



Cambridge O Level

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PHYSICS

5054/02

Paper 2 Theory

For examination from 2023

SPECIMEN PAPER

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

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 or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.
- Take the weight of 1.0 kg to be 9.8 N (acceleration of free fall = 9.8 m/s^2).

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Any blank pages are indicated.

1 Fig. 1.1 is the speed-time graph for a stone as it falls to the ground.

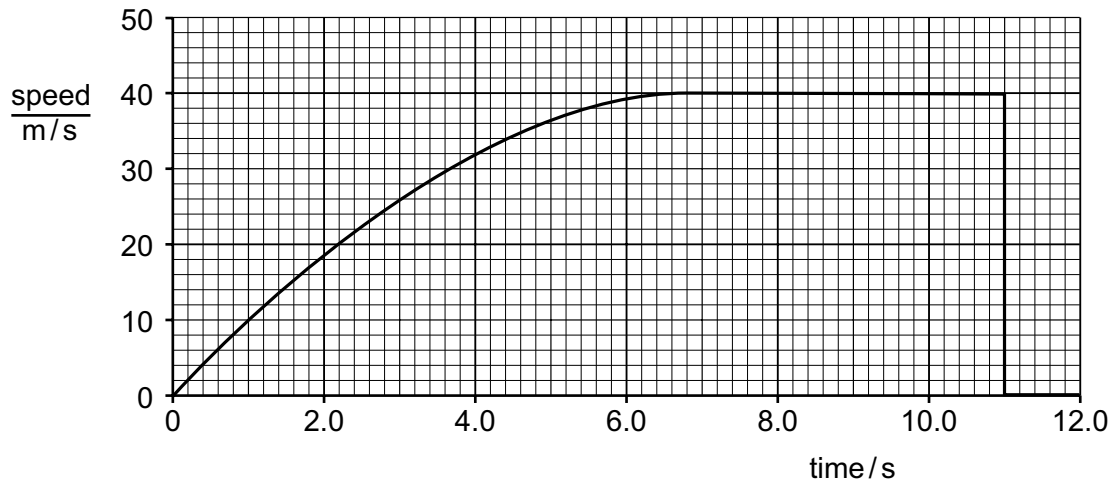


Fig. 1.1

(a) (i) On Fig. 1.1, mark:

- a letter **X** to indicate a point where the rock is moving with a constant speed
- a letter **Y** to indicate a point where the rock is decelerating.

[2]

(ii) At time $t = 0$, the acceleration of the stone is equal to the acceleration of free fall.

Give the name of the force accelerating the stone at time $t = 0$.

..... [1]

(b) The weight of the stone is 4.0 N.

As the stone falls, the force F of air resistance acting on the rock changes.

(i) State the value of F at time $t = 0$.

$F =$ N [1]

(ii) State the value of F at time $t = 10.0$ s.

$F =$ N [1]

(iii) Suggest why F changes between $t = 0$ s and $t = 10.0$ s

.....

 [1]

- (c) (i) Using Fig. 1.1, determine the acceleration of the rock at time $t = 4.0$ s. State the unit of your answer.

You will need to draw a tangent to the graph in Fig. 1.1 and show your working.

acceleration = unit = [3]

- (ii) The mass of the stone is 408 g.

Determine the force F of air resistance acting on the rock at time $t = 4.0$ s.

Show your working.

$F =$ N [2]

[Total: 11]

2 Fig. 2.1 shows a black car going up a hill on a sunny day.

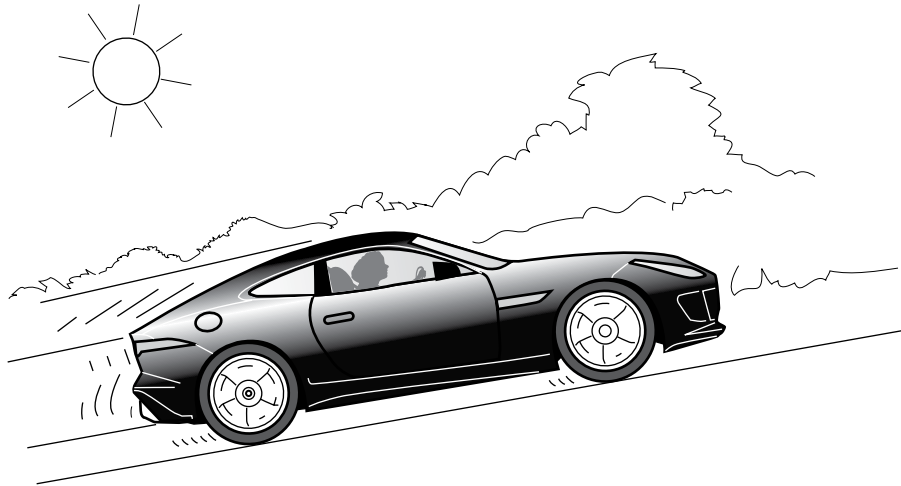


Fig. 2.1

(a) State:

(i) one way in which the car is gaining thermal energy

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

(ii) one way in which the car is losing thermal energy.

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

(b) The car accelerates up the hill.

In addition to an increase in thermal energy, there are other energy transfers taking place.

Describe the other energy transfers.

.....
.....
.....
..... [3]

(c) At one point in the motion, the kinetic energy of the car is 90 kJ.

The mass of the car is 800 kg.

Calculate the speed of the car.

speed m/s [3]

[Total: 8]

- 3 A passenger in an aircraft seals some air inside a plastic bag.

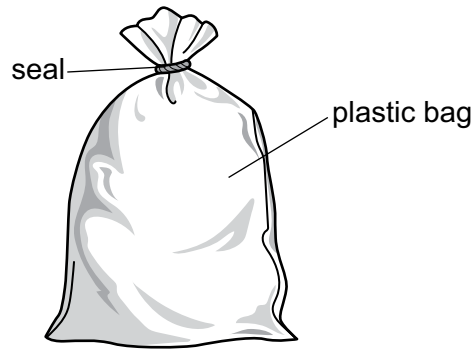


Fig. 3.1

- (a) Explain how the particles of air in the bag exert a pressure on the inside of the bag.

.....

 [2]

- (b) When the bag is closed, the pressure of the air inside the aircraft is 80 kPa and the bag contains 500 cm³ of air.

- (i) When the aircraft is on the ground, the pressure of the air inside the aircraft is 100 kPa.

Calculate the volume of air inside the bag when the aircraft is on the ground.

volume = cm³ [2]

- (ii) State **one** assumption that you made in your calculation in (i).

.....
 [1]

- (c) The point plotted on the graph in Fig. 3.2 shows the initial pressure and volume of the air inside the bag.

Sketch a line on Fig. 3.2 to show how the volume of the air changes as the pressure increases.

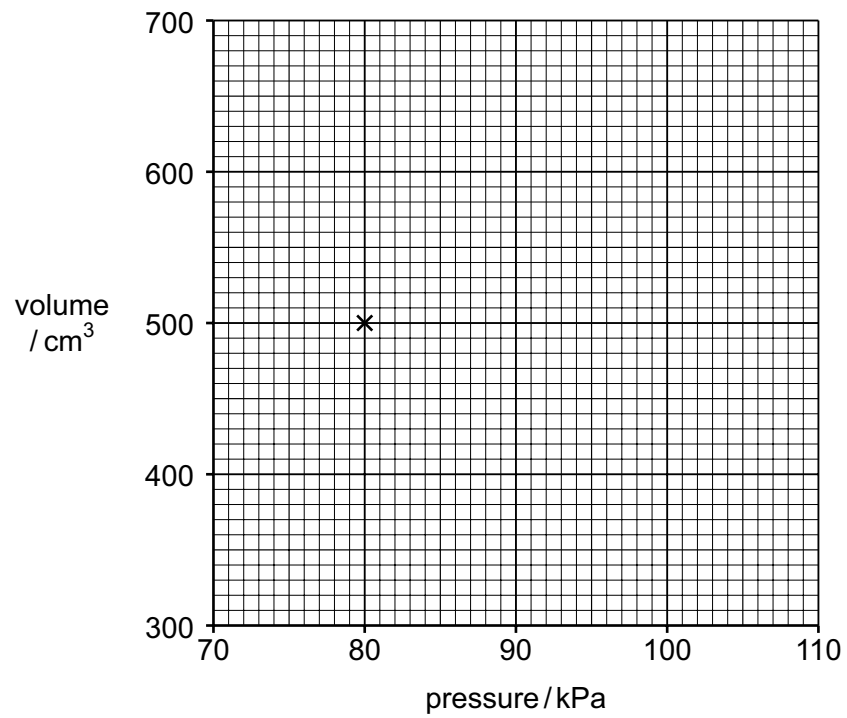


Fig. 3.2

[2]

[Total: 7]

4 One type of renewable energy source is shown in Fig. 4.1.

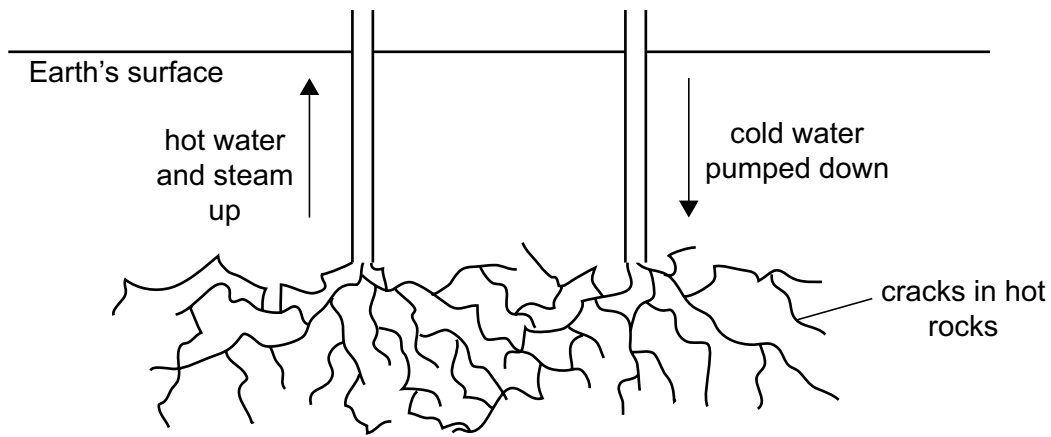


Fig. 4.1

(a) State the name of the renewable energy source shown in Fig. 4.1.

..... [1]

(b) 1000 kg of cold water at a temperature of 20 °C is pumped down to the hot rocks. The water returns partly as steam and partly as hot water. The steam and the hot water are both at a temperature of 100 °C.

The specific heat capacity of water is 4200 J / (kg °C).

(i) Calculate the energy needed to heat 1000 kg of water from 20 °C to 100 °C.

energy = J [2]

(ii) Explain why more energy is transferred when 1 kg of the steam cools to 20 °C than when 1 kg of the hot water cools to 20 °C.

You should include a reference to the arrangement of particles in liquids and in gases in your answer.

.....

 [3]

[Total: 6]

5 Fig. 5.1 shows light in air, incident on the side of a rectangular glass block at an angle of 60° .

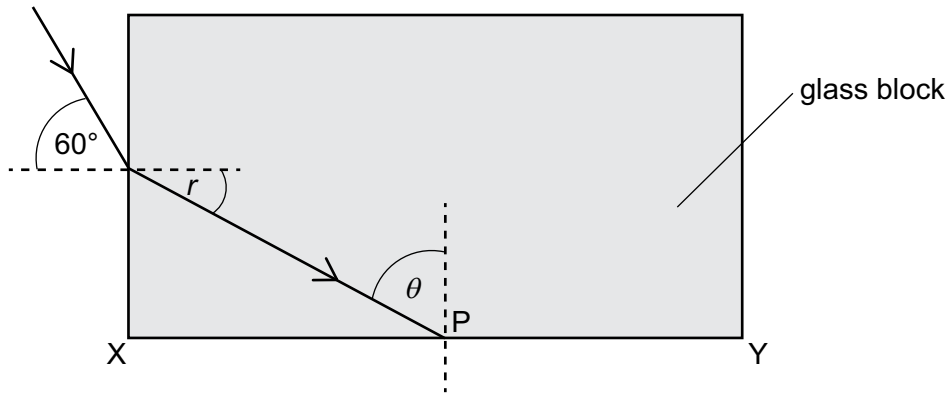


Fig. 5.1

The refractive index of the glass is 1.6. The light travels in the glass and is incident on side XY at P.

(a) Underline **all** the terms that describe a wave of light.

electromagnetic **longitudinal** **radioactive** **transverse** [1]

(b) At the point where the light enters the glass, the angle of refraction is r .

Calculate angle r .

$r = \dots\dots\dots^\circ$ [2]

(c) (i) Calculate the critical angle c for light travelling in the block.

$c = \dots\dots\dots^\circ$ [2]

(ii) At P, the angle θ between the ray and the normal is given by $\theta = 90^\circ - r$.

State and explain what happens to the light when it is incident on side XY.

.....

 [2]

[Total: 7]

- 6 A 4.5 V battery is connected in a circuit with an ammeter, a light-dependent resistor (LDR) and a $1800\ \Omega$ fixed resistor.

Fig. 6.1 is the circuit diagram.

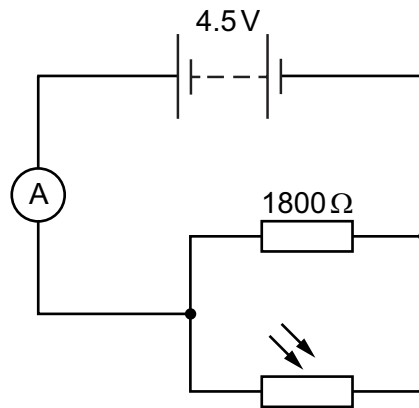


Fig. 6.1

- (a) The light incident on the LDR causes its resistance to be $9000\ \Omega$.

Calculate:

- (i) the total resistance of the circuit

resistance = Ω [2]

- (ii) the reading on the ammeter.

reading = A [2]

(b) A very bright lamp is switched on and the intensity of the light incident on the LDR increases.

(i) State and explain what happens to the current in the LDR.

what happens to the current

explanation

[1]

(ii) State and explain what happens to the current in the 1800 Ω resistor.

what happens to the current

explanation

.....

[1]

[Total: 6]

- 7 (a) Fig. 7.1 shows a horizontal, current-carrying wire PQ in the gap between the poles of a permanent magnet.

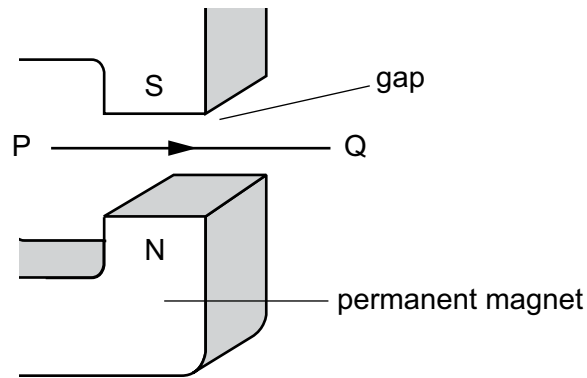


Fig. 7.1

- (i) There is a magnetic field in the gap between the N pole and the S pole.

The current in PQ is from left to right.

Describe the effect of the magnetic field on PQ.

.....
 [2]

- (ii) State the effect on PQ of increasing the strength of the magnetic field in the gap.

.....
 [1]

(b) Fig. 7.2 shows part of a torch. The torch does not contain a battery.

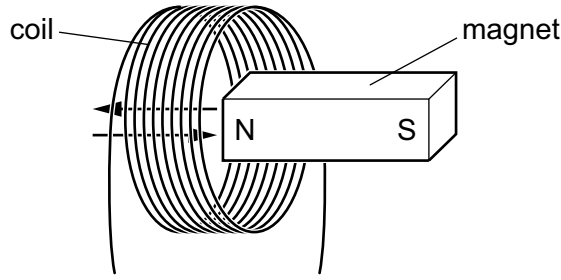


Fig. 7.2

The torch is shaken and this causes the magnet to move backwards and forwards through the coil.

(i) Explain why an electromotive force (e.m.f.) is induced across the coil when the magnet moves.

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

(ii) State **one** way to increase the e.m.f. induced.

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

(iii) As the magnet moves into the coil, the induced e.m.f. produces a current in the coil.

Explain how this opposes the motion of the magnet.

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

[Total: 8]

8 Fig. 8.1 shows a circuit containing a 230 V a.c. supply connected to a television and two lamps.

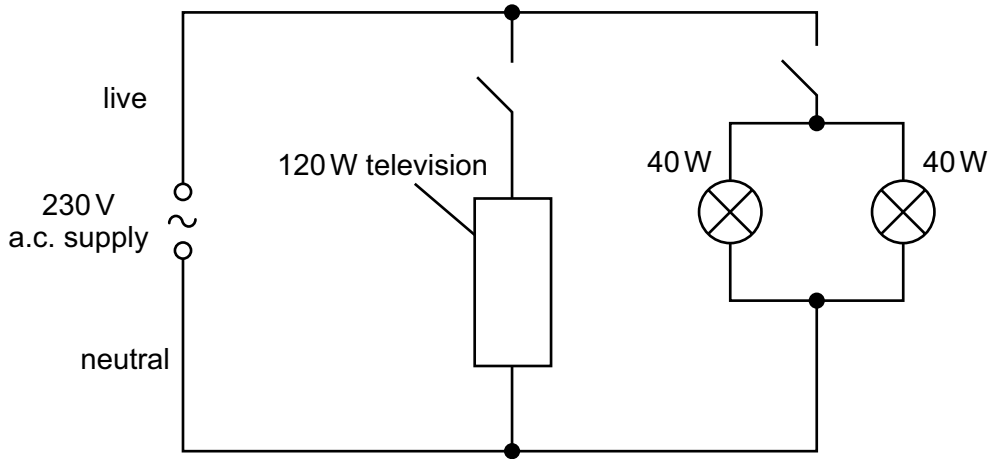


Fig. 8.1

In normal operation, both switches are closed. The power supplied to each lamp is 40 W and the power supplied to the television is 120 W.

(a) Calculate, in normal operation:

(i) the total number of kilowatt-hours (kW h) of energy supplied to the circuit in 1.0 hour

number of kW h = [1]

(ii) the current in each lamp.

current = A [2]

(b) Explain why the switches are placed in the live wire and **not** in the neutral wire.

.....

 [2]

(c) State **one** advantage of connecting the two lamps in parallel in this circuit.

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

[Total: 6]

9 Fig. 9.1 shows the main parts of a nuclear reactor.

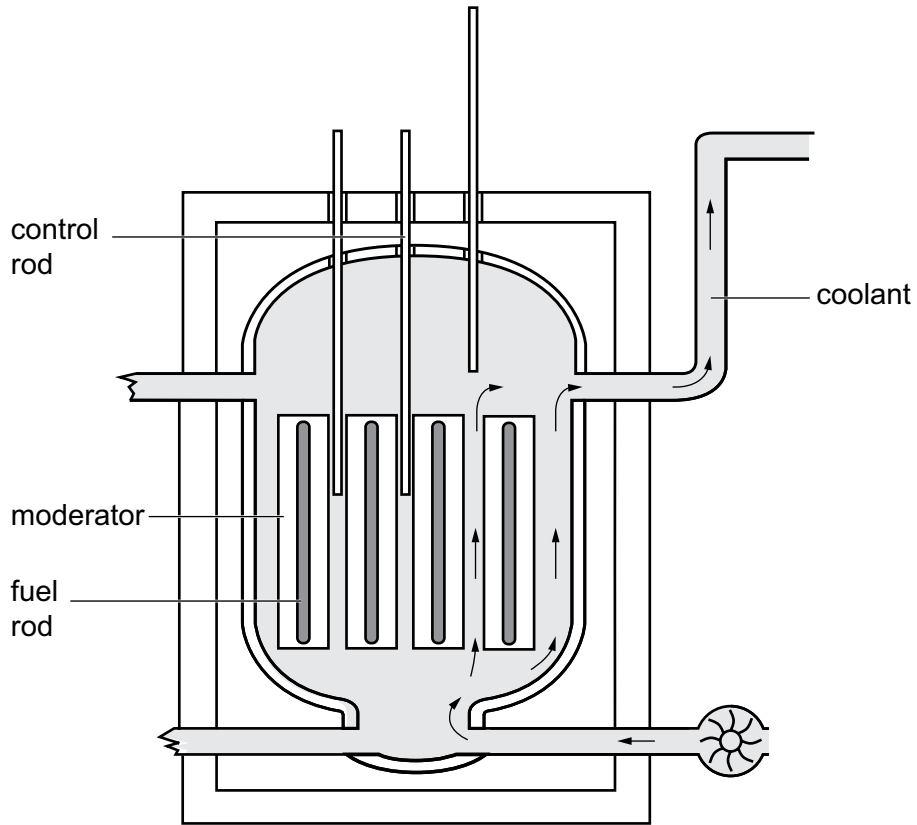


Fig. 9.1

(a) The fuel rod contains uranium-235, which can undergo nuclear fission.

Describe the process of nuclear fission that occurs in the fuel rod.

Your description should include the role of neutrons in the process.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) Explain what happens as a control rod is moved out of the reactor core.

.....

..... [2]

(c) The nuclear reactor releases energy at a steady rate.

By referring to neutrons, describe what is happening to achieve this steady rate.

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

(d) Explain the purpose of the moderator in the nuclear reactor.

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

[Total: 8]

10 The Sun is a star in a stable part of its life cycle.

(a) Using ideas about forces, explain how the Sun remains stable in this part of its life cycle.

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

(b) Describe what happens to stars of similar mass to the Sun at the end of the stable part of their life cycle.

.....
.....
.....
.....
..... [3]

(c) The orbital speed of Earth around the Sun is 30 km / s. Use this value to calculate the distance of Earth from the Sun.

Show your working. State the unit of your answer.

distance = unit = [3]

(d) The light emitted by distant galaxies show various amounts of redshift.

(i) State the name of the galaxy that contains our Sun.

..... [1]

(ii) State what is meant by redshift and describe how it is caused.

.....

 [2]

(iii) An astronomer compares the spectrum of light emitted by the Sun with the spectrum of light emitted by distant galaxies P and Q.

Fig. 10.1 shows the same four lines as observed in all three spectra.

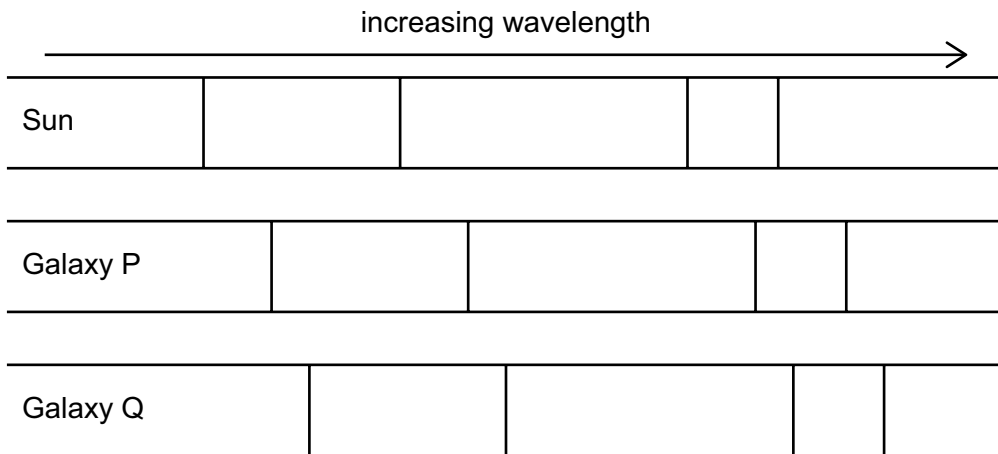


Fig. 10.1

State what Fig. 10.1 enables the astronomer to deduce about galaxy P and galaxy Q.

Explain the astronomer's reasons in your answer.

.....

 [2]

[Total: 13]

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