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ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU - 27
B Sc (PCM/PEM/PMC/EMS/MEC) - III SEMESTER
SEMESTER EXAMINATION: NOVEMBER 2020
GE 318 - PSA SPL - GENERAL ENGLISH - PHYSICAL SCIENCES

This paper contains Four printed pages and ONE section.

Time: 2 ½ Hours **Max. Marks: 70**

INSTRUCTIONS:
1. Mention **SPECIAL COURSE** in your paper.
2. You are allowed to use a dictionary.
3. You will lose marks for exceeding the word limit.

I. Read the following excerpt from the article titled 'There Is No Scientific Method' by James Blachowicz published in *The New York Times*.

In 1970, I had the chance to attend a lecture by Stephen Spender. He described in detail the stages through which he would pass in crafting a poem. He jotted on a blackboard some lines of verse from drafts of one of his poems, asking whether these lines (a) expressed what he wanted to express and (b) did so in the desired form. He then amended the lines to bring them closer either to the meaning he wanted to communicate or to the poetic form of that communication.

I was immediately struck by the similarities between his editing process and those associated with scientific investigation and began to wonder whether there was such a thing as a scientific method. Maybe the method on which science relies exists wherever we find systematic investigation. In saying there is no scientific method, what I mean, more precisely, is that there is no distinctly scientific method.

There is meaning, which we can grasp in a short phrase, then there is the expression of that meaning that accounts for it, in a literal explanation or in poetry or in some other way. Our knowledge separates into layers: Experience provides a base for a higher layer of more conceptual understanding. This is as true for poetry as for science.

Let's look at an example that is a little less complex than poetry. ...

Suppose you and I try to define courage. We would begin with the meaning that is familiar to us. This shared meaning will be used to check proposed definitions and provide typical examples of it.

So what do we mean by courage? Let's try, "Courage is the ability to act in the face of great fear." This is an attempt to articulate what courage means. What we do next is to compare the actual meaning of courage with the literal meaning of the expression "the ability to act in the face of great fear."

In comparing this literal meaning with the actual meaning of courage, we come to realize that the literal meaning of our working definition won't work because, for example, "to act in the face of great fear" could include tying one's shoelace, yelling profanities, even running away.

So we alter our definition to exclude these typically non-courageous actions. One way of doing this is to produce a definition such as, "Courage is the ability to act in the face of great fear, except for tying one's shoelace, yelling profanities and running away."

Yet we wouldn't accept such a definition even if it itemized every possible exception. Why? Because, this definition is inadequate: all it does is try to save the original definition by tacking on ad hoc exceptions. Therefore, we reject it because it fails to be a good, well-formed definition. A good definition is simple and provides a principle that would exclude all possible exceptions without having to enumerate them one by one.

So we come up with a new and simpler definition - "Courage is the ability to act while confronting a great fear." Adding "confronting" would seem to disqualify tying one's shoelaces and even shouting profanities.

Yet adding an ad hoc exception may sometimes be just what is called for. Suppose I define courage as "the ability to act while confronting a danger to oneself." "Confronting" is retained. Yet one could also act out of anger, so that courage may not be the principal trait exhibited. We could add the ad hoc hypothesis "except when motivated principally by anger." This would be desirable and composite, inclusive of actions that may arise from separate causes (courage and anger).

Importantly, see that this process rests on two requirements that have to be met. A good definition or poem must be one (a) whose expressed meaning matches the actual meaning and (b) which satisfies some criterion of form.

Now compare this with a scientific example: Johannes Kepler's discovery that the orbit of Mars is an ellipse.

In this case, the actual meaning of courage corresponds with the actual observations that Kepler sought to explain — that is, the data regarding the orbit of Mars. In the case of definition, we compare the literal meaning of a proposed definition with the actual meaning we want to define. In Kepler's case, he needed to compare the predicted observations from a proposed explanatory hypothesis with the actual observations he wanted to explain.

Initially, Kepler determined that the orbit of Mars was not a circle. There is a very simple equation for a circle, but the first non-circular shape Kepler entertained as a replacement was an oval. Despite our use of the word "oval" as sometimes synonymous with ellipse, Kepler understood it as egg-shaped. Maybe he thought the orbit had to be lopsided, because he knew the Sun was not at the center of the oval. Unfortunately, there is no simple equation for such an oval.

When a scientist tests a hypothesis and finds that its predictions do not quite match available observations, there is always the option of forcing the hypothesis to fit the data. One can resort to curve-fitting, in which a hypothesis is patched together from different independent pieces, each piece more or less fitting a different part of the data. A tailor for whom fit is everything and style is nothing can make me a suit that will fit like a glove — but as a patchwork with odd random seams everywhere, it will also not look very much like a suit.

The lesson is that it is not just the observed facts that drive a scientist's theorizing. A scientist would, presumably, no more be caught in a patchwork hypothesis than in a patchwork suit. Science education, however, has persistently relied more on empirical fit as its trump card, perhaps partly to separate science from those dangerous seat-of-the-pants theorizings that pretend to find their way apart from such evidence.

Kepler could have hammered out a patchwork equation that would have represented the oval orbit of Mars. It would have fit the facts better than the earlier circle hypothesis. But it would have failed to meet the second criterion that all such explanation requires: that it be simple, with a single explanatory principle devoid of tacked-on ad hoc exceptions, analogous to the case of courage as acting in the face of great fear, except for running away, tying one's shoelace and yelling profanities.

Yet in science, just as in defining a concept like courage, ad hoc exceptions are sometimes exactly what are needed. While Galileo's law prescribes that the trajectory of a projectile like a cannonball follows a parabolic path, the true path deviates from a parabola, mostly because of air resistance. That is, a second, separate causal element must be accounted for. And so we add the ad hoc exception "except when resisted by air."

This is enough. There is much more to a theory of inquiry, of course, that could cover forms as disparate as poetry and science.

An obvious question at this point is this: If scientific method is only one form of a general method employed in all human inquiry, how is it that the results of science are more reliable than what is provided by these other forms? I think the answer is that science deals with highly quantified variables and that it is the precision of its results that supplies this reliability. But make no mistake: Quantified precision is not to be confused with a superior method of thinking.

I am not a practicing scientist. So who am I to criticize scientists' understanding of their method? I would turn this question around. Scientific method is not itself an object of study for scientists, but it is an object of study for philosophers of science. It is not scientists who are trained specifically to provide analyses of scientific method.

I. A. Answer the following questions based on the passage in about 150 words. (4 x 10 = 40)

1. Is scientific investigation similar to that of crafting a poem? What is your take on this comparison made by the author?
2. Author mentions science education has relied on 'empirical fit' as its trump card. What is an empirical fit? Do you agree with the author here? Explain your answer.
3. "Our knowledge separates into layers: Experience provides a base for a higher layer of more conceptual understanding. This is as true for poetry as for science." Comment on the above statement by providing an example.
4. The author makes a distinction between a scientist and a philosopher of science. Are they two different people? What is your response to this distinction?

I. B. Answer the following questions based on the passage in about 200 words.
(2 x 15 = 30)

5. "The author neglects the difference between the precision of mathematics and the ambiguity of language". Do scientific communities account for this ambiguity of language during research/investigations? Have scientists been successful in translating ideas to common people? Respond by drawing from your experience of being a science student.

6. Karl Popper in this theory of falsifiability says, "Falsification are attempts, by experiment or observation, to show that a theory is false, rather than attempts to verify it as true." What similarity/difference were you able to identify between Karl Popper theory and the author's arguments on scientific method? Explain your answers using instances from the passage.

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