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Further Mathematics

2010

Trial Examination 2

Core – Data analysis
Module 2 – Geometry and trigonometry
Module 3 – Graphs and relations
Module 4 – Business-related mathematics

Instructions:

Answer all questions in the core and the three modules.

You need not give numerical answers as decimals unless instructed to do so. Alternative forms may involve, for example, π, surds or fractions.

Core – Data analysis

Question 1

A school has only ten year 12 students labelled as A, B, C, ..., J. Their subject choices are shown below.

A   English, Further Maths, Accounting, Legal, Music
B   English, Chemistry, Math Methods, Specialist Maths, Physics
C   English, Further Maths, Math Methods, Chemistry, Physics
D   English, Literature, Math Methods, Chemistry, Chinese, Music
E   English, Further Maths, Math Methods, Physics, Accounting
F   English, Specialist Maths, Accounting, Physics, Indonesian
G   English, Math Methods, Biology, Chemistry, Chinese
H   English, Literature, Legal, Biology, Indonesian
I   English, Math Methods, Psychology, Biology, Chinese
J   English, Psychology, Further Maths, Legal, Chinese

a.   Complete the following table.

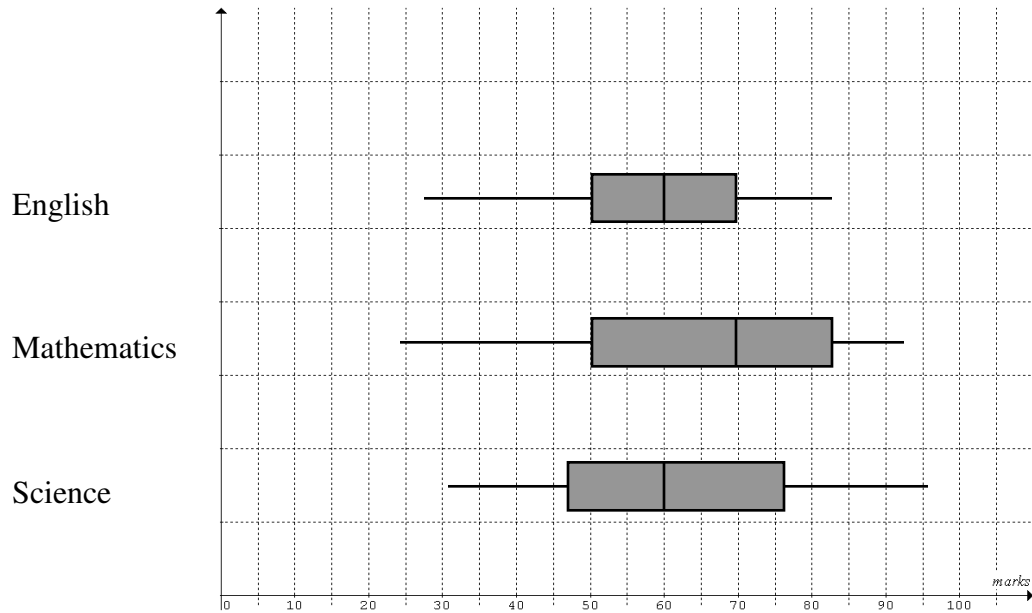| Subject	Number
English	10
Literature	2
Chinese	
Indonesian	2
Legal	3
Accounting	
Music	2
Psychology	2
Biology	
Chemistry	4
Physics	4
Further Maths	
Specialist Maths	2
Math Methods	6

1 mark

b.   Determine the percentage of year 12 students who have chosen Chemistry or Math Methods or both.

1 mark

c.   Explain whether or not the table above is a frequency distribution table.   1 mark

Question 2   The box plots for test marks in three subjects in a class of 24 students are shown below. A student requires 50 or more marks to pass a subject. None of the students scores 50 or 60 marks in each test.

a.   How many students pass the mathematics test?   1 mark

b.   What is the maximum number of students failing both English and Mathematics?   1 mark

c.   Which subject has the highest proportion of students scoring between 50 and 60 marks?   1 mark

d.   Which two subjects have approximately the same class average?   1 mark

Question 3   The number of workers in a factory for the past 10 years is shown below.

Year	1	2	3	4	5	6	7	8	9	10
Number of workers	600	675	710	805	950	900	850	955	955	970
3-year moving average		662		822	885		902	920	960	

a.   Complete the above table.   1 mark

b.   Comment on the trend shown by the 3-year moving average.   1 mark

c.   Assuming a linear relationship and year as the independent variable, determine the equation of the least squares regression line for the first two rows of data in the table above.

                                                                                                                                                      1 mark

d.   Use the regression line to estimate the number of workers required in the 11th year.   1 mark

Question 4   The *test results R* in *%* and the *number of hours t of web surfing* the day before a test were recorded for a group of 18 year 11 students. The data are displayed in the scatterplot below.

R (%)

100

90

80

70

60

50

40

30

20

10

0   1   2   3   4   5   6   7 t (hours)
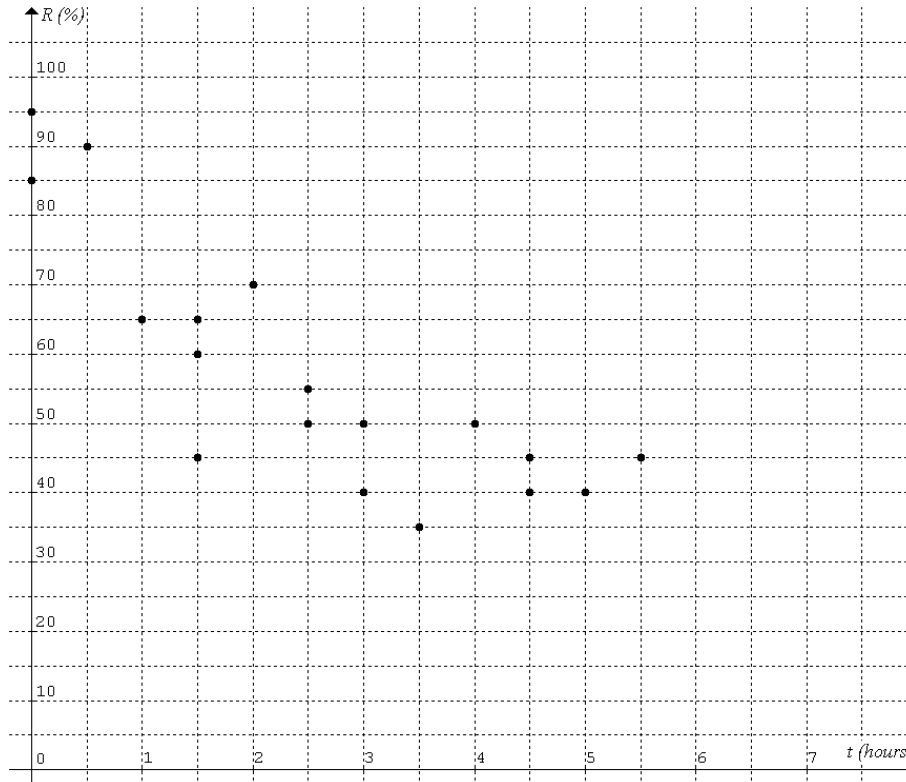
a.   Find the interquartile range of *R* for the group of students.   1 mark

b.   Apply the $\log_{10}$ transformation to the variable *R* to linearise the data and determine the equation of the least squares regression line for the linearised data. Write the coefficients correct to three decimal places.
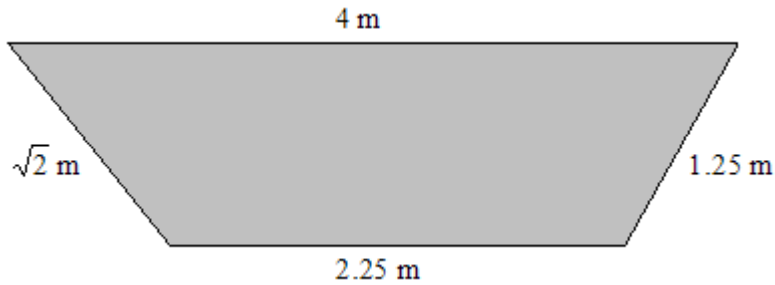
2 marks

c.   What approximate percent (nearest whole number) of the variation in $\log_{10} R$ can be explained by the variable *t*.

1 mark

Module 2: Geometry and trigonometry

Question 1 A 15-m long pool has a uniform cross-section in the shape of an **irregular** trapezium (see diagram below for measurements).

4 m

$\sqrt{2}$ m   1.25 m

2.25 m

a. Calculate the cross-sectional area (m^2, 3 decimal places) of the pool.

3 marks

b. Calculate the volume of water (m^3, 3 decimal places) required to fill the pool.

1 mark

c. Another 15-m long pool has a **similar** cross-section. The top of this pool is 6 m wide. Calculate the volume of water (m^3, 3 decimal places) required to fill this pool.

1 mark

**Question 2**   A house is built on a sloping block of land.
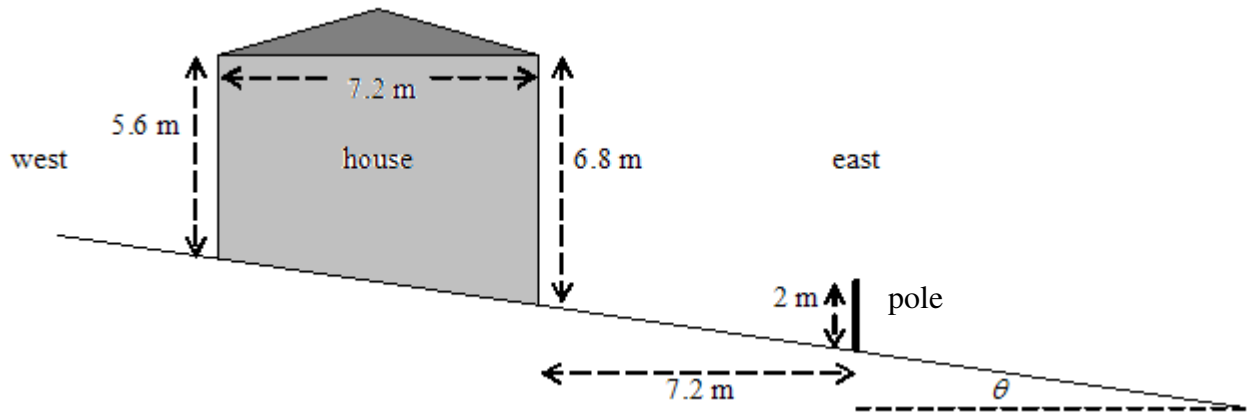
a.   Calculate the slope θ (in degrees to 2 decimal places) of the block of land.   2 marks

A 2-m pole is at a horizontal distance of 7.2 m from the house (see diagram above). At 5:00 pm the sun casts the **longest** shadow of the pole on the sloping ground.

b.   Calculate the horizontal distance (in metres to 2 decimal places) of the end of the shadow from the pole.
                                                                                                                    2 marks

c.   Calculate the length (in metres to 2 decimal places) of the shadow of the pole.
                                                                                                                    1 mark

Question 3   Three vertical poles of heights 1.5 m, 2.5 m and 3.5 m are erected on a horizontal playground at points A, B and C respectively to support triangular shade PQR.
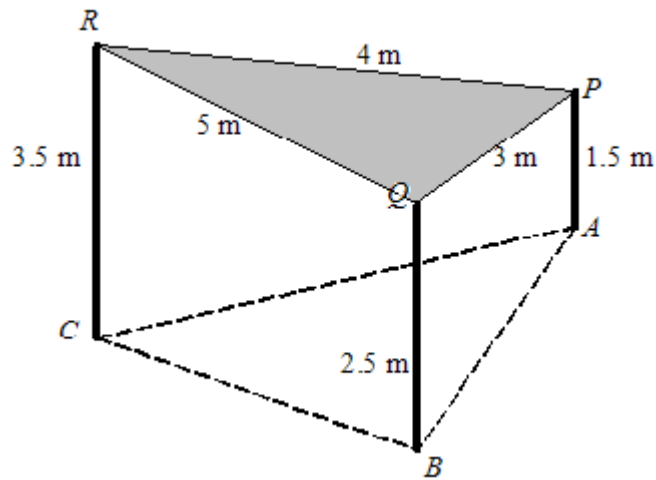

a.   Determine the angle of elevation (in degrees to 1 decimal place) of point R from point A.   2 marks

b.   Calculate $\angle BAC$ in degrees to 1 decimal place.   2 marks

c.   Explain which area is greater, area of $\triangle ABC$ or area of $\triangle PQR$.   1 mark

Module 3: Graphs and relations

Question 1   The cost in posting a *large* (162 × 229 mm) letter within Australia depends on the weight of the letter. The cost schedule is shown in the following graph. If the weight is over 500 g, the letter is considered as a parcel and a much higher rate is charged.
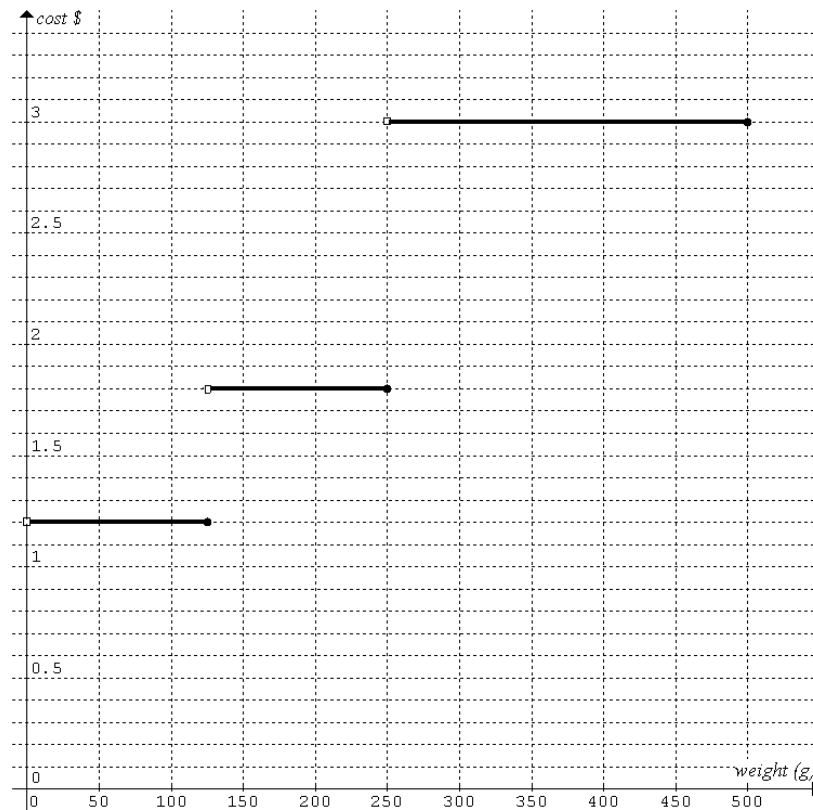
a.   What is the cost in sending a 235 g large letter within Australia?   1 mark

b.   600 g of documents are to be sent to the same address within Australia. Find the lowest cost in sending the documents as large letter/letters.

1 mark

c.   Write down the equations of the above step graph using *C* for cost in dollars and *w* for weight in grams.

2 marks

Question 2   Tides occur with a period of 12 hours and 25 minutes. The depth of water in a channel is given in the graph below for two periods. The first high tide occurs at 1:30 am ($t = 0$).
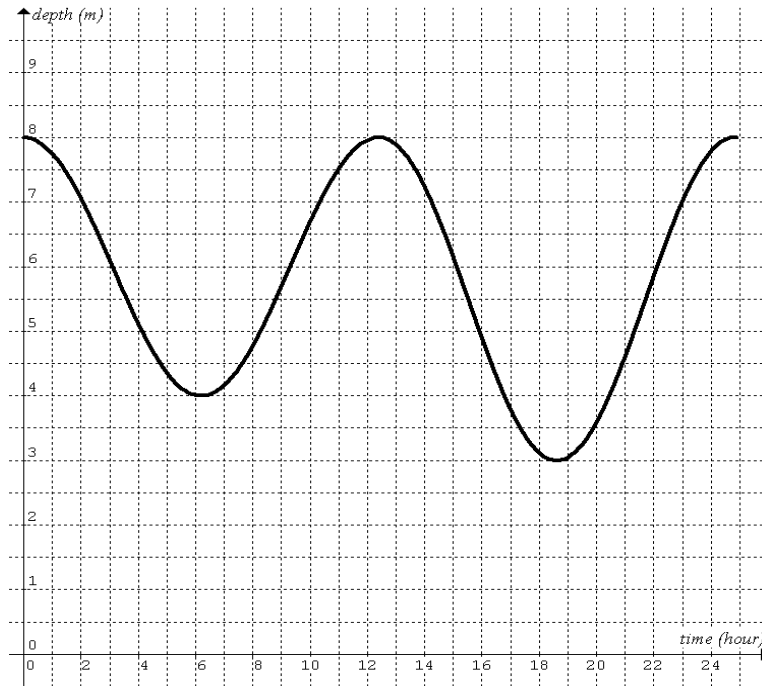

a.   At what time does the next high tide occur?   1 mark

b.   For how long (nearest hour) will the depth of water be between 3 m and 7 m over the two periods?

1 mark

c.   Calculate the fastest rate (metres per hour to 1 decimal place) that the depth of water decreases during the two periods.

2 marks

Question 3 A set of data is shown in the following table. I is the light intensity from a light source and d is the distance from the light source.

d	1.1	1.9	2.4	3.5	4.0
I	0.413	0.138	0.087	0.041	0.031

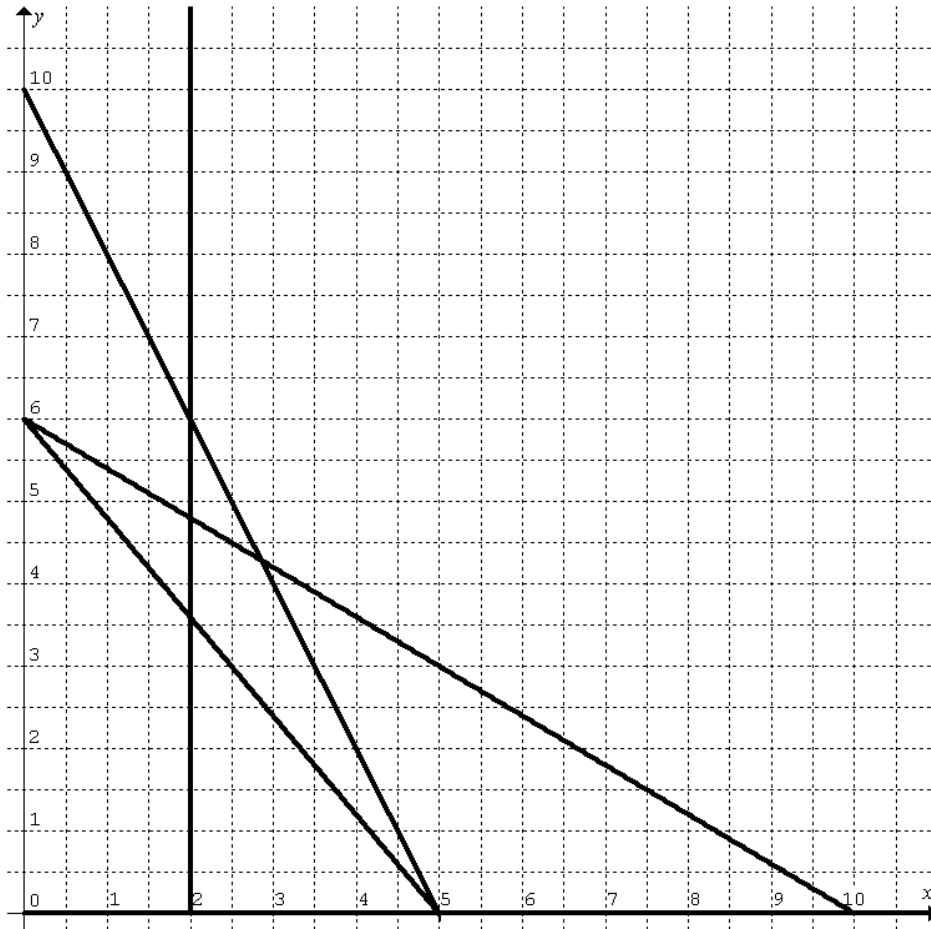a. Plot the graph of I against d^{-2}.
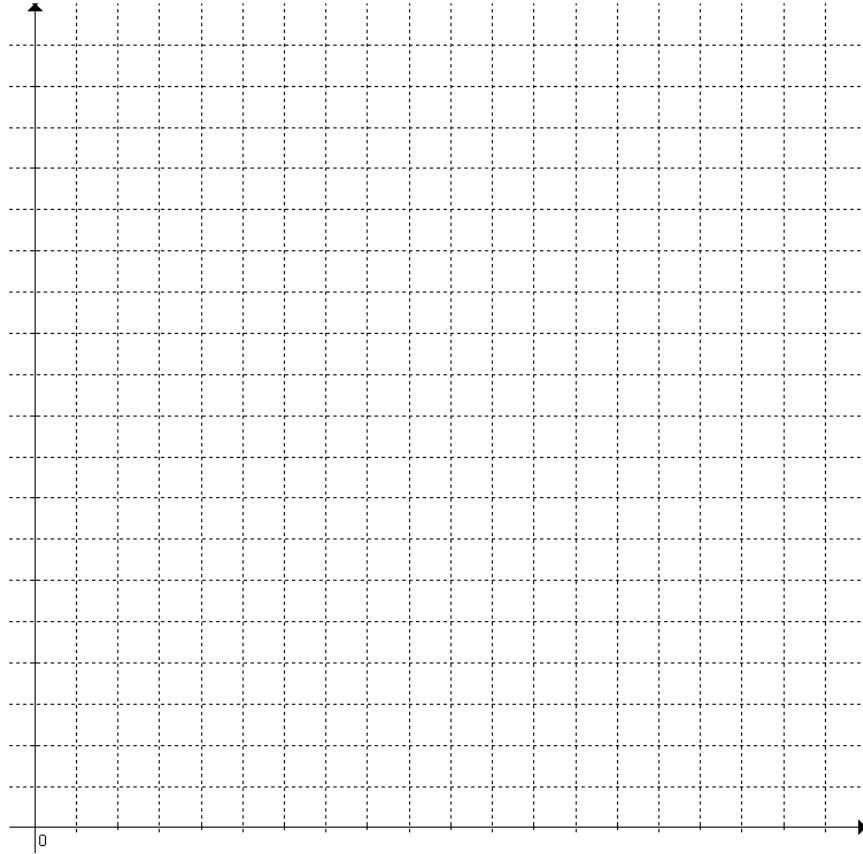
2 marks

b. Determine the equation showing the relationship between I and d. 2 marks

Question 4   There are two variables, x and y, in a linear programming problem. The constraints on x and y are:

$$x \geq 2, \ y \geq 0, \ 3x + 5y \leq 30, \ 6x + 5y \geq 30 \ \text{ and } \ 5x + 2y \geq 20$$

The *equalities* are sketched in the graph below.

a.   Shade in the feasible region.   2 marks

b.   The objective function of the problem is $F = 3x + 5y$. Find a pair of whole number values of x and y satisfying the constraints to maximise F.

1 mark

Module 4: Business-related mathematics

Question 1   An invoice from Norm Murphy AV/IT Store shows the following figures:

4 GB LEXAR JUMPDRIVE	
Retail price	$18.95
Discounted price	$13.00
Cash paid	$13.00

a.   Calculate the % discount (nearest %) of the 4 GB LEXAR JUMPDRIVE.   1 mark

b.   10% GST is included in the discounted price of $13.00. Calculate the amount of GST to the nearest cent.

2 marks

Question 2   A $1200 notebook computer is purchased under the following terms: 10% deposit and 24 monthly instalments of $63 to repay the balance.

a.   Calculate the flat rate of interest per annum.   1 mark

b.   Calculate the effective interest rate per annum.   1 mark

c.   Another $1200 notebook computer is purchased under the following terms: 10% deposit and 52 fortnightly instalments of $29 to repay the balance. Calculate the extra interest paid *effectively* after 2 years.

2 marks

Question 3

CPI, All groups index numbers and percentage changes

| | INDEX NUMBER(*) | PERCENTAGE CHANGE | |
	Jun Qtr 2010	Jun 2009 to Jun 2010	Mar Qtr 2010 to Jun Qtr 2010
Sydney	171.1	2.9	0.4
Melbourne	169.5	3.1	0.6
Brisbane	177.3	3.2	0.7
Adelaide	175.0	2.8	0.7
Perth	173.2	3.5	0.9
Hobart	170.7	3.0	0.4
Darwin	170.1	3.2	0.8
Canberra	172.3	2.3	0.3
Weighted average of eight capital cities	172.1	3.1	0.6

(*) Base of each index: 1989-90 = 100.0.

http://www.abs.gov.au/

a.   Which city has the highest inflation in the period 1989-90 to 2009-10?   1 mark

The weighted average CPI of the eight capital cities in the June quarter of **2010** was 172.1 (refer to the table above for the other figures).

b i.   What was the weighted average CPI of the eight capital cities in the June quarter of **2009**?   1 mark

b ii.   There are 80 quarters from June 1990 to June 2010. If the weighted average CPI of the eight capital cities increased *quarterly* at a constant rate from June 1990 to June 2010, calculate this constant rate (in % to 2 decimal places) given that the CPI in June 1990 is 100.0.

2 marks

Question 4   An investment provides an annuity of $12000 for 10 years at 7.5% p.a.

a.   Calculate the total value of the annuity received at the end of 10 years.   1 mark

b.   Calculate the value (nearest dollar) of the initial investment.   2 marks

c.   Calculate the minimum amount of initial investment needed to provide an annuity of $12000 *forever* at 7.5% p.a.

1 mark

End of Exam 2