



NATIONAL SENIOR CERTIFICATE EXAMINATION  
SUPPLEMENTARY EXAMINATION MARCH 2016

**LIFE SCIENCES: PAPER II**

Time: 2 hours

100 marks

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**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

1. This question paper consists of 10 pages. Please check that your question paper is complete.
  2. All questions must be answered in the Answer Book provided.
  3. This paper consists of three questions. Question 1 and Question 2 are case studies and Question 3 is an essay.
  4. Read the questions carefully.
  5. Read the sources provided for the case studies and use the information and your own knowledge to answer Questions 1 and 2.
  6. Source material is also provided for the essay. Use the information and your own knowledge to first plan and then write your response.
  7. Number the answers exactly as the questions are numbered.
  8. Use the total number of marks that can be awarded for each part of the questions in Question 1 and 2 as an indication of the detail required.
  9. It is in your own interest to write legibly and to present your work neatly.
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**QUESTION 1**

Read the information below on reproduction in seahorses and then answer the questions that follow.

**Seahorse Fathers Take Reins in Childbirth**

Stentor Danielson, National Geographic News

*It's true that male seahorses never play catch with their children or help them with their homework. But they do outdo human dads on one count: Male seahorses undergo pregnancy and give birth to their sons and daughters.*

The trait is unique in these strange and fascinating fish that inhabit tropical and temperate coastal waters worldwide. Seahorses, which range from less than one to 30 centimetres in length, have evolved a series of unusual adaptations – a prehensile tail for clinging to underwater vegetation, a tubelike mouth for sucking in tiny crustaceans, and protective bony plates in their skin.

"They're such an unusual-looking fish, people sometimes don't realise they're real fish," said Alison Scarratt, curator of fishes at the National Aquarium in Baltimore (USA).

Although the bony plates covering its body make the seahorse inedible to most other animals, its survival is under threat from human predation, especially for use in traditional medicines.

No statistical data on seahorse populations is available because relatively little research on seahorses has been done until recently, but fishermen have reported a decline in the number and size of seahorses they catch, according to scientists from a program called Project Seahorse.

Breeding seahorses in captivity is a problem, in part because the babies are so tiny it's hard to keep them alive. Scientists are working to develop effective methods that will help ensure this animal's survival.

The male seahorse has a pouch on its stomach in which to carry babies – as many as 2 000 at a time. A pregnancy lasts from 10 to 25 days, depending on the species.

The reproductive process begins when a male and a female seahorse do daily pre-dawn dances, intertwining their tails and swimming together. Eventually they engage in a true courtship dance, which can last as long as eight hours. It ends with the female depositing her eggs in the male's pouch.

"Their mating ritual is quite beautiful," said Sarah Foster, a research biologist at McGill University. Scientists think the courtship behaviour is designed to synchronise the movements of the two animals so that the male can receive the eggs when the female is ready to deposit them. The eggs are then fertilised in the dad's pouch.

The eggs hatch in the pouch. The father cares for the young as they grow, regulating the water salinity in the pouch to prepare them for life in the sea. "It's quite costly energetically," Foster said. When the tiny seahorses are ready to be born, the male undergoes muscular contractions to expel the young, known as 'fry', from the pouch.

**Cutting the Ties**

While seahorse dads go the extra mile to give birth, the parents do not provide their tiny offspring with any care or protection after they are born. Infant seahorses are susceptible to death from predators and being swept into ocean currents, where they drift away from feeding grounds rich in microscopic organisms. About five infant seahorses in every 1 000 survive to adulthood, which helps explain why the litters are so large.

By fish standards, however, seahorses have a fairly high survival rate because they are sheltered

in the father's pouch during the earliest stages of development. The eggs of many other fish species are abandoned immediately after fertilisation.

### Breeding Difficulties

Scientists are not sure what evolutionary advantage male pregnancy gives seahorses. One theory is that it enables a shorter cycle of reproduction by distributing the costs of the process between the two parents. While the male is bearing the young, the female can prepare more eggs to implant soon after the male has given birth to the last litter. Some seahorses can give birth in the morning and be pregnant again by evening.

Aquariums have only recently developed the technology to raise seahorses in captivity, according to Scarratt. The main challenge has not been getting the seahorses to breed, but to help the fry survive, she explained. The infant seahorses are so small they cannot eat most of the tiny plankton that are fed to the adults. Special food has to be grown so the fry do not starve.

[Adapted: National Geographic, 2002]

- 1.1 Match the terms in Column 1 in the following table with the correct description in Column 2.

Write only the letters from Column 1 underneath each other with the number of the matching statement from Column 2. E.g. '(e) 6.'

Column 1		Column 2	
(a)	Courtship	1.	Young seahorses that are born from a seahorse pouch.
(b)	Prehensile	2.	Microscopic algae that provide food for aquatic organisms.
(c)	Fry	3.	Male and female seahorses swimming together and intertwining their tails.
(d)	Fertilisation	4.	A structure that can be used for grasping/holding.
		5.	Fusion of sperm and egg cells.

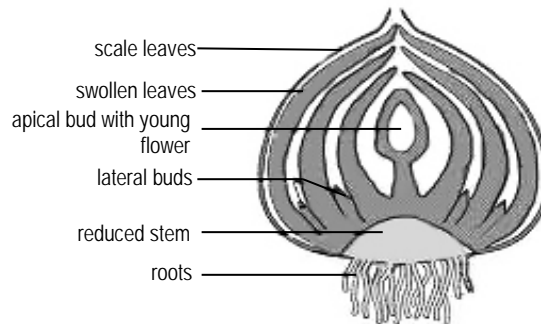
(4)

- 1.2 Can the seahorse be described as oviparous, ovoviviparous or viviparous? Explain your answer. (3)
- 1.3 Calculate the percentage survival rate for each litter of seahorses. Show all working. (2)
- 1.4 Explain the possible evolutionary significance of male pregnancy in seahorses. (3)
- 1.5 Why has it been difficult to study seahorses in captivity? (2)
- 1.6 Draw up a comparative table of THREE differences each in pregnancy and in birth between seahorses and humans. (6 + 2)
- 1.7 Using the information in the text, describe and evaluate the success of the parental care strategy of seahorses. (7)
- 1.8 Although the tone of the article is informal, why can it be regarded as scientifically credible? (1)

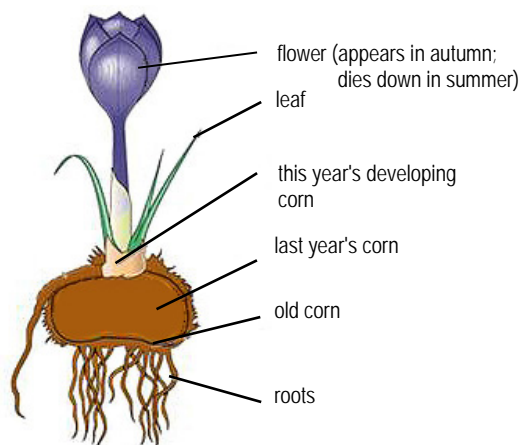
**[30]**

**QUESTION 2**

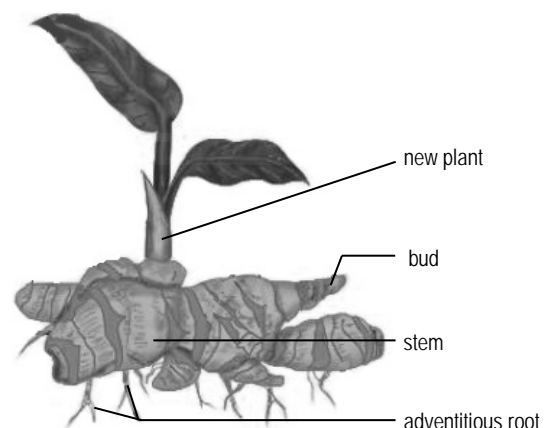
- 2.1 Study the diagrams below of some vegetative reproductive structures in certain plants.

**Diagram A: Onion**

[&lt;www.leavingbionet.com&gt;]

**Diagram B: Tulip Flower**

[&lt;www.sbi3uplantsjan2012&gt;]

**Diagram C: Underground Stem**

[&lt;www.merination.com&gt;]

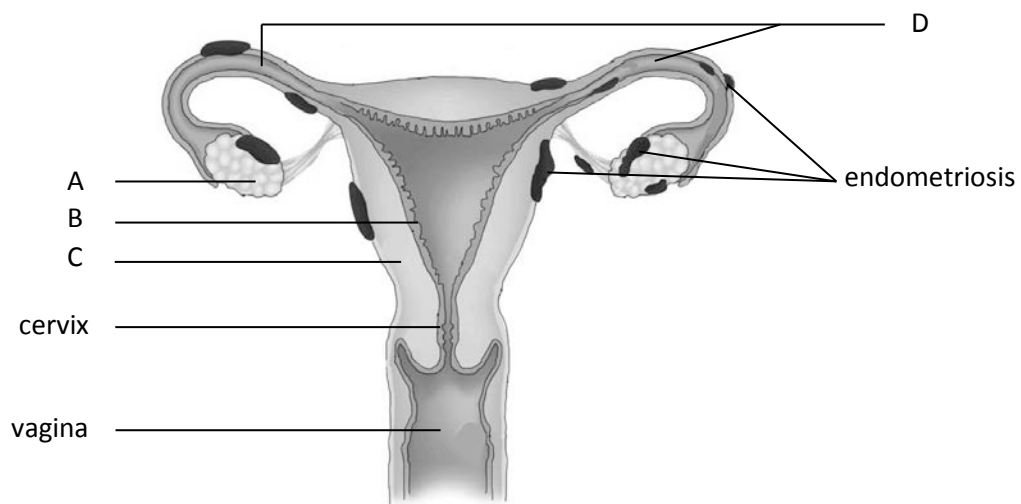
- 2.1.1 Why do these diagrams represent asexual reproduction? (2)
- 2.1.2 (a) How do the structures shown in the diagrams ensure the survival of these plants? (3)
- (b) Other than reproduction, of what importance are these types of structures to humans? (2)
- 2.1.3 Explain ONE advantage and ONE disadvantage of vegetative propagation of plants. (2)

- 2.2 Read the following information on endometriosis, a condition that affects many women, and study the diagrams and graph carefully before answering the questions.

Endometriosis is an often painful disorder in females in which tissue that normally lines the inside of the uterus – the endometrium – grows outside the uterus. Endometriosis most commonly involves the abdomen and ovaries, Fallopian tubes, and ligaments that support the uterus; the area between the vagina and the rectum; the outer surface of the uterus; and the lining of the pelvic cavity. Other sites for these endometrial growths may include the bladder, bowel, vagina, cervix, vulva, and in abdominal surgical scars. Less commonly they are found in the lungs, arms, thighs, and other locations.

In endometriosis, displaced endometrial tissue continues to act as it normally would – it thickens, breaks down and bleeds with each menstrual cycle. Because this displaced tissue has no way to exit the body, it becomes trapped. When endometriosis involves the ovaries, cysts may form. Surrounding tissue can become irritated, eventually developing scar tissue and adhesions – abnormal tissue that binds organs together. Endometriosis can cause pain – sometimes severe – especially during the menstrual period. Fertility problems also may develop. Fortunately, effective treatments are available.

**Diagram A. Female Reproductive System Showing Areas of Endometriosis**



This painful, chronic disease affects at least 6,3 million women and girls in the United States of America, and millions more worldwide. The cause of endometriosis is unknown. One theory suggests that during menstruation some of the menstrual tissue extends into the fallopian tubes, implants in the abdomen, and grows.

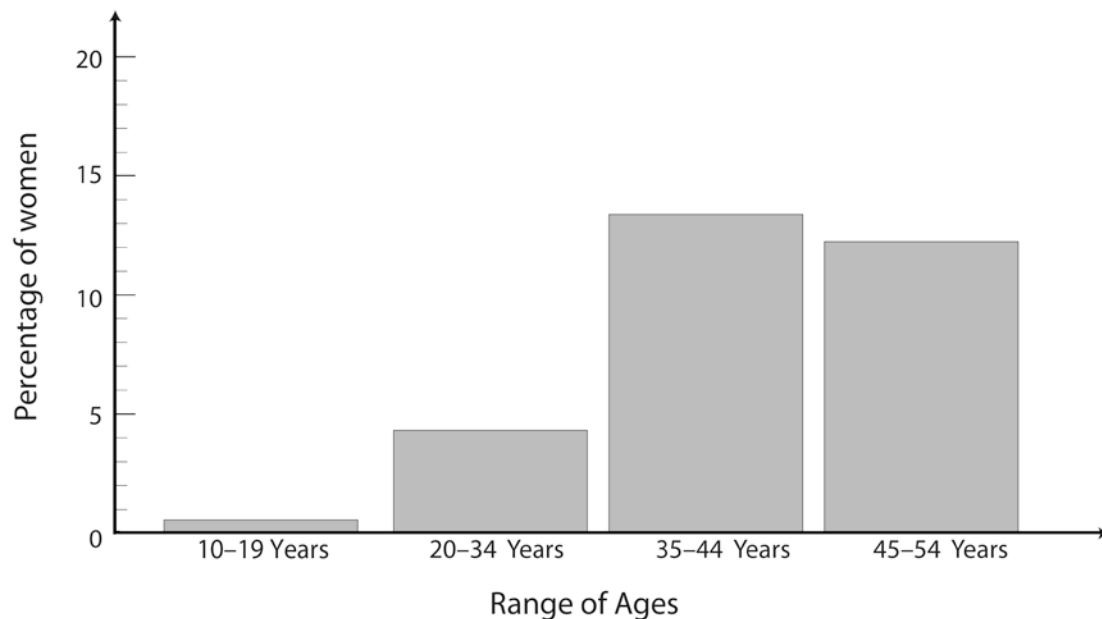
Hormones may also play a role. Endometriosis affects about one in 10 women of reproductive age, which is the time between a female's first menstruation and menopause, when she can no longer become pregnant. These childbearing years are when a woman's oestrogen levels are at their highest. After menopause, a female's oestrogen levels significantly drop and symptoms of endometriosis typically subside.

Research by the Endometriosis Association (EA) revealed a startling link between dioxin exposure and the development of endometriosis. Dioxin is a toxic chemical by-product of pesticide manufacturing, bleached pulp and paper products, and medical and municipal waste burning. The EA discovered a colony of rhesus monkeys that had developed endometriosis after exposure to dioxin. A total of 79% of the monkeys exposed to dioxin developed endometriosis, and, in addition, the more dioxin exposure, the more severe the endometriosis.

[Adapted: <[www.endometriosisassn.org](http://www.endometriosisassn.org) & [www.mayoclinic.org](http://www.mayoclinic.org)>]

**Diagram B. Endometriosis among Women aged 20 to 54 years (Survey 2005 – 2006)**

Adapted: [U.S. Department of Health and Human Services, 2009]



- 2.2.1 (a) Explain clearly what endometriosis is. (2)
- (b) What is menstruation? (2)
- 2.2.2 (a) State the letter from Diagram A on page 5 that represents the endometrium. (1)
- (b) What is the normal function of the endometrium? (2)
- (c) Describe the feedback mechanism between oestrogen and FSH. (5)
- 2.2.3 (a) Explain how the information in the graph and in paragraph 4 support the theory that endometriosis is most severe in women of reproductive age. (4)
- (b) What percentage of women in the 20 to 34 age range develop endometriosis? (1)
- (c) Suggest ONE way in which the graph could have provided more useful information on endometriosis. (2)
- 2.2.4 Do you think the discovery that 79% of a rhesus monkey colony that was exposed to dioxin and subsequently developed endometriosis, has important implications for women? Give reasons for your answer. (2)

**[30]**

**QUESTION 3**

The development of artificial hormones and medicines has provided relief to many who suffer from severe disorders that can be life threatening and which significantly reduce their quality of life. However, the availability of artificially manufactured treatments has led to their widespread abuse.

*There are more disadvantages associated with artificial hormones and medicines than there are advantages.*

Using the source material provided, as well as any other knowledge you have, discuss your opinion on the above statement in the form of a 2½ – 3 page essay.

**[40]**

**To answer this question you are expected to:**

- Read the source material carefully and present a debated argument to illustrate your point of view.
- Select relevant information from sources A to G below. Do not attempt to use all the detail provided.
- It is important to integrate your own relevant biological knowledge. However, do not write an essay based solely on your own knowledge.
- Take a definite stand on the question and arrange the information to best develop your argument.
- Write in a way that is scientifically appropriate and communicates your point of view clearly.
- Provide a clear plan of your essay before you start writing. Note that the plan will be marked as part of the assessment of this question.

**SOURCE A****HOW CANCER HORMONE THERAPY WORKS**

Cancers that are hormone sensitive or hormone dependent need hormones to grow or develop. Hormone therapies are medicines that can slow down or stop the growth of cancer by either:

- Stopping hormones being made or;
- Preventing hormones from making cancer cells grow and divide

Cancers that can be treated with these medicines include:

- breast cancer
- prostate cancer
- ovarian cancer
- uterine and endometrial cancer
- kidney cancer

[Adapted: <[www.cancerresearchuk.org](http://www.cancerresearchuk.org)>]

**SOURCE B                      INSULIN THERAPIES**

For many years insulin was obtained from the pancreatic tissue of cows and pigs, slaughtered for food, and then purified. This was expensive, difficult and the insulin could cause allergic reactions in humans.

Once the structure of human insulin was discovered, it could be manufactured by genetically-engineered bacteria to be the same as human insulin. They produce human insulin in a pure form that is less likely to cause allergic reactions.

[Adapted: <www.abpischools.org.uk>]

**SOURCE C                      HUMAN GROWTH HORMONE**

Synthetic human growth hormone (HGH) was developed in 1985 and approved for specific uses in children and adults.

**Children**

HGH injections are approved for treating short stature and pituitary dwarfism, as well as poor growth due to a number of medical causes including:

- Turner's syndrome, a genetic disorder that affects female development
- Chronic kidney malfunction
- HGH deficiency
- Children born small for gestational age

**Adults**

- Short bowel syndrome, a condition in which nutrients are not properly absorbed due to severe intestinal disease or the surgical removal of a large portion of the small intestine
- HGH deficiency due to rare pituitary tumours
- Muscle-wasting disease associated with HIV/AIDS

**Abuse of HGH**

- The most common uses for HGH are not medically approved. Some people use the hormone, along with other performance-enhancing drugs, in an attempt to build muscle and improve athletic performance. Yet HGH's effect on athletic performance is unknown.
- Because the body's HGH levels naturally decrease with age, some so-called anti-aging experts have speculated and claimed that HGH products could reverse age-related bodily deterioration. These claims, too, are scientifically unproven.
- Companies that market these products claim that they turn back the body's biological clock, reducing fat, building muscle, restoring hair growth and colour, strengthening the immune system, normalising blood sugar, increasing energy and sleep quality, vision, and memory. However, there is no reliable scientific evidence to support the claim that these products sustain these effects in the long term.

**HGH side effects and other hazards**

Possible side effects of HGH use include:

- Nerve, muscle, or joint pain
- Swelling due to fluid in the body's tissues (oedema)
- Carpal tunnel syndrome
- Numbness and tingling of the skin
- High cholesterol levels

HGH can also increase the risk of diabetes and contribute to the growth of cancerous tumours. Furthermore, if the drug is illegally obtained, it is not known what it actually contains. The high cost of HGH drugs results in many of them being faked.

[Adapted: <www.webmd.com>]



**SOURCE D****Thyroid Disease Symptoms**

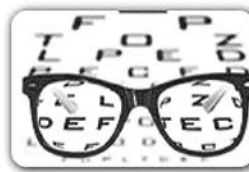
Sweating



Weight loss



Irritation



Vision problems



Depression



Menstrual problems



Nervousness



Weight gain



Dry skin



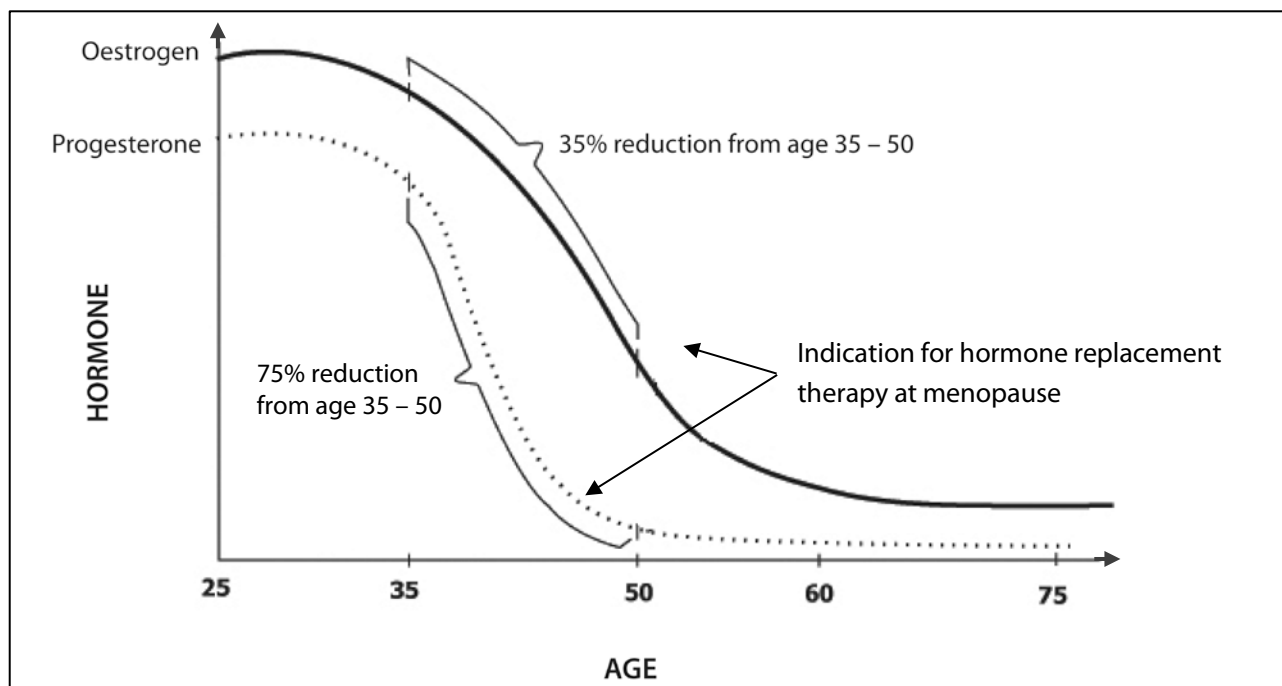
Common cold

Some of the most common hormonal disorders are associated with the thyroid gland. Around one in 20 people will experience some form of thyroid problem in their lifetime. Women are more likely than men to develop thyroid disorders.

**Thyroid Disease Treatment**

Medications – If the condition is **hyperthyroidism**, oral medication is the first line of treatment to reduce the hyperactivity of the thyroid gland and control the levels of thyroxine hormone in the body. To treat **hypothyroidism**, synthetic thyroid hormone is given daily. A very small amount of synthetic hormone may be given to treat a goitre in order to shrink it to its previous size.

[Adapted: <[www.lloydhealthcare.org](http://www.lloydhealthcare.org)>]

**SOURCE E HORMONE LEVELS WITH AGE**

[Adapted: <[www.precisionnutrition.com](http://www.precisionnutrition.com)>]

**SOURCE F****Lance Armstrong Biography**

Occupation – Cyclist, Philanthropist (1971–)

In January 2013, during a televised interview with Oprah Winfrey, Lance Armstrong admitted to using performance-enhancing drugs throughout his career, beginning in the mid-1990s. During his interview with Winfrey, Armstrong stated that he took the hormones cortisone, testosterone and erythropoietin (also known as EPO), and he used blood transfusions to boost his oxygen levels. "I am deeply flawed ... and I'm paying the price for it, and I think that's okay. I deserve this," Lance stated during the interview, adding that he took illegal drugs as a professional athlete due to a 'ruthless desire to win ... the level that it went to, for whatever reason, is a flaw'.

[Adapted: &lt;www.biography.com&gt;]

**SOURCE G****RITALIN – A MIRACLE DRUG**

A research team led by Nora Volkow, the head of Brookhaven's biology and medical departments, finds that the brains of children with attention deficit hyperactivity disorder (ADHD) have too little dopamine, a brain chemical needed for several vital brain functions. Why? It's because ADHD children's brains have too many molecules that take up dopamine before it can work in the correct areas of the brain. Ritalin combines with these molecules, so the dopamine is free to carry out its function.

[Adapted: &lt;www.webmed.com&gt;]

**How Ritalin Abuse Starts**

It seems so simple at first. A student gets a little behind in his studies. An exam comes up and he needs to prepare. He'll have to stay up late to have a chance of making the grade. Coffee gives him the jitters, but many of his friends use Ritalin pills to stay awake. Why not? A couple of bucks; one pill; an entire night of study; a feeling of 'focus'.



That may be where it starts, but it is very often not where it ends. Some students are chopping up Ritalin and snorting it like cocaine for faster absorption. "It keeps you awake for hours," said one.

And just like cocaine or any other stimulant, that nice 'up feeling' is inevitably followed by a 'crash', a feeling of fatigue, depression and decreased alertness.

[Adapted: &lt;www.drugfreeworld.com&gt;]

**Total: 100 marks**