UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level and Advanced Subsidiary Level

THINKING SKILLS **9694/04**

Paper 4: Applied Reasoning **June 2007**

1 hour and 30 minutes

Additional Materials: Answer Booklet/Paper

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READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use staples, paper clips, highlighters, glue and correction fluid.
DO **NOT** WRITE ON ANY BARCODES
Electronic Calculators should be used.

Answer **all** the questions.
Start each question on a new answer sheet.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question.

This document consists of **11** printed pages and **1** blank page.

1 *Study the following evidence and answer the questions which follow. Show your working.*

An Arctic research company needs to decide the best way to provide power for a 100-day expedition. It is considering the purchase of a combination of diesel generators, wind turbines and solar panels. These will provide power for a variety of different appliances, not all of which will need to run all the time.

The purchase costs and power outputs of the different possible products are given below.

Solar Power

Possible products	Cost of purchase ($)	Maximum power (watts)
Solar A	900	175
Solar B	500	90

You may assume that the solar panels give out their maximum power throughout the 12 daylight hours. You may assume that the length of the day stays the same throughout the expedition (although in reality 12 hours is an average).

Wind Power

Possible products	Cost of purchase ($)	Average power (watts)
Wind A	750	450
Wind B	550	360

The power output of the wind turbines varies (when it is windless they give nothing, but this is compensated for when it is windy), and therefore they cannot be relied upon for the vital power appliances. However, for the purposes of calculation it can be assumed that the power output is continuous.

Diesel Power

Possible products	Cost of purchase ($)	Maximum power (watts)
Diesel A	5000	3000
Diesel B	1800	900

The cost of running the generators for an hour is shown in Figure 1.

Power Requirements

The appliances needed for the expedition can be divided into the following categories:

- Vital appliances which need power 24 hours a day: 2100W in total.
- Appliances which need power continuously throughout the 12 hours of daylight (but not during the night): 1000W in total.
- Other appliances which could be used at anytime: these average a total of 1250W throughout the day and night.

Cost Restriction

The company has $10 000 available to spend on the provision of electricity for the expedition.

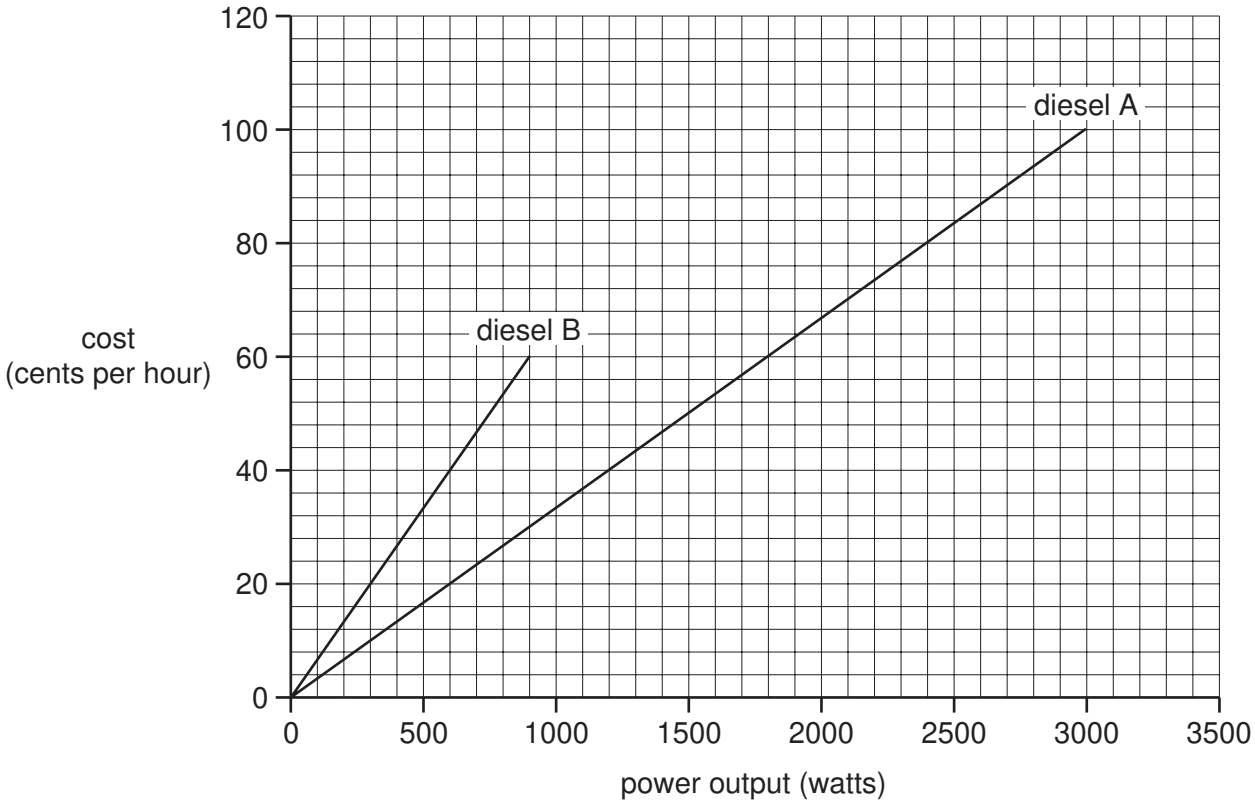

Figure 1

(a) Calculate how much it would cost to run the 24-hour vital appliances for the entire expedition, using only Diesel B generators. You need to include the cost of purchase and the cost of running the generators.

[1]

(b) Is it possible to produce **all** the necessary power using diesel power only, given the $10 000 spending limit? Explain your conclusion by showing the costs of purchase and diesel required.

[3]

(c) If solar power was to be used to provide as much of the power requirements as possible, what would be the minimum cost of the provision of the solar power?

[2]

(d) **(i)** Assuming that the diesel generator(s) run at full power all the time, investigate possible combinations of the power sources. Give **one** example of a combination of power sources which fits the requirements of the expedition, and is within the budget ($10 000).

[2]

(ii) You should find that your combination produces more than the required total power. With the aid of the graph in Figure 1, calculate the minimum cost to produce exactly the required power if the generators can be run at reduced power to lower diesel costs.

[2]

2 *Study the following information and answer the questions which follow. Show your working.*

A credit union is a financial co-operative owned and controlled by its members. It offers savings and low-interest loans. Each credit union has a 'common bond' which determines who can join it. Examples of a 'common bond' are people working for the same employer or people belonging to the same association.

The Tweakit Credit Union is operated by, and for, employees of Tweakit Engineering. Members save by agreeing to have a certain amount deducted from their monthly salary payment. Each member has a credit union account into which the savings are paid.

Members may also borrow money from the credit union. New members qualify immediately for an introductory loan of up to $300. To borrow larger sums members must have been saving for at least three months, after which time they can apply for a loan of up to three times their savings balance (for instance a member with $600 savings may apply for a loan of up to $1800).

Interest on all loans is charged at 1% per month on the remaining balance of the loan, and is calculated immediately before each repayment.

Information is presented in Tables 1-4.

(a) Alice has made monthly payments of $110 since she joined the credit union 4 months ago. She would like to borrow $2700. Assume she continues to make the same monthly payments.

(i) How many more payments must be credited to her share account before she can borrow $2700? [1]

(ii) How many months will it then take for the loan to be repaid? [1]

(b) Ben has made 5 payments of $150 per month towards repaying a loan of $2400.

(i) How much of his 5^{th} payment was credited to his savings account? [3]

(ii) Following a pay rise, Ben has decided to increase his payments to $200 per month. He does this after he has made his 5^{th} payment. How much sooner will he pay off the loan than originally expected? [2]

(c) The introductory loan example in Table 3 claims that if a loan of $300 is repaid at $50 per month then the total interest is $12.80 and $87.20 is paid into the savings account. Using other information given, show that these figures are correct. [3]

LOAN REPAYMENT GUIDE – MONTHLY LOAN REPAYMENTS ($100 TO $1600)

Amount of Monthly Payment ($)	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
150	1	2	3	4	5	5	6	7	8	9	10	10	11	12	13	14
125	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
100	2	3	4	5	7	8	9	10	12	13	14	15	17	18	19	20
90	2	3	5	6	7	9	10	12	13	14	16	17	19	20	21	23
80	2	4	5	7	8	10	11	13	15	16	18	19	21	22	24	25
70	2	4	6	8	9	11	13	15	17	18	20	22	24			
60	2	5	7	9	11	13	15	17	19	21	23					
50	3	5	8	10	13	15	18	20	23							
45	3	6	9	12	14	17	20	23								
40	4	7	11	13	16	19	22									
35	4	8	11	15	18	22										
30	5	9	13	17	21											
25	5	10	15	20												
20	6	13	19													
15	9	17														
10	13															
5																

AMOUNT OF LOAN ($)

Table 1

LOAN REPAYMENT GUIDE – MONTHLY LOAN REPAYMENTS ($1700 TO $3200)

Amount of Monthly Payment ($)	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000	3100	3200
220	10	11	11	11	12	13	13	14	14	15	15	16	16	17	18	18
210	11	11	12	12	13	13	14	14	15	15	16	17	17	18	18	19
200	11	12	12	13	13	14	14	15	16	16	17	18	18	19	19	20
190	12	12	13	14	14	15	16	16	17	18	18	18	19	20	20	21
180	12	13	14	14	15	15	16	17	17	18	19	19	20	21	22	22
170	13	14	14	15	15	16	17	18	18	19	20	21	21	22	23	24
160	14	15	15	16	16	17	18	19	20	20	21	22	23	23	24	25
150	15	15	16	17	18	18	19	20	21	22	23	23	24	25	26	27
140	16	17	17	18	19	20	21	21	22	23	24	25	26	27	28	29
130	17	18	19	19	20	21	22	23	24	25	26	27	28	29	30	31
120	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
110	20	21	22	23	24	25	26	27	28	30	31	32	33	34	35	
100	22	23	24	25	26	28	29	30	31	33	34	35				
90	24	25	27	28	29	31	32	33	35							
80	27	29	30	31	33	34	36									
70	31	33	34													
60	36															

AMOUNT OF LOAN ($)

Table 2

Notes on Tables 1 and 2:

1. **Find the amount of loan you wish to apply for along the bottom of the chart.**
2. **Find the amount of your monthly payroll deduction along the left of the chart.**
3. **The box at which these two lines meet is the number of payments required to repay the loan.**
   e.g. $2500 loan at $170 per month would take 18 months to repay.
4. **The monthly deduction is your full deduction including loan repayment, interest due and addition to your savings.**
5. **80% of your total deduction goes towards repaying your loan each month.**
   The remaining 20% of your payment will pay the interest due with the remaining amount going into your savings account.

Introductory Loan Example

Introductory Loan of $300 repaid at $50 per month would take 8 months to repay.

Loan Repaid	$300.00
Interest Paid	$12.80
Savings	$87.20
Total	$400.00 (8 payments of $50)

The total interest would be $12.80 and the member would now have savings of $87.20 with the credit union.

Table 3

Standard Loan Example

Member with $350 savings is issued a loan of $1000 at $60.00 per month.
Repayment period 21 months:

Loan Repaid	$1000.00
Interest Paid	$109.20
Savings	$150.80
Total	$1260.00 (21 payments of $60.00)

The total interest would be $109.20 and the member would have added $150.80 to their savings of $350.00 leaving a new savings balance of $500.80.

Table 4

[Turn over

3 *Study the following evidence and answer the questions below.*

Definition: **Sustainable development** (SD) is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

At the heart of ongoing debates on sustainable development is the issue of the possibility of living better while consuming less.

(a) Read Document 1 and provide a brief analysis of the argument presented by Miss B.

[6]

(b) Give a critical evaluation of Miss B's reasoning. You will need to justify your assessment clearly by identifying strengths and weaknesses and any unstated assumptions in Document 1.

[8]

'Sustainable development is incompatible with real human development.'

(c) Construct an argument **either** for **or** against the above statement by critically referring to Documents (1) – (5) and introducing your own ideas in support of your case.

[16]

DOCUMENT 1

Sustainable Development: A Deception?

Many environmentalists claim that sustainable development initiatives, such as agroforestry[1] and extractivism[2], are better than large-scale development projects installed in the Amazon by the Brazilian Government and large multinational corporations. They argue that large-scale projects such as dams and mines which destroy the Amazon's natural resources and environment (upon which peasants depend) are implemented by authoritarian means and do not give work to most of the Amazon's poor peasants. They claim that sustainable developments can offer the peasants more opportunities and control over their own development, because they are sustainable, local and small-scale. However, these environmentalists are mistaken.

It is wrong and deceptive of environmentalists to base their arguments for environmental preservation solely on the social needs of the poor in the Amazon. By confusing the two issues of environmental and social needs, environmentalists in fact help keep these people poor. These issues must be separated if peasants and workers in the Amazon are to enjoy better lives.

Although mega-projects do destroy huge tracts of the forest and can be inefficient, the attitude towards development expressed by their construction is progressive. The most important factor for the development of the Amazon is the human being. Human beings have transformed the forest and manipulated the economy for tens of thousands of years for their needs. The Amazon itself, as a natural phenomenon, does not have any development needs. It spontaneously evolves and is devoid of any plans or opinions. It is, therefore, up to us to explore how best the Amazon can serve human needs.

Today, unlike previous periods of mankind's occupation of the Amazon, we have the capacity to more fully exploit it to serve our needs. As we research its potential we have discovered how it can supply huge amounts of hydroelectric power and minerals and that it is a source of biodiversity and genetic wealth which could be used for drugs and the manufacture of food stuffs. All that is lacking is the application of technological knowledge.

Thus, large development programmes in the Amazon are an attempt to promote real human development by expanding and exploiting such discoveries. But sustainable development threatens to stall the massive benefits. It is driven by the belief that the forest itself is our main resource of development and that we must therefore preserve it at all costs. The environmentalists' notion of 'natural capital' presents the forest as a static natural resource: a resource which has to be exploited through methods which are in harmony with its ecology and which allows it to be a renewable resource if it is to serve the economic needs of its inhabitants. Small-scale and local development initiatives such as agroforestry and extractivism therefore promote a precautionary and anti-experimental approach to human intervention in the Amazon and can only result in poverty for the majority of the Amazon's inhabitants.

Miss B

[1] agriculture within the forest
[2] cultivating and harvesting forest produce

DOCUMENT 2

Needs or Wants?

Philosophers from Plato onwards have discussed the relevance of human needs to conceptions of 'good life' and the role of self-discipline. Like the radical environmentalists, the ancient Stoics aspired to a simple life in harmony with nature. They thought our failure to achieve this was due to a mismatch between our subjective desires and objective needs.

However, the modern economics textbook, generally, does not focus on the word 'need', choosing instead to cast its arguments in terms of wants, tastes or consumer preferences. Anderton, for example, introduces the question of human needs on the first page of his undergraduate textbook on economics: - 'Human needs are infinite… [But] no-one would choose to live at the basic human need if he [sic] could enjoy a higher standard of living. This is because human wants are infinite.' The idea that human wants can never be satisfied underlies the whole of consumer society. Increasing consumption is seen as synonymous with an improved standard of living.

But there has been growing criticism of modern society which argues that there is something unsavoury about recent patterns of consumption. Erich Fromm identified two main psychological premises on which the modern economic system is built:

- the aim of life is happiness, that is maximum pleasure, defined as the satisfaction of any desire or subjective need a person may feel (radical hedonism);
- egotism, selfishness and greed (which the system needs to generate in order to function) lead to harmony and peace.

Fromm admits this kind of radical hedonism has been practised throughout history, most particularly by the richest populations. But he points out that ancient philosophers in China, India, the Near East and Europe did not subscribe to such a theory of well-being. All the great teachers and philosophers concerned with humankind's overall well-being drew a distinction between 'needs (desires)' which are only 'subjectively felt' and whose satisfaction leads to momentary pleasure, and 'objectively valid needs' which are rooted in human nature and whose satisfaction promotes human growth. The theory that certain universal motivations underlie human behaviour appears to allow us to distinguish between what is consumed in the consumer society and what contributes to human well-being.

DOCUMENT 3

Enlightened Self-interest

In 1973, I proposed a twin strategy to deal with the growing damage to our life support systems. These were 'do ecology' for developing countries and 'don't ecology' for industrialised countries.

The following examples illustrate this.

The tsunami of December 26th 2004 miraculously changed the outlook of people along coastal Tamil Nadu. Villages adjoining thick mangrove forests were saved from the fury of the tsunami, because of the speed-breaker role played by the mangroves. In the nearby villages where mangroves had been destroyed either for fuel wood or aquaculture ponds, several hundred fishermen died. Now local people refer to mangroves as 'life-savers'. What we could not achieve in 15 years by arguing that mangroves would serve as a bio-shield in the event of sea-level rise was achieved in a day. The same tsunami brought home to farmers near the shoreline the importance of conserving local varieties of rice. Several thousand hectares of rice fields along the coast got inundated with sea-water and several varieties perished. Conservation of local biodiversity got a shot in the arm and now every farmer wishes to maintain a gene bank (i.e. on-farm conservation) and a seed bank.

A second example relates to the revitalisation of the conservation traditions of tribal communities in the Eastern Ghats region. Fifty years ago the tribal communities in the Koraput region of Orissa were familiar with more than 1000 varieties of rice, but at the turn of the century this figure had come down drastically. It became clear that the only way tribal families would once again start conserving agro-biodiversity would be by creating an economic stake in the conservation. A dynamic programme of participatory conservation and breeding coupled with agronomic improvement soon led to a big spurt in the production of Kalajeera, an aromatic local variety, which is snapped up by the market almost as soon as it is harvested. The same has started happening in Kerela with medicinal rices like Navara, used in traditional ayurvedic practice, and with under-utilised millets in the Kolli Hills region of Tamil Nadu.

In short, 'do ecology' is triggered either by an ecological disaster or an economic opportunity. Preaching does not help. Enlightened self-interest, however, motivates people and leads to harmony with nature. Developing countries with pervasive poverty should spread a 'do ecology' methodology which can confer tangible ecological and economical benefits. The industrialised countries with high standards of living should engage in 'don't ecology' (i.e. regulate and restrict carbon emissions and unsustainable consumption of natural resources).

Mr S

DOCUMENT 4

Dilemmas for Sustainable Development

Ethical shoppers have a lot to worry about, from whether farm workers are receiving above-minimum wages, to concerns about their soaps threatening the habitat of the orang-utan, and whether their tofu is contributing to the cutting of another chunk of the Amazon forest. To reassure consumers that familiar household brands use materials that can be produced sustainably, retailers are joining sustainable business programmes for sourcing palm oil, soya beans, cotton, sugar cocoa and tea. These aim to supply food or fibres without harming the environment, and in the case of palm oil and soya beans means no clearing of virgin forests for plantations in Malaysia, Indonesia or Brazil.

Sustainable commodity programmes look for the most environment friendly methods of farming, such as reducing the use of fertilizers and pesticides, efficient use of water and implementing modern farm techniques that can boost crop yield, including genetically modified crops of cotton and soya beans. Says Mr Jason Clay, vice-president for agriculture at the Worldwide Fund for Nature: 'Our results show a two-year payback of our programmes if they are followed.' The programmes are broadly representative of producers and consumers, with salmon sustainable initiatives including 55% of farmed salmon suppliers and 25% of retailers. The cotton programme has 12% of the world's largest retailers of cotton, including Gap and IKEA, and the sugar pact has 10% of industrial users of sugar cane including Coca-Cola.

However the impact of bio-fuels on crops such as palm oil and soya beans, used for making bio-diesel, has complicated sustainable development. Mr Jan Kees, from Unilever, says: 'If we include the increase in palm oil demand from biofuels the palm market would double much sooner than 20 years, and we would struggle to meet that demand from our sustainable programmes.' There is now a move to talk to the European Union (EU) about its target for bio-fuels. 'It sets these targets for alternative fuels, which will lead to a sharp increase in palm oil production for bio-diesel, and that is not compatible with sustainable development, which the EU is also very keen to support.'

Kevin M

DOCUMENT 5

Problems: Forest Conversion

During the last two decades of the twentieth century, more than 300 million hectares of tropical forests – an area larger than the size of India – have been cleared for plantations (including palm oil and soya), agriculture, mining, or urban development. Over the next 25 years, a further 250-300 million hectares of tropical forests are likely to be lost in this way.

Among the most important factors behind forest conversion are: the fact that forests are not valued for the long-term benefits they provide, and that conversion often costs very little money. Of rising concern is the conversion of forests to palm oil and soya plantations. Because the palm oil industry generates valuable foreign exchange earnings and employment opportunities for tropical producer countries, it is the fastest expanding crop in the tropics. The growing demand for animal feed – and finally for meat – drives the production of soya bean. Soya oil is the world's most consumed vegetable oil, having a 25% market share. The driving forces behind its expansion in South America are exports to Europe and China.

The conversion of forests to other land uses carries with it severe environmental and social costs arising from forest clearing, and disregard for the rights and interests of local communities. Large-scale oil palm and soya plantations are primarily planted as monoculture plantations offering considerable economic benefits. They have a significant negative impact on biodiversity because forest clearance wipes out diverse natural vegetation and the wide variety of habitats for wildlife. As forests and their natural functions are removed from the landscape, problems such as soil erosion or pollution of fresh water from pesticides used in the growing of crops then arise.

Plantations of oil palm have caused huge destruction in parts of Asia – especially tropical lowland rainforests, biologically the richest of the world's terrestrial ecosystems, in Indonesia and Malaysia. The demand for soya is expected to increase by 60% in the next 20 years. This could lead to the loss of an additional 16 million hectares of savannah and 6 million hectares of tropical forests in South America. This will pose a major threat to some of the world's most important remaining forests and fresh water ecosystems, affecting the livelihoods of forest-dependent people and the survival of endangered species such as elephants, rhinos, tigers and great apes.

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