Philosophy 2330: Science and Society

Exam 1 Sample Answer Sheet

Here are sample answers for the test questions. This test would receive a perfect score (and it has two extra essays!). However, you did not have to say exactly this to get a perfect score. There are multiple, correct answers (this is especially clear in the case of the essays). In particular, these answers here often say more than you would need to say for full credit.

Part I: Short Answer

1) What does Kelly James Clark mean by "metaphysical naturalism" and "methodological naturalism" and how are they different?

"Metaphysical naturalism" is a view about what in fact exists. For a metaphysical naturalist, the ONLY kinds of things and stuff that exists is matter, energy, forces, etc. On this view, everything that exists can be described in purely physical terms, such as by physics, chemistry, biology, etc. Nothing supernatural or immaterial exists—no god(s), ghosts, angels, etc.

"Methodological naturalism" is a view about how, and by what method, science should be conducted (notice the "method" in the title). On the methodological naturalist view, science and scientists should proceed by only considering physical, material, natural explanations for phenomena in the world. In other words, methodological naturalism says science will go on "as if" there is nothing supernatural or immaterial.

The difference is that the metaphysical naturalist is giving us a theory about what does, in fact, exist—just physical stuff—while the methodological naturalist does not take a position on whether the supernatural or immaterial exists—maybe it does, but maybe it doesn't.

2) Stephen Jay Gould calls his view about the relationship between science and religion "NOMA". What does this mean? Why does Richard Dawkins think this is a bad view?

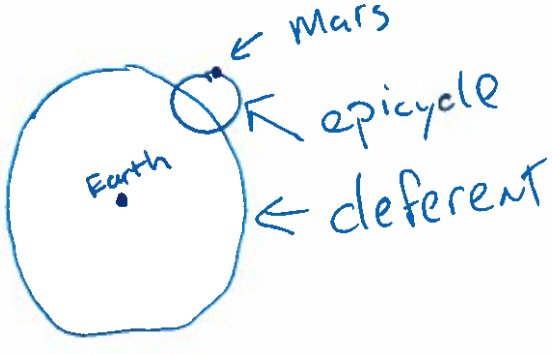
"NOMA" stands for Non-Overlapping Magisterium. On this view, science and religion are in separate domains, or magisteria. There is no overlap whatsoever between science and religion. This means that science and religion are about different things; they ask different kinds of questions. Science is in the domain of empirical facts about the world and events, causes, phenomena going on in it. Religion is entirely within the domain of values, ethics, and meanings—what should we value, how should we live our lives, what is right and wrong, etc. There is no conflict whatever because religion does not make any empirical, factual claims about the world, and science does not make any claims about values, ethics, and the meaning of our lives.

Richard Dawkins thinks NOMA is a bad view because he thinks religion does in fact make empirical, factual claims about the world (e.g. whether Christ in fact rose after being crucified, whether Mary was a virgin, whether there was ever a global flood, etc.). In addition, Dawkins believes that the claims made by religion and the claims made by science are in conflict; they are contradictory, and science and religion cannot both be right about at least some of these claims. Finally, some of the claims about the world made by, for example, Christianity, are hallmarks of what it means to be a Christian (such as that Christ died and was resurrected, that God created everything in the universe, etc.) and cannot be easily given up by Christians.

3) Explain what an epicycle is in Ptolemy's model of the cosmos

An epicycle is the circular orbit of a planet such as Mars around a point at the center of the epicycle. This point at the center of the epicycle itself moves along a circle (called a deferent) around the Earth.

Epicycles are needed in Ptolemy's model of the cosmos to account for retrograde motion as well as the apparent speeding up and slowing down of the planets' motion through the sky.



4) Briefly describe Galileo's views on Biblical interpretation as it relates to the interaction between science and religion.

Galileo's view on Biblical interpretation encompasses 4 general principles. First, interpretive humility. This means that we should always be aware that our understanding and interpretation of Scripture is fallible. While Scripture cannot be false, we may fail to properly interpret it. We should be especially careful to remember this in matters not related to the central concern of Scripture, which is salvation.

Second, the naturalistic stance. This means that, when doing science, we should set aside our religious beliefs and commitments, and look for natural explanations. This is (more or less) the same notion as "methodological naturalism".

Third, the accommodation principle. This means that the Bible's language is accommodated the beliefs and practices of the culture of those for whom it was written, as well as considering the lack of education and literacy of most people of the time. Hence, Scripture is written in terms that are sensitive to the concepts, knowledge, and understanding of the its ancient audience. And given that the Bible's central point is salvation, we should not expect it to go into significant detail about scientific matters, nor (given the above) that what the Bible says about scientific matters is to be understood literally.

Finally, the 'two books' doctrine or view. This states that there are 'two books', the Book of Scripture and the Book of Nature. Both are completely true, but they reveal their truths about different subjects. We can come to know important things about God, faith, and salvation through Scripture, but we can also come to understand and gain knowledge about the natural world and the whole cosmos by inspecting events, things, and phenomena around us, which also reflects God's creation and power. Each book is authoritative on its own subject matter.

5) How does Steve Dilley characterize arguments for evolution such as those that Theodosius Dobzhansky gives in his famous article "Nothing in Biology Makes Sense Except in the Light of Evolution"? Why does Dilley think that these arguments are (partly) theological in nature?

Dilley points out that every argument that Dobzhansky offers for thinking evolution is true depends on certain claims about God's nature, what God would or wouldn't do, and so on. The arguments are all roughly of the form that we see X. If evolution were true, we would expect to see X. If creationism were true, we would expect something other than X. Therefore evolution is a better explanation of X than creationism (and so is therefore true).

While Dilley does not discuss whether these arguments are good or bad, he does point out that Dobzhansky's arguments (and those of many other prominent biologists) are all partly theological in nature, because they all depend on premises that make claims about Creationism which are really just claims about how God is or is not, or what God would or would not do. If Dobzhansky's arguments are successful, then his claims about God must also be true. However, Dilley notes that there are some apparent inconsistencies between Dobzhansky's claims about God. Finally, it isn't obvious that Dobzhansky is right about God's nature or what God would do, especially given that there is little consensus about these claims even among theologians.

6) Does Plantinga think that questions such as those about the age of the earth are religious questions? Or scientific questions? How does he recommend that we determine what to believe about questions like this?

Plantinga thinks that questions about matters such as the age of the earth are both religious AND scientific questions. These questions are both scientific and religious because when we have to decide what to believe about something, and we have conflicting answers, we should not bracket out any part of our knowledge (i.e. Plantinga REJECTS methodological naturalism). Rather, for any question whatever, we should bring all our evidence, knowledge, understanding to bear—including religious and scientific knowledge—and see which answer has the strongest evidence behind it. Whichever side does have the

strongest evidence in favor of it is what we should believe. There is no reason to set aside things that we know when we are trying to get at the truth, nor is there any reason to think that questions can always be neatly separated as religious or scientific; many questions may be both, and perhaps some are neither.

Part II: Essay

NOTE TO STUDENTS: the below are just examples of how to answer the questions well; one might disagree with much of what is said below, and still put together a thoughtful, well-done answer. The below sample answers are just one of many possible ways to answer the questions well.

7a) If we track the motion of a planet such as Mars in the sky over time it occasionally undergoes what is called "retrograde motion". What does this motion look like from our viewpoint? How does the Ptolemaic model of the cosmos explain this apparent motion and how does the Copernican model explain it? Explain why Copernicus, Galileo, and others took this to be an argument for the heliocentric view.

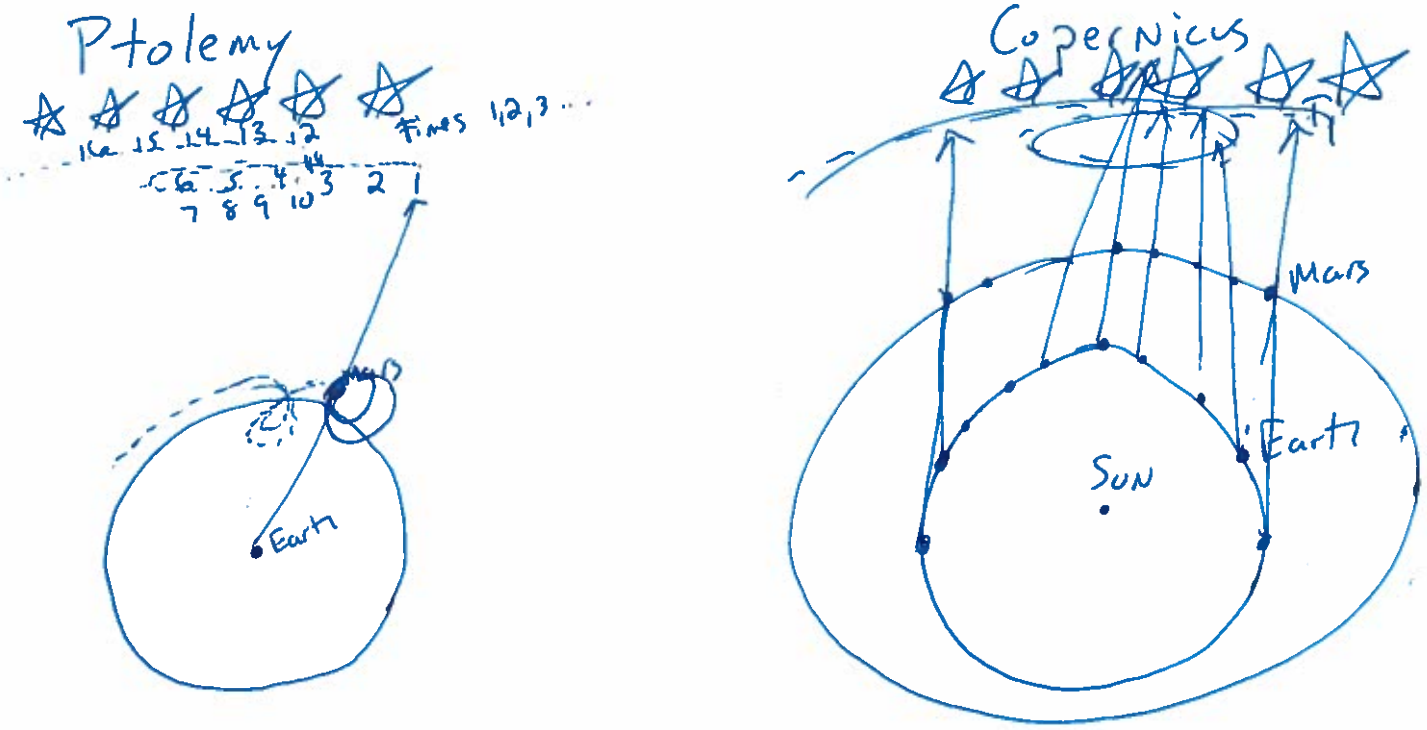
Retrograde motion, from our perspective, is that when looking at the night sky at the same point (Mars) at the same time every night (say once a day at midnight) and plotting that point over time, while Mars typically moves west to east over time, for a brief period of roughly two months every two years, Mars appears to slow down, begin to move backward, stop, then loop back, and continue moving forward.

The Ptolemaic model explains this apparent motion with epicycles. Rather than the planets all moving in a circle directly around the Earth, the planets are moving in circles (the epicycle) around a point which itself orbits the earth on a deferent – a circle around the Earth. Thus, when the motion along the epicycle is moving against the motion of the epicycle around Earth, the planet will appear to move as described above.

On the Copernican model, retrograde motion would simply be expected from the structure of the cosmos, since the planets are all circling the Sun, and as they are moving at different speeds, a planet closer to the sun such as the Earth will approach and then overtake another, more distant planet such as

Mars. Just as when one faster car passes a slower one on the highway, the perspective from inside the fast car is such that it appears as though the other car is moving backwards.

This was taken to be evidence for the heliocentric model because rather than being able to model retrograde motion with sufficient mathematical ingenuity (on the geocentric model), on heliocentrism, retrograde motion is just a consequence of the structure of the model. One would predict retrograde motion, whereas geocentrism is compatible with retrograde motion, but it could not predict it in advance as could happen on the heliocentric model. In addition, Copernicus' system could jettison some of the stranger parts of the Ptolemaic system, such as the equant point, making it much simpler in structure.



7b) With a telescope Galileo was able to observe that Venus went through phases. Explain what this means and explain how this observation is relevant as evidence in understanding the structure of the cosmos.

The phases of Venus are like the phases of the Moon. Venus begins a cycle not visible (the 'new' phase), then slowly becomes more and more visible as it is illuminated by the Sun, and then reaches its full point (just like a full moon), and then slowly wanes back through crescent stages and finally to being not visible any more.

This was relevant to understanding the structure of the cosmos because it was definitive evidence that Venus must orbit around the Sun, not the Earth. On the Ptolemaic model of geocentrism, it was impossible that Venus could have observable phases of this kind while remaining always close to the sun in the sky (as astronomers have long known). On the assumption Venus orbited the Sun, we could predict in advance the kind of observations that Galileo in fact had. When Venus is between the Earth and the Sun, it is 'new' and when it is on the opposite side of the Sun as the earth, it is 'full'. With the Earth at the center, Venus would never be on the 'opposite side of the sun' and so could never be full. Hence, this was evidence that the Ptolemaic model of the cosmos was false.

8) Kelly James Clark lists many different types for evidence for evolution including the fossil record, biogeography, comparative anatomy, embryology, and genetics. In addition to some of these, Dobzhansky also lists observations that he puts under the headings of the unity of life, the diversity of life, and adaptive radiation. Describe some empirical observations covering at least three of these categories and explain why they are taken to be evidence for evolution.

By "evidence for evolution" Clark and Dobzhansky are typically talking about evidence for common ancestry – the idea that all species are related to each other by genealogical descent.

The fossil record contains a number of fossils that are evidence for common ancestry. For example, transitional fossils, fossils that have some, but not all, of a modern groups diagnostic traits, are evidence that distinct groups are related. For example, *Tiktaalik rosae* (the 'fishapod') has gills, scales, and fins like a fish, however, it also has lungs, a neck, and a neck like an amphibian. The natural explanation for this is that *Tiktaalik* is descended from fish that amphibians are descended from *Tiktaalik* or other closely related species. Other examples mentioned by Clark include fossils representing the transition from land mammal to whale.

Comparative anatomy has discovered a number of examples of evidence for evolution. There are very similar anatomical structures in many different species that perform different functions. These structures are homologous if they are the same because they have descended from a common ancestral

form. For example, all of the tetrapod limps (including frog legs, bird wings, bat wings, whale fins, and human arms) have a humerus, a radius and ulna, carpals and metacarpals (a wrist) and phalanges – usually five of them. The natural explanation for this is that all tetrapods are descended from one tetrapod species in the past which had this collection of traits and all tetrapods today are descended from that species.

Modern genetics has discovered a number of things that are evidence for common ancestry. For example, the existence and location of pseudogenes, of virus inserted sequences, and of movable genetic elements. For example, pseudogenes are genes that are broken due to mutation and across species there are often the same pseudogenes broken in the same places in the genome. The natural explanation of this is that the mutation occurred in the past breaking the gene and then the pseudogene simply got passed on to all of those organisms' descendants which today includes multiple species.

Similar cases exist throughout biogeography, embryology, and other fields in biology. In each cases there are empirical observations (such as similarities between different species) that are best explained by those species having descended from a common ancestor. Similarities that exist across all of life (such as basic biochemistry) is evidence that all life is related in this way.

9) Kelly James Clark uses the initials "C.S.I." to describe three possible types of views of the relationship between science and religion. Describe and critically evaluate each of these types of views.

C.S.I stands for Conflict, Separation, Integration. The conflict view says that religion and science are in direct conflict with one another. For example, the Bible seems to tell us the Earth was created in only 7 days and is only 6,000-10,000 years old. On the other hand, science appears to tell us the Earth was formed billions of years ago, and took much, much longer to come together as a single planetary body than 7 days.

The separation view is that religion and science are fully separate from one another, there is no conflict and there is also no overlap. They are asking completely different kinds of questions, and the one has nothing to do with the other.

The integration view is that religion and science do overlap, but they are not in (any major) conflict. We can understand each better in the light of the other, and using the insights of both, we can have a view of the world that is both religious and scientific.

(Note to students: the question asks for critical evaluation. This means that there should be an analysis of the strengths and weaknesses of each view. You need not take a stand on a particular view, but you critical discussion should note that these 3 views ARE in conflict. Adopting the separation view, for example, is inconsistent with the other two views. The conflict and integration views are inconsistent with the separation view. And depending on how you understand conflict and integration, these views are so likely to be inconsistent with each other.)

One might note that the conflict view appears to correctly describe the relationship between science and certain religious beliefs. There really does seem to be claims in Scripture that are about the world—a global flood, for example—that modern science tell us are false. On the other hand, one can give up literal interpretations of Scripture (ala Gould), and this seems to get rid of this conflict. But that is problematic, as Richard Dawkins points out, because Scripture really does appear to be making claims about how the world is and what happened in the past as matters of fact, which are essential to Christianity. Could one be a Christian without believing that Christ was crucified, died, and was resurrected? Another concern is how to decide what to believe if we accept there is a conflict: does science always win? Does religion always win? If science always wins when it conflicts with religion, then we seem to be saying that science is a better source of knowledge about the world than religion, and this calls into question many common beliefs about ethics, the meaning of our lives, and our place in the universe. But if religion always wins, we seem to have a problem with the way we usually go about our everyday lives, in which we depend almost entirely on how the world appears to look as well—what if religion were to say something that our direct experience of the world right in front of us seemed to tell us was false?

The separation view does have certain attractions, and it does appear to be a popular view in history as well as in the present (especially if we think of ‘separation’ as implying methodological

naturalism). Galileo appears to have had something like a separation view, and Gould is a modern example. In addition, there are many religious scientists who don't appear to think their scientific work has anything to do with their religious commitments. But we might wonder, with Plantinga, why we would set aside some of our knowledge and understanding when deciding what to believe about certain questions. Shouldn't we always use all the knowledge and evidence we have, to give us the best chance to discover the truth? However, some kinds of evidence are precluded in certain contexts—consider a court rejecting testimony as hearsay, or not allowing evidence that was illegally obtained. Perhaps there is something analogous in the relationship between science and religion.

The integration view has a certain attraction, too. Science and religion are both very important in the lives of people all over the world, and both shape our everyday experiences, beliefs, intentions, and so on. And Plantinga's point that we should never exclude things that we know when deciding what to believe is also a very compelling point. But what are we to do when religion comes to some conclusion that our best science contradicts, or vice versa? The integration view must either have a method of deciding between options, or it must have a way of showing that the conflict is only apparent, and there is agreement between the conclusion of religion and science—and, further, the option of saying they are just separate is not open someone who accepts the integration view. There are some elements of Galileo's view that speak to this sort of view. He believes both science and religion, when done properly, cannot get things wrong, and that since truths cannot contradict truths, there cannot be a conflict. But neither is there is not a separation ala NOMA, since science and religion both reveal important truths to us about the world and our place in it, and we will need to understand both the physical world and that which transcends the natural world, and if we are to live a good, meaningful, prosperous life, we will likely need to know both scientific and religious truths.

10) Do you think methodological naturalism is the best way to do science? Could there be another way to do science (that would still properly count as science)? In particular, is methodological naturalism a reasonable view even if you do not accept metaphysical naturalism? In giving an argument for your view,

be sure to consider some reasons why someone (such as an author we read in class) might disagree with you and why you think they are wrong.

(NOTE TO STUDENTS: this is just an example of how to answer the question well; one might disagree with everything said below, and still put together a thoughtful, well-done answer)

Methodological naturalism is a good way to do science. So far, science has been very successful in understanding the natural world without recourse to supernatural explanations. We have advanced our understanding of physics, chemistry, biology, and medicine in ways that could not have been anticipated a few centuries or even a few decades ago, and none of these discoveries and advances has been due to anything but a progressively more complex and deep understanding of the natural world, physical processes, and so on.

Further, the notion that we shouldn't bracket some of our knowledge when we are investigating the world and deciding what to believe is also not a good principle. Consider a case where getting the truth is of the utmost importance: a trial for criminal offenses in court. In this case, we simply do not allow all evidence from any source whatever. If evidence is illegally obtained, it may not be allowed in, and typically this restriction constrains the means used to gather evidence. This is like experimental ethics in science, where some experiments that could be very, very informative are simply not done because they would be deeply, deeply unethical. This is not the only kind of legal restriction on evidence in court (e.g. hearsay, entrapment, etc.), but it shows that the general principle that we never ignore possible evidence or knowledge is simply false: in some cases it is highly desirable to ignore evidence and knowledge.

On the assumption that we reject metaphysical naturalism, methodological naturalism is still the best way to do science. There is no good evidence, so far, that science will run into limitations anytime soon. This does not guarantee that there will never be any limits to scientific investigation, but at this time, we should be optimistic about the future, since there is as yet no obvious example of a question that is in principle unanswerable without some kind of supernatural explanation. So, until we have such an

example, or strong evidence one exists, we should proceed in science in the way we have been, by assuming methodological naturalism.

Nor is there any good evidence to think that we could make any sense of how supernatural, immaterial stuff could interact, or cause, changes in natural, material stuff or vice versa. Our whole notion of cause and effect is understood in physical terms, and thus even if we were to admit the possibility supernatural entities or forces exist, we would have no idea of how they could possibly interact with the natural, physical world anyways. On that basis, then, even if there were supernatural explanation for phenomena in the world, it doesn't seem that we would be able to (1) understand it or (2) detect it or (3) that such an explanation would be informative in the same way that natural science has been.