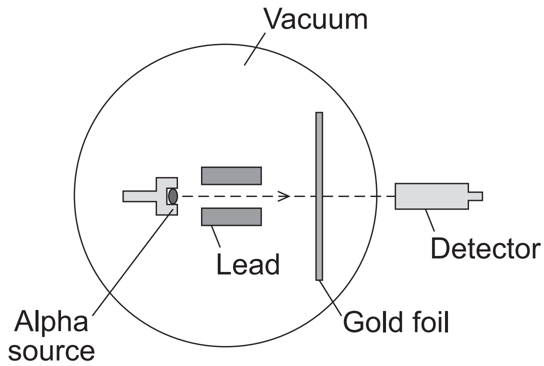
(1 mark)

5 (b) An experiment, designed to investigate the 'plum pudding' model, involved firing alpha particles at a thin gold foil.



If the 'plum pudding' model was correct, then most of the alpha particles would go straight through the gold foil. A few would be deflected, but by less than 4°.

The results of the experiment were unexpected. Although most of the alpha particles did go straight through the gold foil, about 1 in every 8 000 was deflected by more than 90°.

Why did this experiment lead to a new model of the atom, called the nuclear model, replacing the 'plum pudding' model?

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(1 mark)

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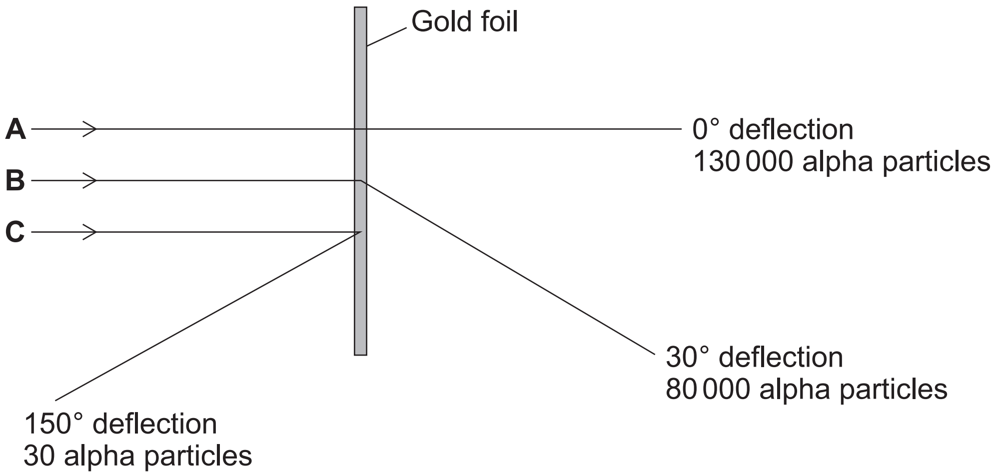
5 (c) The diagram shows the paths, **A**, **B** and **C**, of three alpha particles. The total number of alpha particles deflected through each angle is also given.



5 (c) (i) Using the nuclear model of the atom, explain the three paths, **A**, **B** and **C**.

A ....

....

B ....

....

C ....

....

(3 marks)

5 (c) (ii) Using the nuclear model, the scientist E. Rutherford devised an equation to predict the proportion of alpha particles that would be deflected through various angles.

The results of the experiment were the same as the predictions made by Rutherford.

What was the importance of the experimental results and the predictions being the same?

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(1 mark)

6

Turn over ▶

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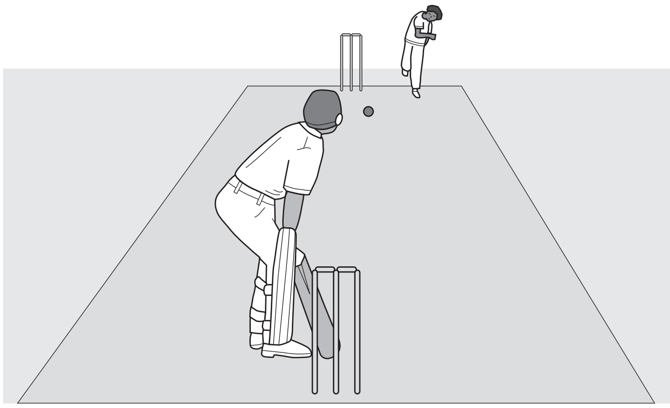
6 The picture shows players in a cricket match.



6 (a) A fast bowler bowls the ball at 35 m/s. The ball has a mass of 0.16 kg.

Use the equation in the box to calculate the kinetic energy of the cricket ball as it leaves the bowler's hand.

$$\text{kinetic energy} = \tfrac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

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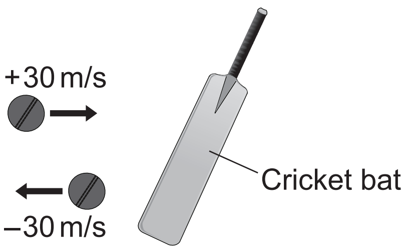
Kinetic energy = ... J

(2 marks)

6 (b) When the ball reaches the batsman it is travelling at 30 m/s. The batsman strikes the ball which moves off at 30 m/s in the opposite direction.



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6 (b) (i) Use the equation in the box to calculate the change in momentum of the ball.

$$\text{momentum} = \text{mass} \times \text{velocity}$$

Show clearly how you work out your answer.

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Change in momentum = ... kg m/s

(2 marks)

6 (b) (ii) The ball is in contact with the bat for 0.001 s.

Use the equation in the box to calculate the force exerted by the bat on the ball.

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

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Force = ... N

(1 mark)

6 (c) A fielder, as he catches a cricket ball, pulls his hands backwards.

Explain why this action reduces the force on his hands.

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(2 marks)

7

END OF QUESTIONS

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