Please enter your name and number all bluebooks that you use. Answer all questions in your bluebook. You do not need to answer the questions in order, but please be sure to label each answer.

The value of each question is proportional to the number of minutes listed in parentheses at the beginning of each equation.

1. (10 minutes) Sketch and briefly describe the age pyramids for three societies: (a) high mortality, high fertility (such as Nigeria), (b) low mortality, moderate to low fertility (such as the United States (c) low mortality, very low fertility (such as Japan).

2. (15 minutes) Describe the two measures of “sustainability” presented in the paper by Arrow et al. (2004) “Are we consuming too much?” *Journal of Economic Perspectives*. Do the measures necessarily agree? Why or Why not? What do the authors conclude about current consumption patterns?

**Answer:**

(a) 5 points: The two measures are: maximum discounted value of current and future consumption (inter temporal Social Welfare), which they denote as $V(t)$. And (2) sustainability which they represent as $\frac{d}{dt}V(t) \geq 0$, that is the sustainability criteria is in terms of change not levels. The first measure is favored by economists while the second is preferred by biologists.

(b) 5 points: As the article discusses at length the two criteria are related but distinct. Consequently, they need not agree. Economists would label a path of consumption as preferred if it yields a higher value even if it requires $\frac{d}{dt}V(t) < 0$, thus violating the sustainability criteria. That is, economists are willing to accept a lower consumption level for larger (discounted) gains in the future. The biologists want a consumption profile that never diminish consumption capabilities of the earth’s resources.

(c) 5 points: The article presents evidence for the economic measure that we are not consuming too much, but the authors argue that incomplete markets and tax policy probably leads us to over consume. With respect to the sustainability criteria we are likely consuming too much because we may undervalue the social value of ecological diversity.

3. (20 minutes) **True, False, or Uncertain.** Please label each of the following statements as True, False, or Uncertain (i.e., need additional information to assess statement). Briefly, justify your answer. **No points for unsupported assessments.**
(a) According to Becker, “rotten kids” can only exist in households lacking an altruistic head.

**Answer:** False. Rotten kids can exist in any household. But the actions of selfish kids can only be offset when an altruistic head has sufficient resources to establish incentives for kids not to act selfishly.

(b) Population aging is a necessary consequence as a country experiences the demographic transition.

**Answer:** True. During the demographic transition mortality rates decline, and longevity (say as measured as life expectancy at birth.) increase and fertility rates decline. Hence the average age of the population increases.

(c) The nuclear family was first dominant in Western and Northern Europe in the nineteenth century.

**Answer:** False. According to Hajnal and discussed in class the nuclear family appears to date from fifteen or sixteenth centuries and is not a nineteenth century phenomenon.

(d) During the nineteenth century in the U.S. declines in mortality and fertility occurred at about the same time, consistent with Demographic Transition theory.

**Answer:** False. It is true that fertility and mortality defines in the United States were essential coincidental, but according to the theory of the Demographic Transition, mortality rates are to decline prior to the decline in fertility.

(e) In a population closed to migration, it is possible for the crude birth rate (# births divided by # people in the population) to decline while age–specific (# births to women in age interval [25–29] divided by # of women in age interval) to remain unchanged in each group.

**Answer:** True. The crude birth makes no adjustment for the age distribution. An increasing share of women in the older age groups (which exhibit lower levels of fertility) will lower the crude fertility rate while leaving unchanged the age–specific measures.

(f) According to Malthus, preventive checks on population growth include famine, disease and war.

**Answer:** False. The famine, disease, and war are positive checks (as in “objective”).

(g) No–fault divorce legislation increased divorce rates during the 1970s and 1980s in the United States.

**Answer:** Uncertain (or false). Divorce rates increased around the time of the implementation of no–fault divorce. However, causation is unclear.

(h) At their current level of fertility and mortality Germany and Japan are certain to experience population decline over the next fifteen to twenty years.

**Answer:** True (or uncertain). These countries currently exhibit (very) modest population declines. Each has low fertility rates. Unless the countries allow substantially higher immigration, population momentum implies a declining population over the next generation.
(i) With the introduction of agriculture (about 10,000 B.C.E.) mortality rates and fertility rates increased.

**Answer:** True. The agriculture led to a sedentary life style and increased the reliability and quantity of the food supply. These factors led to an increase in the fertility rate. However, increased population density facilitated the transmission of infectious diseases, which increased mortality rates. The evidence (by historians and anthropologists) is that fertility rates increased negligibly more than did mortality rates so there was a slight increase in population growth, which remained at a minuscule level compared to recent times.

(j) A stable population must exhibit a time invariant age distribution and but may exhibit positive, negative or no growth.

**Answer:** True. This is the definition of a stable population — the age composition is “stable” or unchanging. Unlike a stationary population which must have constant size, a stable population may be increasing or decreasing.

4. (10 minutes) Please define the “demographic dividend.” What property of demographic change generates the demographic dividend? What is the economic significance of the demographic dividend?

**Answer:**

(a) 5 points. Identify and define the concept of population momentum.

(b) 5 points. The economic significance of the dividend is the large fraction of the countries population are concentrated in most productive years of life. Economy should exhibit higher than average economic growth.

5. (20 minutes) The following quote is from the editorial page of the New York Times, April 18, 2012. The author is Steven Philip Kramer, professor of grand strategy at the National Defense University’s Industrial College of the Armed Forces. The views expressed here are his own.¹

**Mind the Baby Gap**

Although overpopulation plagues much of the developing world, many developed societies are now suffering from the opposite problem: birthrates so low that each generation is smaller than the previous one. Much of southern and eastern Europe, as well as Austria, Germany, Russia and the developed nations of Southeast Asia, have alarmingly low fertility rates, with women having, on average, fewer than 1.5 children each, well below the replacement level.

At the same time, life expectancies in those places have reached record highs. As a result, the dependency ratio — the ratio of the working population to the nonworking population — has become increasingly unfavorable, and it is projected to get more so. Making matters worse is that economic growth gets harder to achieve as workers age and their ranks dwindle; aging societies will have a tough time succeeding in an era of rapid technological change.

¹I’ve shortened Kramer’s article to fit the time constraints of the exam.
But demographics are not self–regulating, and successful population policies require governments to make long–term investments in encouraging childbirth. This means a great deal of financial support, even in times of austerity; when it comes to population policies, there is no such thing as short–term success.

Countries that fail to take low birthrates seriously do so at their own peril. Time matters. If they wait too long and get caught in the low–fertility trap, they could find themselves in an uncharted era of depopulation that will be eerily different from anything before. And escaping that scenario will be difficult, if not impossible.

**Question:** Write an informed, reasoned response to the editorial. Be sure to incorporate ideas and evidence from class lectures and reading materials to support your reasoning.

**Answer:** Many directions to take here. The editorial is factually correct — TFRs of the countries mentioned indeed have and have had low fertility for roughly the last 25 years. Yet, it is not obvious to me his conclusions follow directly from these facts.

These are the kind of responses I expected. I don’t expect answers to have all of these points covered nor is the list exhaustive. The number of points assigned below is offered as a guide on the relative significance of the point.

(a) (10 points) The quote makes no mention of immigration. Low fertility and an aging population can be offset by liberalizing the immigration laws.

(b) (5 points) The claim that an aging population slows economic growth is frequently made. Societies with an aging population are among the richest countries (e.g., Germany, Japan). Do such countries exhibit slow growth because they are aging or because they are large and highly developed?

(c) (5 points) An aging population should save more which implies investment should be higher and thus standard of living and possibly the rate of economic growth.

(d) (5 points) It is not clear what policies the author wants these countries to follow. Is he advocating for income transfers or other economic incentives to increase fertility within these societies?

(e) (5 points) His argument is confused. He is not clear what policies he wants countries to follow. And advocates that behavior must be corrected before it is too late. Indeed, in the last line of the article he notes it may be too late. If it is too late what’s the point of the editorial?

(f) (5 points) I am not sure of what a low–fertility trap is, but he’s correct that population momentum implies that increased fertility rates today will not directly influence the economy for ten to twenty years.

(g) (5 points) Any argument that makes direct reference to the course readings receives additional points.