4. The following is an excerpt from a newspaper article describing a controversy.

Pesticide Use in Agriculture—A Controversy

Recently, Jonesville County inhabitants have been embroiled in a controversy regarding the use of pesticides on crops grown in the county. The *Jonesville Express* interviewed county residents for opinions on pesticide use. Below is a sampling of their responses.

Charles Ehler, farmer: "I'm not going to use those pesticides because I don't want to end up with leukemia."

Maurice Gordon, farmer: "The people who oppose the use of pesticides should have to decide which third of the world would starve."

Wendell Mullison, chemical salesman: "The health risks are minimal because these chemicals have been intensively tested by the chemical companies."

Robert Rodriguez, Environmental Protection Agency employee: "I worry about pesticides that find their way into groundwater. My agency has trouble keeping up with the new developments in farm chemistry. We don't even test the water for most of the pesticides that are in use today."

Bessie Smith, 80-year-old resident: "I'm against pesticides. When those planes spray on the farm next to me, most of those chemicals end up in my yard."

Alice Evans, farmer: "I couldn't earn a living without pesticides. My farm would not make a profit."

Judy Johnson, college professor: "We're in a vicious cycle. We develop pesticides, apply them, and the pests evolve resistance. Then we have to do it all over again."

Ben Jackson, librarian: "Pesticides are much safer than they used to be. The newer pesticides only affect specific pests and break down more quickly in the environment."

(a) Select four of the people interviewed. Provide a concise argument, based on scientific principles, that supports or refutes each individual's viewpoint.

(b) Identify one specific pest and explain its adverse effects on either agriculture or human health. Describe a viable method, other than the use of pesticides, of controlling this pest.

END OF EXAMINATION

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Question 4

Part A Maximum 8 points

For each of the 4 people selected (maximum of 2 points per person)

- 1 point for each concise argument based on scientific principle
- 1 point for a supporting example

students do not receive credit for rewording the statements provided or for simple agree/disagree

general arguments/scientific principles:
human health

Pro Pesticide

- eliminates or reduces pest, less disease, saves lives
- pesticides used according to manufactures directions are safer
- lack of proper scientific evidence linking pesticide use to leukemia
- pesticide use below acceptable or threshold levels is considered safe
- pesticide use safer with improvements in technology for application

Con Pesticide

- pesticides linked to cancer, birth defects, mutations, respiratory problems, allergic rxns, low sperm count
- implications of lifetime dosage
- toxic effects on agricultural workers
- pesticide data may be presented in a biased or incorrect manner

general arguments/scientific principles:
food resource/agricultural production

Pro Pesticide

- farmers who use pesticides have less crop loss in the short term (an application of pesticide may save a specific season's crop)

  Con Pesticide

- problem with distribution, not agricultural production
- efficient use of available food resources
- eat at lower trophic level (must indicate connection with lower pesticide use)
- market exists for organic products because of concern about pesticide use/residues
- pesticides use not profitable if all costs are internalized (ex. - health care)
- no clear evidence that pesticide use improves crop yield (long term increase in crop yield primarily due to fertilizers/new strains)
- population grows exponentially, while crop yield increases arithmetically
- due to improved biodegradability, newer pesticides require more frequent application, therefore increasing the cost
- increased expense of pesticide use due to pesticide treadmill (treadmill explained in this section or elsewhere)

  general arguments/scientific principles:
  chemical

  Pro Pesticide

- more testing than in past
- ore regulations than in past
- bans on DDT
- improved pesticides are less persistent, narrow spectrum
- FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) of 1972 provides specific Guidelines for testing

  Con Pesticide

- unexpected effects of inert ingredients, reactions with other chemicals
- problems with manufacture, handling, transport of pesticides
- lack of testing on humans
- lack of testing in nature
- new pesticides more toxic to humans (ex. Organophosphates)
- more testing than in past, but still too many new pesticides to allow for proper testing

general arguments/scientific principles:
migration of pesticides (movement from site of application)

Pro Pesticide

Con Pesticide

- movement in soil, water
- movement in air by wind
- goundwater/aquifer contamination by leaching
- runoff, irrigation increases movement
- pulse effect

general arguments/scientific principles:
genetics

Pro Pesticide

- use of genetically engineered crops is not well tested; until risks are understood, stick with the known risks of pesticides
- rotating the use of existing pesticides will decrease the chances of pest developing resistance

Con Pesticide

- genetic resistance with explanation, pesticide as selective agent natural selection, pass trait to offspring

- reproductive strategies of pest: high birth rate, large population, r-strategist
- pesticide treadmill with explanation

general arguments/scientific principles:
alternatives to pesticides

Pro Pesticide

- Integrated Pest Management (IPM) (needs explanation) incorporates the responsible use of pesticides

Con Pesticide

- Integrated Pest Management (IPM) (needs explanation) incorporates a variety of alternative control techniques with responsible use of pesticides
- use of natural predators (provide specific)
- interruption of reproduction: irradiation, hormones, sterile males
- others: hot water, soaps, vacuuming, traps, diatom powder, etc.

note: see detailed list at end of rubric

general arguments/scientific principles:
characteristics of pesticides

Pro Pesticide

- biodegradablity
- improve specificity using narrow spectrum

Con Pesticide

- persistence
- toxicity

- broad spectrum pesticides kill non-targeted species

  general arguments/scientific principles:
  ecosystem

  Pro Pesticide

  Con Pesticide

- biological magnification movement in food chain, trophic levels
- reduces biodiversity

- resurgence of target pest
- secondary pest outbreaks
- elimination of natural predator

  samples of examples useful in part "A"

- explanation of DDT and genetic resistance or biological magnification
- use of a specific pest and its natural predator
- details of contamination of a specific location (Ogallala aquifer)
- organic rice farming in Indonesia (crop yield increased after use of DDT eliminated)
- carcinogenic and/or health effects of Agent Orange
- FIFRA as example of regulation to improve toxicity testing

Question 4 (cont.)

The following control methods may be found in either part "A" or part "B".

*note - alternative control methods (must be possible to work for the specific named pest)

natural predators
natural repellents
attracting traps
insect repellents
live traps
physical removal
diatom powder
eggshell (snails)
Bt (Bacillus thuringensis)
introduce competing species
intercropping
killing traps
interrupt reproductive cycle
hormones
crop rotation
sterile males
alternative sprays (soaps)
hot water (steam)
boric acid
biopesticides
pheromones
electric zappers
a vaccine that eliminates disease
botanicals
pest specific fungus
adjust planting times
(pest no longer a pest)
trangenics
Integrated Pest Management (IPM)
pest-resistant varieties
virus (Australian rabbit)
quarantine
eliminate habitat of pest (ex. - drain standing water for mosquito)
physical barrier
border inspection
increase natural habitat of pest / reduce habitat destruction (ex. - increase space available for deer population)
companion plants (ex. - marigold) - exudes airborne repellent (pyrethrums)
allelopathic plants (ex. - Mexican marigold) - exudes soil repellents
sacrificial plants (ex. -) - pest eats instead of crop

Part B (maximum 4 points)

- *ID specific pest - 1 point
- adverse effects - 1 point per accurate effect (max 2 points)
- describe control method - 1 point
- elaboration of control method - 1 point

note:
correct statements applying to part ‘A’ found in part ‘B’ only receive credit if correctly referenced

Question 4 (cont.)

The following two lists include examples commonly used by students. There were many other correct possibilities that received full credit.

examples of a specific pest (1pt)	adverse effect (1pt) (must be accurate agric. or health)	alternative control (1pt) (possible to work for named pest)
gypsy moth	feeds on tree leaves	parasitic wasp, pest specific fungus
Anopheles mosquito	transmits malaria	drain standing water
fire ant	stings, allergic rxn	interrupt reproductive cycle
Africanized bee (killer OK)	stings, allergic rxn	hormones
aphid	feeds on crops	ladybird beetles (ladybugs)
tobacco hornworm/budworm	eats tobacco	remove by hand
Mediterranean fruit fly	eats crops	sterile males
kudzu	competes with crops	remove by hand
screwworm fly	harms cattle	sterile males
white flies	destroys citrus crop	soapy water
tomato hornworm/sphinx moth	eats tomatoes	braconid wasp
leafhopper/planthoppers	feeds on cotton, soybeans	natural predator
boll weevil	Cotton	parasitic wasp
deer tick	transmits Lyme/spotted fever	protective clothing, repellent
purple loostrife	competes with aquatic crops	discover natural predator

*the following are appropriate only if a specific indication is given of why it is a pest (adverse effect point only given if adverse effect is agricultural or human health)

explanation:	ant	0 pts	
	ant eating food in house	1 pt	(indicates why organism is a pest)

examples:

- bees that sting
- fleas biting, carrying disease
- weeds competing with crops
- deer eating garden plants
- mosquito transmits specific disease (malaria, dengue fever, yellow fever, meningitis, encephalitis)
- locust eating crops
- rabbits eating crops
- rodents eating grain
- snails eating garden crops