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Examiners' Report
June 2022

International GCSE Physics 4PH1 2P

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Introduction

As in examinations for previous sessions, most candidates handled the calculations well. Candidates who gave the best practical descriptions usually appeared to be writing from first-hand experience. Responses to the longer questions showed that the less able candidates tended to struggle when assembling a logical description or when asked to offer more than one idea. There were a wide range of responses and it was good to see that many candidates could give full and accurate answers.

Question 1 (a)

This question requires recall of a specification point and a description of an idea, rather than the recall of a formula.

(a) State what is meant by the term **power**.

(1)

The amount of ~~power~~ energy transferred by an appliance in a given time (1 second for Hz).

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Examiner Comments

This candidate has referred to the "amount of energy...in a given time" which is ambiguous. There needs to be a clear sense of a **rate** of energy transfer.

Question 1 (b)

Virtually all candidates completed a table with two columns or transposed into two rows. A common misconception is to include the units in the main body of the table.

(b) The student measures the mean power output (in watts) for six different appliances.

Diagram 1 shows their results.

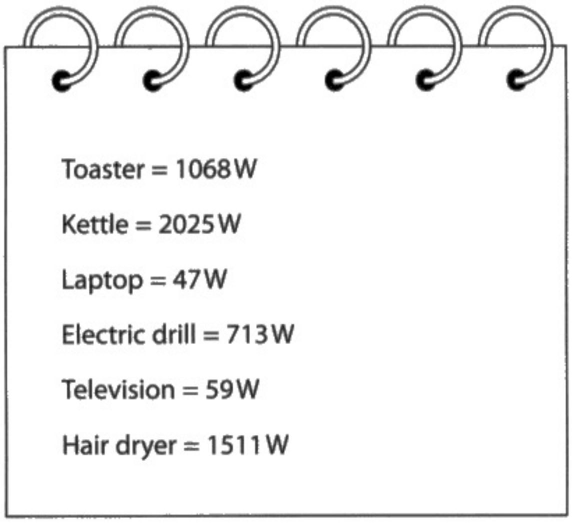

Diagram 1

Draw a results table for the student's results.

(2)

appliance	mean power output (W)
toaster	1068 W
kettle	2025 W
laptop	47 W
electric drill	713 W
television	59 W
hair dryer	1511 W

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Examiner Comments

A well-constructed table, although the units have also been included in the main body of the table. This is not standard scientific practice.

Draw a results table for the student's results.

(2)

Appliance	power output (watts)
Toaster	1068
kettle	2025
lap top	47
Electric Drill	713
Television	59
Hair Dryer	1511

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Examiner Comments

This candidate has followed correct scientific protocol and has not included the units in the main body of the table.

Question 1 (c)

Most candidates calculated a mean correctly, either with or without the anomalous data. A significant minority did not round their value to the required number of significant figures.

(c) The student measures the power output for a different appliance.

Diagram 2 shows their raw data.

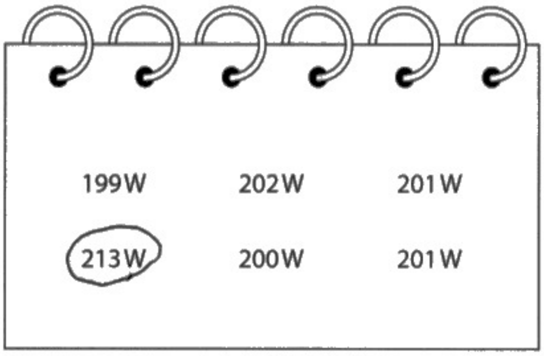

Diagram 2

(i) The student identifies an anomalous result in their data.

Draw a circle around the anomalous result.

(1)

(ii) Calculate the mean power output for this appliance.

Give your answer to three significant figures.

(3)

$\frac{199+202+201+200+201}{5} =$

mean power output = 200.6 W

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Examiner Comments

This candidate has successfully identified the anomalous result and not included that data point in the mean calculation.

The mean has been calculated correctly, however, it has not been rounded to 3 significant figures.

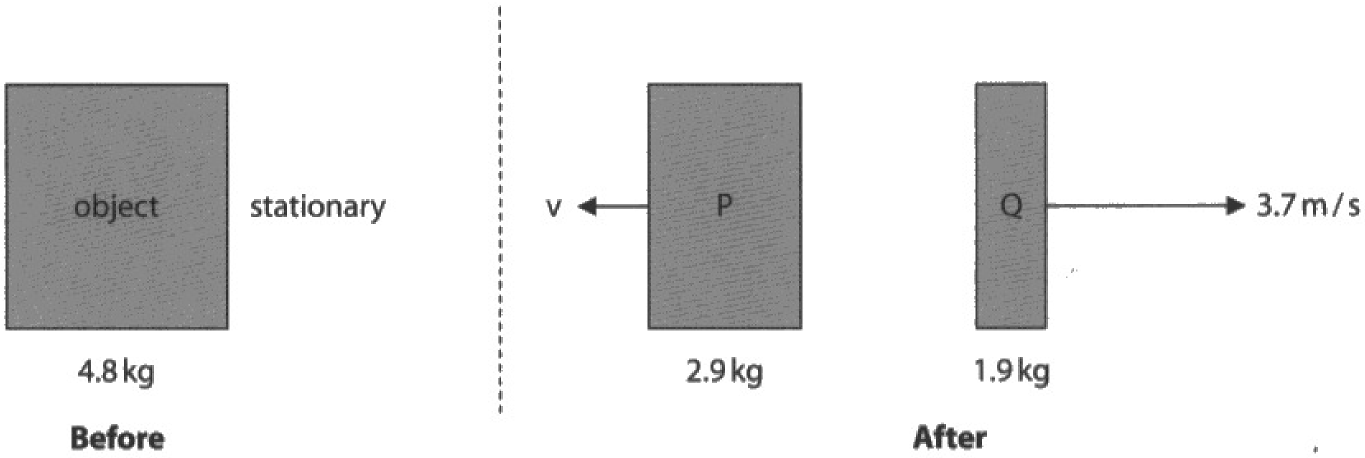
Question 2 (b)(i)

In any item, merely repeating the question will not score any marks. In this question, therefore, "momentum is conserved" is not acceptable. Other candidates confused moments or energy with momentum and so also did not gain credit. Many candidates did, however, convey the idea of 'momentum before=momentum after' which was sufficient here.

(b) The diagram shows an object before and after an explosion.

The object breaks into two parts, P and Q.

The parts move away from each other in opposite directions.



(i) State what is meant by the **principle of conservation of momentum.**

(1)

The ~~sum of~~ total momentum before collision equals the ~~sum of~~ total momentum after collision.

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Examiner Comments

This candidate has made it clear that they know that the total momentum before and after a collision is the same.

Question 2 (b)(ii)

A reasonable fraction of candidates arrived at the correct answer. The physics part of this question is setting up an equation using conservation of momentum. Candidates that got this physics correct invariably calculated the velocity of P correctly.

(ii) Calculate the magnitude of the velocity of part P after the explosion.

(3)

Before momentum = m × v

$= 4.8 \times 0$

$= 0$ kg m/s

After momentum = $m_1 \times v_1 + m_2 v_2$

$0 = 2.9 \times v_1 + 1.9 \times 3.7$

~~0 =~~ $2.9 \times v_1 = -7.03$

$v_1 = -2.42$ m/s

velocity = 2.42 to the right m/s

ResultsPlus Examiner Comments

This candidate has been careful to use words to describe what they are doing at each stage of the calculation.

They have correctly deduced that the initial momentum of the system is 0 (kg m/s) and that the momentum of Q after the split is 7.03 (kg m/s).

They have gone on to equate the total momentum before and after which gives a formula from which the magnitude of the velocity of P can be determined.

ResultsPlus Examiner Tip

Using words to 'signpost' a complex calculation can assist with checking your work and making it clearer to the examiner.

Question 2 (c)

There was no credit for answers involving forces being absorbed, reduction of impact or other comparisons between hard and soft materials. The ideas in this question are the same as those for crumple zones and seatbelts in cars.

Candidates that made this link often scored very well by adapting their pre-rehearsed answers to crumple zone-type questions.

(c) A child drops an egg from a height of 10 cm and the egg lands on the floor.

Explain why the egg is less likely to break if the floor is covered with a thick carpet than if the floor were covered in hard tiles.

(3)

The thick carpet will increase the collision time therefore it will decrease the force that the egg experiences. Since $F = \frac{(mv - mu)}{t}$ when time increases, the force decreases. because the change in momentum remains the same

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Examiner Comments

This candidate concisely explains how the carpet reduces the force on the egg by increasing the collision time. The candidate uses a formula to further justify the argument and goes on to include which factor stays the same: in this case this is the momentum change.

ResultsPlus
Examiner Tip

This type of question appears frequently. Refer to a formula, state which variable remains constant and then describe the effect one variable has on the other.

Question 3 (a)

The calculations in Q3(a)(i) and Q3(a)(ii) were completed well by many candidates, however, a small number did not rearrange the formulae correctly.

Question 3 (b)(i)

This formula was given on the formula insert.

Question 3 (b)(ii)

Provided that the candidate used the correct current (the output current of 1.2 A) and not the input current, candidates could determine the time taken for the battery to charge. The conversion from seconds to minutes was unusual yet most candidates completed this step correctly even if they used the wrong current previously.

Question 3 (b)(iii)

Many candidates correctly determined that a larger output current would result in a shorter charging time.

(iii) Charger Y can also be used to charge the mobile phone battery.

Diagram 2 shows the information label for charger Y.

Input voltage = 230 V
Output voltage = 5.0 V
Output current = 2.1 A

Diagram 2

Explain how the time taken to transfer the same amount of charge to the mobile phone battery will be affected when charger Y is used instead of charger X.

(2)

The output current is much higher in charger Y, thus it will take less time to transfer the same amount of charge.

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Examiner Comments

This question is similar to Q2(c) in that there is a constant variable (charge in this case), an independent variable (current here) and a dependent variable (time). This candidate has correctly linked the three variables using the formula in Q3(b)(i) to arrive at a suitable conclusion.

Question 3 (c)

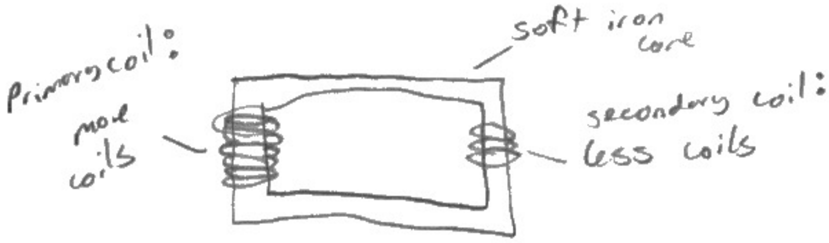
The function of a transformer is a familiar requirement on the specification. The majority of candidates scored at least one mark for remembering that a step-down transformer has a larger input voltage than output voltage. After this point, if a candidate recalled the ideas of generating a magnetic field with a current and inducing a voltage due to a changing magnetic field, then they tended to score highly.

(c) Both chargers contain step-down transformers.

Explain how a step-down transformer works.

You may include a diagram to support your answer.

(4)



There are two coils of wire on different sides
of a soft iron core. The primary coil will
have more turns than secondary coil in a step down transformer. ~~The~~
~~p~~ An alternating current is run through the primary
coil which causes the soft iron core to magnetise
and demagnetise, inducing an alternating current
with a lower voltage & current in the secondary
coil, as it has less turns on the coil.

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Examiner Comments

This candidate drew an acceptable diagram which provided evidence for marking point 1. After this, they scored marking point 3 by referring to alternating current and marking point 2 for stating that the core magnetises and de-magnetises. The candidate also scored marking point 7 for an acceptable reference to induction in the secondary coil, in this case induction of a current.

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Examiner Tip

Plan out and rehearse answers to questions which require a longer response.

Question 4 (a)

Many candidates remembered at least one of the two frequency limits in average human hearing with a large proportion remembering both accurately. In this case 'range' will require both a lower and an upper limit, as opposed to a single number.

Question 4 (b)(i)

The only acceptable answer for this question was 'microphone', which was well-remembered by the majority of candidates.

Question 4 (b)(ii)

This question tests one of the prescribed practicals listed on the specification. There is an excellent online simulation of an oscilloscope that can be used in conjunction with a computer microphone to record traces of the sounds nearby. The link is https://academo.org/demos/virtual-oscilloscope/

Candidates can practice finding the period from this simulation and compare it to the given frequency as a check.

(ii) The time period of the ultrasound waves must be measured to determine their frequency.

Describe how the oscilloscope is used to measure the time period of the ultrasound waves.

(3)

Place a microphone near the sonometer, ultrasound, and connect it to the oscilloscope. Adjust the oscilloscope to get a stable trace. Adjust the ~~oscilloscope~~ time base to fit at least one wave. Measure the number of divisions for one wave. Time period = number of divisions x time base.

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Examiner Comments

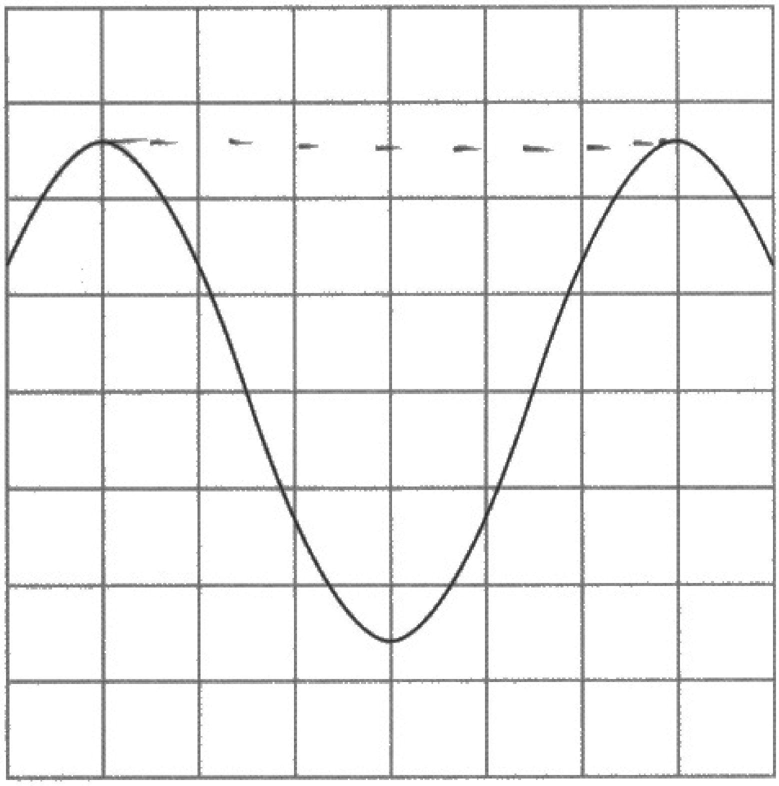
This candidate has made it clear how to get a usable trace on the oscilloscope and how to read the oscilloscope screen. The conversion from number of squares to a time period is apparent.

Question 4 (c)

As stated in the discussion for Q4(b)(ii), reading an oscilloscope accurately to determine the period and hence the frequency can be practised using a virtual oscilloscope if real ones are not available. Many candidates could find the frequency given the period. Some candidates measured the entire width of the screen rather than just one oscillation. Fewer confused amplitude with period.

(c) The diagram shows the oscilloscope screen when an ultrasound wave is detected.

The oscilloscope settings are also shown.



oscilloscope settings:

y direction: 1 square = 2V

x direction: 1 square = 5×10^{-6} s

(i) Determine the time period of the ultrasound waves.

(2)

$5 \times 10^{-6} \times 6 = 30 \times 10^{-6}$

$= 3 \times 10^{-5}$

time period = 3×10^{-5} s

(ii) Calculate the frequency of the ultrasound waves.

(2)

$f = \frac{1}{t}$

$= \frac{1}{3 \times 10^{-5}}$

$= 33000$ Hz (2sf)

frequency = 3.3×10^{4} (2sf) Hz

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Examiner Comments

This candidate has scored full marks. They have done so by making it clear what it is they are reading from the trace and how that relates to the period of the ultrasound waves.

From there they have successfully calculated the frequency by using the given formula.

There was no requirement to use standard form, although given that the relevant setting was given in standard form, it would make sense for the period to be similarly represented.

Question 5 (a)

Many candidates successfully navigated this question with good knowledge of function and likely materials of parts of a fission reactor.

Question 5 (b)

Two ideas prevented some candidates from scoring both marks on this question. The first is that shielding **absorbs** the radiation. The radiation does **penetrate** into the shielding yet crucially does not penetrate all the way through and outside the shielding. The second is that the radioactivity is specific ie neutrons, gamma radiation or fission products/daughter nuclei. Most candidates scored at least one mark because they had the idea of preventing the radiation from escaping, even if they could then not discuss the mechanism or the specific radiation.

(b) Describe the role of shielding around a nuclear reactor.

(2)

High levels of gamma radiation are released during fission. The lead shielding absorbs this to prevent it entering the environment and causing damage.

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Examiner Comments

This candidate required very few words to score both marks. They have identified a specific radiation that would cause a problem to those outside the shielding (ie gamma radiation) and what the shielding does to protect (ie absorbs the radiation).

Question 5 (c)

In Q5(c)(i), while some candidates forgot to apply the 3 percent idea, many candidates performed the calculation to the extent they got some credit. The number of nuclei cannot be less than 1 so numbers in standard form with negative powers of ten cannot be correct.

In Q5(c)(ii), whatever number was calculated in the previous part should be used to calculate the energy per event. This gave huge, unlikely, numbers however credit was still given, applying 'error carried forward'.

(c) A uranium fuel rod is made from fuel pellets that contain uranium-235 and uranium-238.

Only uranium-235 undergoes nuclear fission in the reactor core.

Energy is released when the uranium-235 nuclei undergo fission.

The box gives some data about a typical uranium fuel pellet.

Total mass of uranium in fuel pellet	0.0088 kg
Percentage (by mass) of uranium-235 in fuel pellet	3.0 %
Mass of uranium-235 atom	3.90×10^{-25} kg
Total energy released from fuel pellet due to fission	2.17×10^{10} J

(i) Calculate the number of uranium-235 atoms in the fuel pellet.

(2)

$$\frac{0.0088}{3.90 \times 10^{-25}} \times 3.0$$

number of uranium-235 atoms = 6.7×10^{22}

(ii) Calculate the energy released when the nucleus of a single atom of uranium-235 undergoes fission.

(2)

$$\frac{2.17 \times 10^{10}}{6.7 \times 10^{22}}$$

energy released = 3.2×10^{-13} J

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Examiner Comments

This candidate has correctly applied the 3 percent idea to the mass of the whole sample in part 5(c)(i). They have then used their answer from part 5(c)(i) correctly to determine the energy released per fission event.

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Examiner Tip

Calculations involving many factors can be made much simpler to understand with some accompanying words, to keep track of each stage of the calculation.

Question 6 (a)

Many candidates scored full marks here. A small number made incorrect references to global warming affecting the temperature of the whole universe.

Question 6 (b)

Many candidates recognised and could recall the two pieces of evidence required from the specification. It was not always clear that candidates knew that although light comes from stars it is the red shift of **galaxies** that forms the real evidence for the Big Bang. Some candidates incorrectly focused on the explanation of the Doppler effect, rather than concentrating on the change of redshift brought about by the different recessional speeds from galaxies at different distances.

With the Cosmic Microwave Background Radiation (CMBR), many candidates did not make the link between the CMBR being (broadly) the same in all directions and being everywhere to the universe all being at the same point a long time ago. Other candidates confused microwave background radiation with the ionizing background radiation around us on Earth.

(b) Discuss two pieces of evidence that support the Big Bang theory.

(6)

Red shift is one piece of evidence that suppopt the big bang theory. ~~Red shift sugg suggests it~~ The frother the galaxy is away from ~~up~~ the earth, the greater the red shift. The greater the red shift, the faster the galaxy is moving away from us. Speed is increasing with increasing distance. ~~This~~ Speed is directly proportional to distance. This relationship of speed and distance implies expansion. Expansion implies that there was a point a long time ago. Another piece of evidence is cosmic microwave background radiation. It appears to be in everywhere, which implies that all the parts in the universe ~~where~~ were in contact long ago. ~~Wave lengt Wave length~~ Wavelength increased due to expansion of the universe and became microwaves. The universe was significantly hotter long ago.

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Examiner Comments

This response is excellent – it goes through all of the relevant points in a coherent and logical way, whilst getting the technical language correct. There is no attempt to go beyond the specification and as a result, is clearer. Maximum 6 marks awarded, although it would have scored all ten marking points.

Question 7 (a)

While many candidates could recall the idea of raising (or lowering) the temperature of a substance by 1 degree Celsius, significantly fewer related the 'specific' to the idea energy **per unit mass**.

Question 7 (b)

Many candidates referred to repeating and finding an average value, which strictly speaking does not improve accuracy except in rare cases but was given some credit. The most common answers to gain credit here were the ideas of placing a lid on the container or using some insulating material around the container. Some candidates did make reference to the other marking points, yet they were very much in the minority.

Question 7 (c)(i)

Most candidates deduced that the final temperature of the water and the final temperature of the aluminium block would be the same. Some tried, unsuccessfully, to convert the answer into kelvin which was not necessary.

Question 7 (c)(ii-iii)

Virtually all candidates correctly calculated the change in temperature in part 7(c)(ii).

The majority of candidates substituted in the correct values to the formula then got the correct answer, although some needlessly converted the mass into grams or divided their answer by 1000 to get the answer into J/g ^{O}C without changing the unit on the answer line.

The most common misconception was to muddle the energy change and the specific heat capacity in the substitution.

Question 7 (d)

There was a lot of information to digest in this question. Firstly that the water was freezing at some point, so there needed to be a horizontal portion of the graph at 0 ^{O}C. Then there was the initial and final temperatures of 38 ^{O}C and – 20 ^{O}C.

The extra factor to add in was that the specific heat capacities of liquid water and ice are different, so the gradients of the non-horizontal lines would necessarily have to be different.

With all this in mind, many candidates scored at least two marks and no further because their non-horizontal lines were the same gradient.

Paper Summary

Based on their performance on this paper, candidates should:

- take care when drawing diagrams to add labels and draw accurately.
- either build or simulate circuits in which the number of components changes and noting the effect on the currents and voltages in or across those components.
- ensure that they have either seen or performed the practicals named in the specification where possible.
- take note of the number of marks given for each question and use this as a guide as to the amount of detail expected in the answer.
- take note of the command word used in each question to determine how the examiner expects the question to be answered, for instance whether to give a description or an explanation.
- be familiar with the equations listed in the specification and be able to use them confidently.
- structure multi-step calculations as simply as possible to facilitate checking at each stage.
- recall the units given in the specification and use them appropriately, for instance frequency.
- be familiar with the names of standard apparatus used in different branches of physics.
- practise structuring and sequencing longer extended writing questions.
- show all working so that some credit can still be given for answers that are only partly correct.
- signpost working with words, this may help with structuring calculations clearly.
- be ready to comment on data and suggest improvements to experimental methods.
- take care to follow the instructions in the question, for instance when requested to use particular ideas in the answer.
- take advantage of opportunities to draw labelled diagrams as well as, or instead of, written answers.
- allow time at the end of the examination to check answers carefully and correct basic slips in wording or calculation.

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