Unit2   3rd Physics

READING PASSAGE :   Paul Adrien Maurice Dirac

P.A.M. Dirac, in full **Paul Adrien Maurice Dirac**, (born August 8, 1902, Bristol, Gloucestershire, England—died October 20, 1984, Tallahassee, Florida, U.S.), English theoretical physicist who was one of the founders of quantum mechanics and quantum electrodynamics. Dirac is most famous for his 1928 relativistic quantum theory of the electron and his prediction of the existence of antiparticles. In 1933 he shared the Nobel Prize for Physics with the Austrian physicist Erwin Schrödinger. Dirac's mother was British and his father was Swiss. Dirac's childhood was not happy—his father intimidated the children, both at home and at school where he taught French, by meticulous and oppressive discipline. Dirac grew up an introvert, spoke only when spoken to, and used words very sparingly—though with utmost precision in meaning. In later life, Dirac would become proverbial for his lack of social and emotional skills and his incapacity for small talk. He preferred solitary thought and long walks to company and had few, though very close, friends. Dirac showed from early on extraordinary mathematical abilities but hardly any interest in literature and art. His physics papers and books, however, are literary masterpieces of the genre owing to their absolute perfection in form with regard to mathematical expressions as well as words. On his father's wish for a practical profession for his sons, Dirac studied electrical engineering at the University of Bristol (1918–21). Having not found employment upon graduation, he took two more years of applied mathematics. Albert Einstein's theory of relativity had become famous after 1919 through the mass media. Fascinated with the technical aspect of relativity, Dirac mastered it on his own. Following the advice of his mathematics professors, and with the help of a fellowship, he entered the University of Cambridge as a research student in 1923. Dirac

had no teacher in the true sense, but his adviser, Ralph Fowler, was then the only professor in Cambridge at home with the new quantum theory being developed in Germany and Denmark.

In August 1925 Dirac received through Fowler proofs of an unpublished paper by Werner Heisenberg that initiated the revolutionary transition from the Bohr atomic model to the new quantum mechanics. In a series of papers and his 1926 Ph.D. thesis, Dirac further developed Heisenberg's ideas. Dirac's accomplishment was more general in form but similar in results to matrix mechanics, another early version of quantum mechanics created about the same time in Germany by a joint effort of Heisenberg, Max Born, Pascual Jordan, and Wolfgang Pauli. In the fall of 1926 Dirac and, independently, Jordan combined the matrix approach with the powerful methods of Schrödinger's wave mechanics and Born's statistical interpretation into a general scheme—transformation theory—that was the first complete mathematical formalism of quantum mechanics. Along the way, Dirac also developed the Fermi-Dirac statistics (which had been suggested somewhat earlier by Enrico Fermi). Satisfied with the interpretation that the fundamental laws governing microscopic particles are probabilistic, or that "nature makes a choice," Dirac declared quantum mechanics complete and turned his main attention to relativistic quantum theory. Often regarded as the true beginning of quantum electrodynamics is his 1927 quantum theory of radiation. In it Dirac developed methods of quantizing electromagnetic waves and invented the so-called second quantization—a way to transform the description of a single quantum particle into a formalism of the system of many such particles. In 1928 Dirac published what may be his greatest single accomplishment—the relativistic wave equation for the electron. In order to satisfy the condition of relativistic invariance (i.e., treating space and time coordinates on the same footing), the Dirac equation required a combination of four wave functions and relatively new mathematical quantities known as spinors. As an added bonus, the equation described electron spin (magnetic moment)—a fundamental but theretofore not properly explained feature of quantum particles.

From the beginning, Dirac was aware that his spectacular achievement also suffered grave problems: it had an extra set of solutions that made no physical sense, as it corresponded to negative values of energy. In 1930 Dirac suggested a change in perspective to consider unoccupied vacancies in the sea of negative-energy electrons as positively charged "holes." By suggesting that such "holes" could be identified with protons, he hoped to produce a unified theory of matter, as electrons and protons were then the only known elementary particles. Others proved, however, that a "hole" must have the same mass as the electron,

whereas the proton is a thousand times heavier. This led Dirac to admit in 1931 that his theory, if true, implied the existence of "a new kind of particle, unknown to experimental physics, having the same mass and opposite charge to an electron." One year later, to the astonishment of physicists, this particle—the antielectron, or positron—was accidentally discovered in cosmic rays by Carl Anderson of the United States. An apparent difficulty of the Dirac equation thus turned into an unexpected triumph and one of the main reasons for Dirac's being awarded the 1933 Nobel Prize for Physics. The power to predict unexpected natural phenomena is often the most convincing argument in favour of novel theories. In this regard the positron of quantum theory has often been compared to the planet Neptune, the discovery of which in the 19th century was spectacular proof of the astronomical precision and predictive power of classical Newtonian science. Dirac drew from this experience a methodological lesson that theoretical physicists, in their quest for new laws, should place more trust in mathematical formalism and follow its lead, even if physical understanding of the formulas temporarily lags behind. In later life, he often expressed the view that, in order to be true, a fundamental physical theory must also be mathematically beautiful. Dirac's prediction of another new particle in 1931—the magnetic monopole—seems to have demonstrated that mathematical beauty is a necessary but not sufficient condition for physical truth, as no such particle has been discovered. Numerous other elementary particles discovered after 1932 by experimental physicists were, more often than not, stranger and messier than anything the theorists could have anticipated on the basis of mathematical formulas. But for each of these new particles, an antiparticle also exists—a universal property of matter first uncovered by Dirac. In his later work, Dirac continued making important improvements and clarifications in the logical and mathematical presentation of quantum mechanics, in particular through his influential textbook *The Principles of Quantum Mechanics* (1930, with three subsequent major revisions). The professional terminology of modern theoretical physics owes much to Dirac, including the names and mathematical

notations *fermion, boson, observable, commutator, eigenfunction, delta-function,* $\hbar$ (for $h/2\pi$,

where h is Planck's constant), and the bra-ket vector notation. Compared with the standard of logical clarity that Dirac accomplished in his formalization of quantum mechanics, relativistic quantum theory seemed incomplete to him. In the 1930s quantum electrodynamics

encountered serious problems; in particular, infinite results appeared in various mathematical calculations. Dirac was even more concerned with the formal difficulty that relativistic invariance did not follow directly from the main equations, which treated time and space coordinates separately. Searching for remedies, Dirac in 1932–33 introduced the "many-times formulation" (sometimes called "interaction representation") and the quantum analog for the principle of least action, later developed by Richard Feynman into the method of path integration. These concepts, and also Dirac's idea of vacuum polarization (1934), helped a new generation of theorists after World War II invent ways of subtracting infinities from one another in their calculations so that predictions for physically observable results in quantum electrodynamics would always be finite quantities. Although very effective in practical calculations, these "renormalization" techniques remained, in Dirac's view, clever tricks rather than a principled solution to a fundamental problem. He hoped for a revolutionary change in basic principles that would eventually bring the theory to a degree of logical consistency comparable to what had been achieved in nonrelativistic quantum mechanics. Although Dirac probably contributed more to quantum electrodynamics than any other physicist, he died dissatisfied with his own brainchild. Dirac taught at Cambridge after receiving his doctorate there, and in 1932 he was appointed Lucasian Professor of Mathematics, the chair once held by Isaac Newton. Although Dirac had few research students, he was very active in the research community through his participation in international seminars. Unlike many physicists of his generation and expertise, Dirac did not switch to nuclear physics and only marginally participated in the development of the atomic bomb during World War II. In 1937 he married Margit Balasz (née Wigner; sister of Hungarian physicist Eugene Wigner). Dirac retired from Cambridge in 1969 and, after various visiting appointments, held a professorship at Florida State University, Tallahassee, from 1971 until his death.

Grammer

I– Tenses :

Tenses	Verb To Be	Verb To Have	Used words
Simple Present	.I <u>am</u> / He, She, It <u>is</u> . .We, You, They <u>are</u>	.I, You, We, You, They <u>have</u> . He, She, It <u>has</u>	Always, usually, often, sometimes, never, every,..
Simple Past	. I, He, She, It <u>was</u> .We, You, They <u>were</u>	. I, You, He, She, It, We, You, They <u>had</u>	Yesterday, ago, once, last, this morning, in the past,…
Future Simple	. I, You, He, She, It, We, You, They <u>will be</u>	. I, You, He, She, It, We, You, They <u>will have</u>	Tomorrow, soon, next, this evening, in the future,.

<u>Negation</u> : The rules:	1-With the following auxiliary verbs we use (not) and put them after the auxiliary verb: am, is, are, was, were, has, have, had, can, could, will, would, shall, should, must, may, might. 2- With an ending present verb with the letter (s) we use (doesn't) before the verb and delete the (s). 3- With the present tense verb not the last (s) we use (don't) before the verb. - With a past tense, we use didn't before the verb and return the verb to the infinitive. 4- With the words (sometimes, usually, always) we delete the same word and put (never) instead of it and we don't delete the (s).
<u>Ask a question</u>: The rules:	1- Return these auxiliary verbs to the beginning of the sentence (am, is, are, was, were, has, have, had, can, could, will, would, shall, should, must, may, might). 2– With a simple present verb at the end of the letter (s), we use (does) at the beginning of the sentence and remove the (s) from the verb. 3– With the present verb not the last (s) , we will use (do) at the beginning of the sentence, and the verb remains the same, and we also change the (I) and(We) to (You). 4– With a past tense , we use (did) at the beginning of the sentence and return the verb to the infinitive as we convert (my) and (our) to (your).

Examples :	- He can swim. / He can't swim. / Can he swim?
	– Ali travels to London every summer. / Ali doesn't travel to London every summer. / When does Ali travel to London?
	– I go to the club twice a week. / I don't go to the club twice a week. / How often do you go to the club?
	– We went to London by plane. / We didn't go to London by plane. / How did you go to London?
	– She always gets up late. / She never gets up late.
	– They are playing tennis in the club. / They are not playing tennis in the club. / Where are they playing tennis?

II-**Measurements:**

Structures :	Dimensions can be expressed by four structures.	It is 78 m high, or it is 78 m in height, or its height is 78 m, or it has a height of 78 m.
Area:.	To obtain the area, you multiply the length by the width	100 cm^2 = a hundred square centimeters. $(3.14)\text{r}^2$ = pi r squared. $\sqrt{X}$ = the square root of x.
Volume:	To obtain the volume, you multiply the length by the width by the height	1000 cm^3 = a thousand cubic centimeters. x^3 = x cubed . $\sqrt[3]{y}$ = the cube root of y.
Power:	It is a mathematical term for the exponent	X^7 = x to the power seven or x to the seventh. X^{-7}= x to the power minus seven or x to the minus seventh.

III-**Meanings of words in Araic:**

Words	In Arabic	Words	In Arabic	Words	In Arabic
However	على اية حال	Soever	أيا كان	Wherever	حيثما
Whatever	مهما كان	Whatsoever	مطلقا	Whenever	كلما