Unit Number

U3051246/KA3T

Key Skills
Application of Number
Level 3

Monday 13 June 2005

Total Marks: 50

No. of Questions: 6

Time: 1 hour 30 minutes

Materials required for examination

This test paper	A ruler marked in mm and cm
An answer booklet	2mm squared paper
A pen with black or blue ink	A scientific calculator
A pencil and eraser	**You may use a bilingual dictionary**

Instructions to Candidates

Do NOT open this test paper until you are told to do so by the supervisor.
In the boxes on the answer book, write your centre number, registration number, surname and initials. The paper reference is shown above.
Write in black or blue ink only.
At the end of the test, hand the test paper, the Answer Booklet(s) and all notes to the supervisor.

Information for Candidates

There are two parts to this test.
Part A (total 26 marks) consists of 5 short-answer questions.
Part B (total 24 marks) consists of 1 extended-answer question.
Try to answer ALL the questions.

Advice to Candidates

Make sure that your writing is clear, and show all your working.
Read each question carefully.
If you need extra paper, use a second answer booklet. Make sure you put your personal details on the front of this booklet too.

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Part A - Short Answer Questions

1 The cost of showing a cinema advertisement in a particular area of the United Kingdom is calculated in direct proportion to the length of the advertisement, in seconds, and the number of admissions to a cinema screen in that area.

Cost per 1000 admissions of a 30-second advertisement shown for one week in different areas of the United Kingdom

Area	Cost of a 30-second advertisement per 1000 admissions
London, South and Midlands	£65.77
All other areas	£45.59

Number of admissions per week to cinema screens in different areas of the United Kingdom, July to September 2004.

Area	Admissions
London	870525
South	295650
E.England	210240
Midlands	453330
Yorkshire	269370
N.East	121545
Lancashire	354780
Wales & West	210240
South West	68985
Border	29565
C.Scotland	229950
N.Scotland	65700
N.Ireland	105120

a What is the total cost of a 40 second advertisement shown for one week on screens in the Midlands area and in the Lancashire area?

2 marks

The total number of cinema admissions in the United Kingdom increased by 20.5% to 167.3 million between the year 1999 and the year 2003.

b What was the total number of cinema admissions in the United Kingdom in the year 1999?

2 marks

Total 4 marks

2 Solar panels are used to convert solar radiation to electrical energy.

A homeowner in Birmingham considers installing one solar panel with an area of 3.384 square metres. It will convert 45% of the available solar radiation into electrical energy. The average annual solar radiation available in Birmingham is 1 000 kWh per m^2 (kilowatt-hours per square metre).

a How many kilowatt-hours of solar energy can this solar panel convert into electrical energy in one year?

2 marks

The homeowner buys a larger solar panel that converts 1 950 kilowatt-hours of solar radiation each year into electrical energy to heat water. It will save the homeowner money on gas which costs 2.78 pence per kilowatt-hour to produce heat energy to heat water. The total cost of installing this solar panel is £2 110

b If his annual saving on gas remains constant, how many complete years will it take for the homeowner's total savings on gas to exceed the cost of the solar panel?

2 marks

Total 4 marks

Please go on to the next page

3 Average house prices in England and Wales have risen rapidly in recent years, although price increases varied region by region.

The table gives the prices of a sample of semi-detached houses sold in Bracknell in July 2004.

Prices of semi-detached houses in Bracknell sold in July 2004

Price (£)	Number of houses
0 -150000	10
151000 -175000	51
176000 - 200000	45
201000 - 225000	33
226000 - 250000	44
251000 - 300000	42

a Use the data in the table to calculate the mean price in this sample of semi-detached houses in Bracknell in July 2004.

3 marks

The average price of a house in Bracknell increased by 2% between June 2003 and June 2004. In the same period of time the average price of a house in England and Wales increased from £149 935 to £175 401.

b What was the percentage increase in the average price of a house in England and Wales between June 2003 and June 2004?

1 mark

c Make one comparative comment about the rise in the average price of a house in Bracknell and the rise in the average price of a house in England and Wales between June 2003 and June 2004.

1 mark

In July 2004, one daily newspaper predicted that the average price of a house in England and Wales would increase by 13.1% per year over the next decade.

d If this prediction is correct, how many complete years from June 2004 will it take for the average price of a house in England and Wales to exceed £350 000?

2 marks

Total 7 marks

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4 In December 2003, a Ferrari Formula 1 car and a Eurofighter jet aircraft raced over 1 200 metres. Both the car and the aircraft started from rest. The Ferrari Formula 1 car reached a maximum speed of 194 miles per hour.

1 mile is equivalent to 1 690 metres

a What was the maximum speed of the Ferrari Formula 1 car in metres per second?

1 mark

In their advertising literature, Ferrari specify the acceleration of their Formula 1 car to two significant figures. The acceleration of the Ferrari Formula 1 car can be found using the formula below.

$$\mathbf{v^2 = 2as}$$

where **v** is the maximum speed in metres per second
a is the acceleration in metres per second squared
s is the distance travelled in metres

b What value will Ferrari put in their literature for the acceleration of their Formula 1 car using the data from the race with the Eurofighter?

2 marks

c Use estimation to show how to check your answer to part b.

1 mark

The time taken for the Eurofighter or the Ferrari Formula 1 car to cover 1 200 metres can be found using the formula below.

$$\mathbf{v = at}$$

where **v** is the maximum speed in metres per second
a is the acceleration in metres per second squared
t is the time in seconds

The Eurofighter won the race. It was 1.5 seconds faster over 1 200 metres than the Ferrari Formula 1 car.

d How long did the Eurofighter take to travel the 1 200 metres?

2 marks

Total 6 marks

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5 The Grasberg mine in Indonesia is one of the largest copper mines in the world. The mining company extracts raw ore from the mine and processes it into copper.

Between April 2004 and June 2004 each tonne of ore extracted from the mine contained 8200 grams of copper and 88.2% of this copper was processed from the ore.

The mine produced an average of 2.52×10^6 pounds weight of copper per day.

1 pound weight is equivalent to 0.454 kilograms 1 tonne is equal to 1 000 kilograms

a How many tonnes of ore **per day** did the company process between April 2004 and June 2004?

3 marks

Reserves of copper ore at Grasberg are estimated at 2.51 billion tonnes. From 2005, the mining company expects to take 230 000 tonnes of ore per day from the mine and expects that the mine will be in production for 365 days per year.

1 billion is 1 000 million

A report states that the mine has enough reserves for at least a further 25 years.

b Is the statement in this report correct? Show calculations to support your answer.

2 marks
Total 5 marks

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Part B - Extended Answer Question

6 The Queen Anne Ferry Company operates a ferry across a river.

The operating times of the ferry are shown below.

During the summer season the ferry operates for a total of 131 days on Mondays to Saturdays and for a total of 22 days on a Sunday.

The engines that move the ferry are started 10 minutes before the first crossing every morning. They run throughout the working day and are switched off 10 minutes after the last crossing. The ferry engines need to be serviced after running for 200 hours and after running for every subsequent 200 hours. The service can be carried out whilst the ferry is running.

a What is the minimum number of times the ferry engines need to be serviced in the summer season?

2 marks

The ferry engines use diesel fuel at the rate of 94 gallons per week. The diesel tanks on the ferry hold a total of 13 500 litres when full.

1 litre is equivalent to 0.22 gallons

b For how many complete weeks can the ferry engines run on full tanks of diesel fuel without topping up?

2 marks

In the summer season 2004 the Ferry Company collected data on the numbers of different types of vehicle using the ferry.

Vehicle useage in summer season 2004

Type of vehicle	Number of vehicles
Car	86729
Motorbike	31285
Van	23761
Bicycle	4716
Coach	421

The ferry fares are shown in the table below.

Queen Anne Ferry fares, summer season 2004

Type of vehicle	Fare(£)
Car	3.50
Motorbike	1.00
Van	6.00
Bicycle	0.50
Coach	9.00

c Approximately what fraction of the total income from fares for the summer season 2004 came from cars?

2 marks

The ferry company offers membership and lower fares to frequent users. Membership costs £6.50 and a member's fare for one ferry crossing in a car is £3.15 (a saving of 35 pence on the normal fare).

d Form an algebraic equation and use it to calculate the minimum number of crossings a car driver needs to make for membership to be the most economical way of paying for ferry crossings.

2 marks

The table below shows the operating costs of the ferry and the income from fares for the eight years since the ferry started operating.

Year	Operating cost (£000's)	Income from fares (£000's)
1997	229.7	371.7
1998	238.3	362.5
1999	245.6	432.9
2000	248.9	428.6
2001	261.3	429.7
2002	250.1	486.5
2003	269.9	491.5
2004	279.2	520.0

e Plot a scatter graph to show the relationship between the operating cost of the ferry and the income from fares for the eight years since the ferry started to operate.

4 marks

f Explain what your graph tells you about the relationship between the operating cost and the income from fares since the ferry started to operate.

1 mark

On an average crossing during the year there are 7 cars and 2 motorbikes. To meet the cost of a new slipway that it intends to build, the company proposes to raise fares. It wants to obtain fares of £30.10 from an average crossing, but to keep the existing £2.50 difference between the fare for a car and the fare for a motorbike.

g Use this information to construct two equations about the proposed new fares.

1 mark

h Calculate the proposed new fares for a car and for a motorbike.

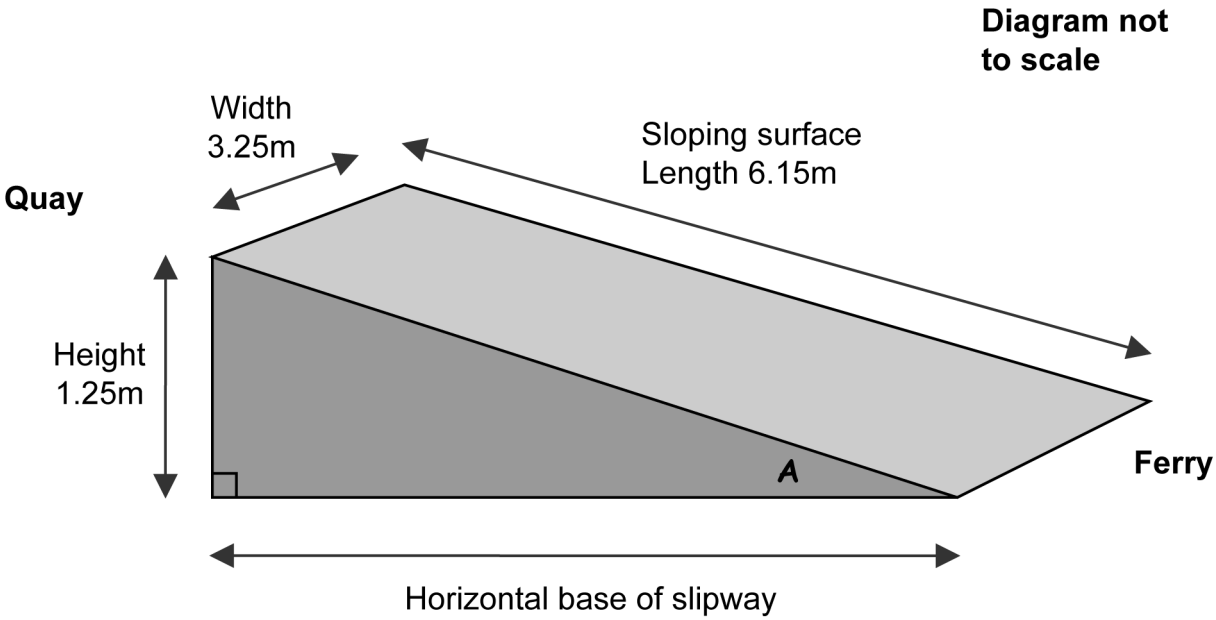
2 marks

i Show how to check your answers to part g.

1 mark

To get on and off the ferry, vehicles use a slipway. The company plans to build a new slipway. To meet building regulations the angle of slope for a slipway must be less than 12°.

Simplified diagram of new Queen Anne ferry slipway



j Will the new slipway meet building regulations for the angle of slope (A)? Show calculations to support your answer.

2 marks

The new slipway will be 3.25 metres wide and will be made of concrete. Concrete costs £106.90 per cubic metre and is sold in multiples of half a cubic metre.

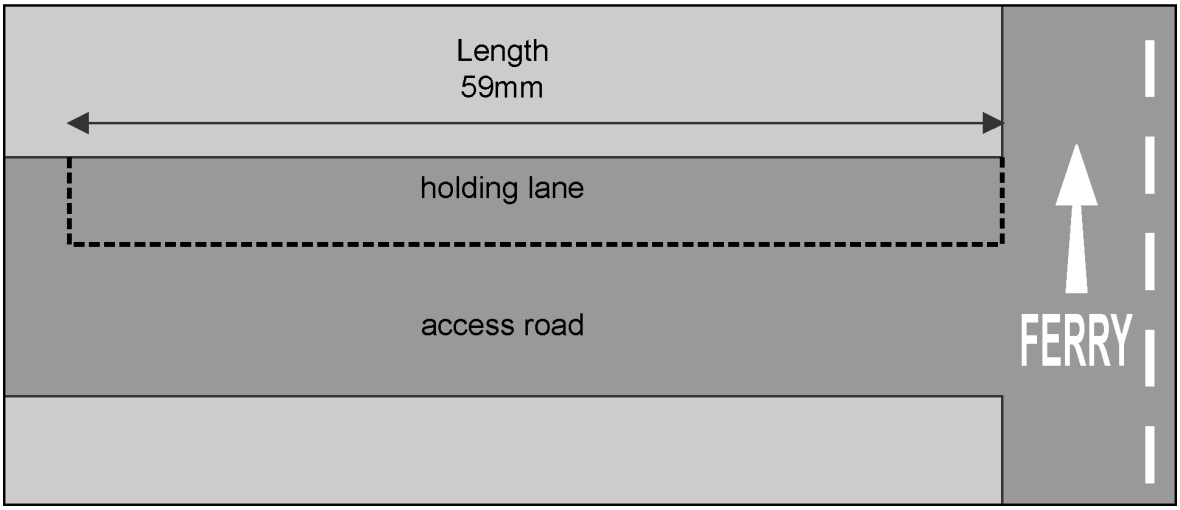
k What will be the cost of the concrete needed to make the new slipway? Give your answer to the nearest £10.

3 marks

The company plans to create a holding lane on the access road to the ferry where vehicles can queue for the next crossing. A scale plan of the holding lane is drawn to a scale of 1 : 1 250. On this plan, the length of the holding lane measures 59 millimetres.

Plan of proposed holding lane

Diagram not to scale



An allowance of 4.6 metres, to cover the length of an average vehicle and the space between the vehicles, is made for each vehicle using the holding lane. This is called the 'average length' of a vehicle.

l How many vehicles of average length will fit completely within the holding lane?

2 marks

Total 24 marks

End of test

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