Level 3 Certificate
MATHEMATICAL STUDIES

Paper 2C

Name: _____

Class: _____

Date: _____

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a clean copy of the Preliminary material
- a scientific calculator or a graphics calculator
- a copy of the formulae sheet
- a ruler.

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in your name, class and the date at the top of this page.
- Answer all the questions.
- Do all rough work on this paper. Cross through any work that you do not want to be marked.
- In all calculations, show clearly how you work out your answer.
- The final answer to questions should be given to an appropriate degree of accuracy.
- You may not refer to the copy of the Preliminary material that was available prior to this examination. A clean copy is enclosed for your use.

Information

- The maximum mark for this paper is 60.
- The marks for each question are shown in brackets [ ].
- Use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Question	Mark
1	
2	
3	
4	
5	
6	
7	
Total	

Paper 2C

1 The results of a survey of salaries is illustrated by the graph shown below.

Salaries (£000s)
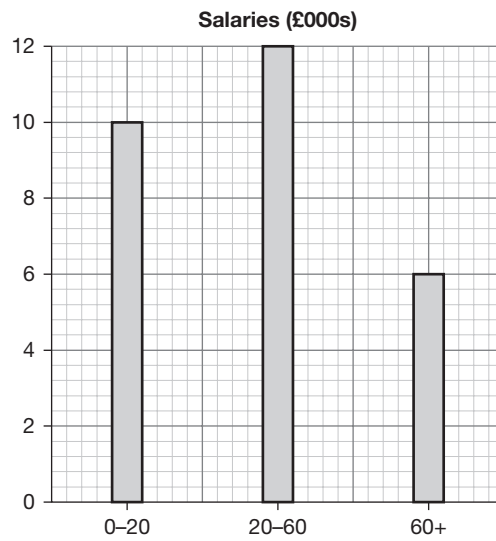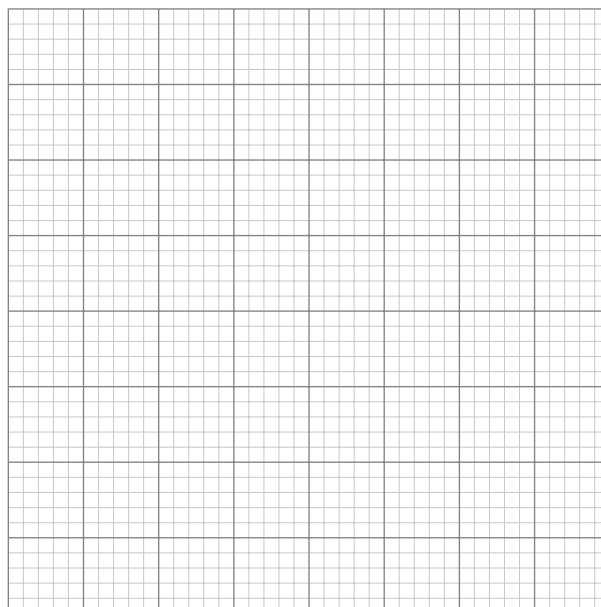

a) Criticise this graph.

[2 marks]

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b) Making any necessary assumptions, which should be stated, draw a more suitable diagram to represent these data.

[4 marks]

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2 Andy has borrowed £1000 which he must repay in two equal instalments, £600 at the end of the first year and a final payment of another £600 at the end of the second year. Andy makes the statement:

I will have to pay £200 interest over the two years of the loan. This is £100 per year and means that I am paying 10% interest per year.

a) Which part of Andy's statement is correct?

[1 mark]

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b) Andy is not a mathematician. Using simple calculations, explain to him why the interest rate that he is paying is more than 10%.

[3 marks]

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3 Use **Make schools pay!** in the Preliminary Material.

a) The report *Crossing the Line* was discussed on a radio programme on 25th August 2015. Referring to the data used in the report, it was stated that

Further Education colleges take five times more English students and six times more maths students who don't make the grade than schools.

Comment fully on the numbers used in this statement.

[4 marks]

b) Explain briefly why '*fining schools **could** be self-defeating*'.

[2 marks]

c) Explain the observation that

The work that is done in secondary schools in the five years leading up to GCSEs may greatly affect the result of an individual student or the result of all the students in that school but does not affect the overall GCSE results of the nation's students.

[4 marks]

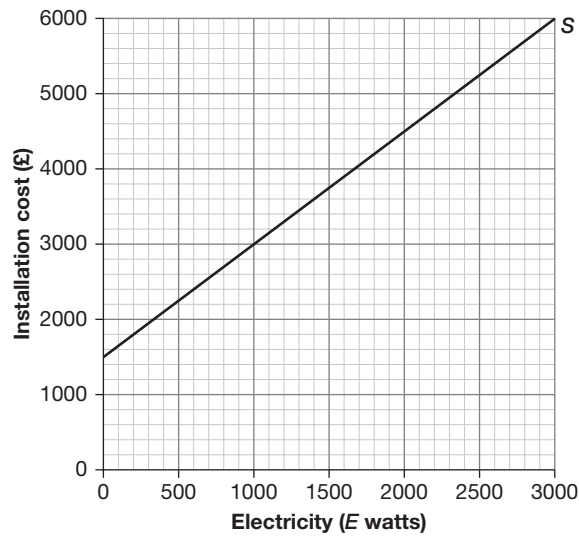**4** The graph below shows how the installation cost, £S, of a solar panel system depends upon its capacity for generating electricity, E watts.

a) Explain why you would not expect a graph of installation cost against electricity to go through the origin.

[2 marks]

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b) The cost (£S) and capacity (E watts) are related by an equation of the form

$$S = mE + c.$$

Find the values of the constants m and c.

[3 marks]

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c) The installation cost, £T, of a wind turbine system of capacity E watts is given by the formula

$$T = 0.75E + 2000.$$

Draw the graph of $T = 0.75E + 2000$ on the same axes as the graph of S against E.
Hence comment on which system is cheaper to install and justify your answer.

[5 marks]

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5 Following a period of rapid growth, the populations of European countries are now roughly stable.

This same pattern appears to be being followed in most other countries in the world. United Nations (UN) predictions are that these countries may experience strong population growth until 2050 but that, thereafter, growth will slow significantly and will be stable or even falling by 2100.

African countries are an exception. On this continent, the UN is forecasting rapid population growth throughout the 21st century.

The table compares the populations of India and Africa, in millions, in 1950 and 2000.

	India	Africa
1950	360	230
2000	1020	811

a) Assuming a linear model for the population of India, estimate its population by 2050.

[4 marks]

b) Assume an exponential model for the population of Africa. By solving the equation

$$811 = 230e^{50x}$$

estimate Africa's population by 2050.

[5 marks]

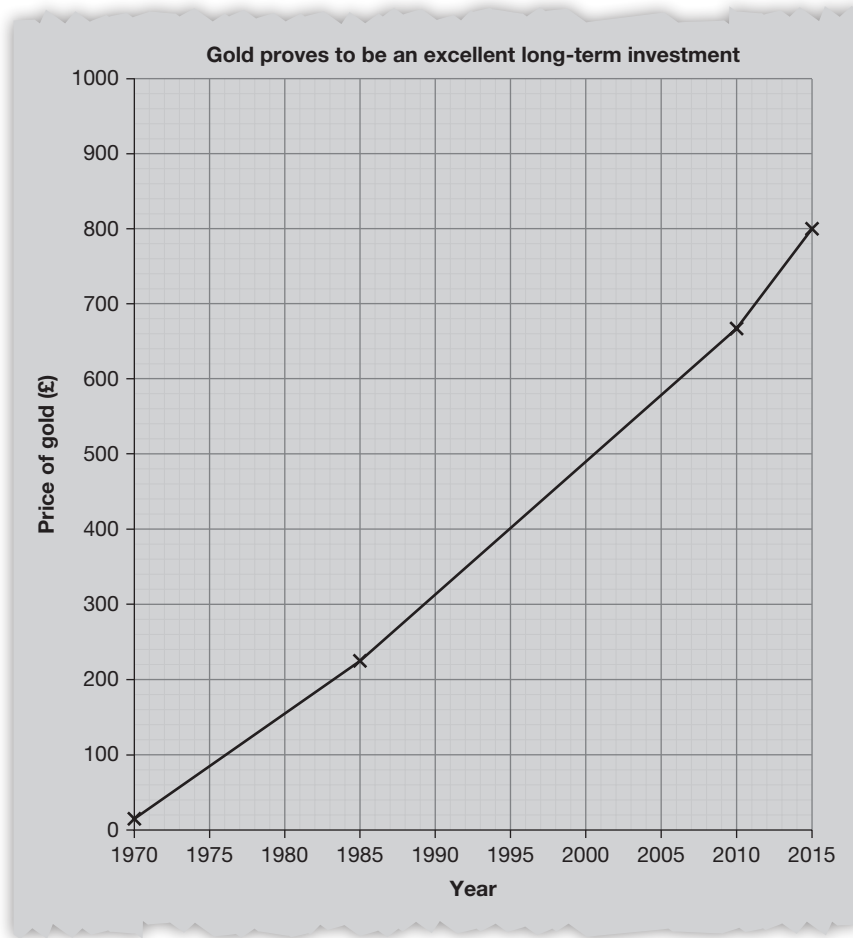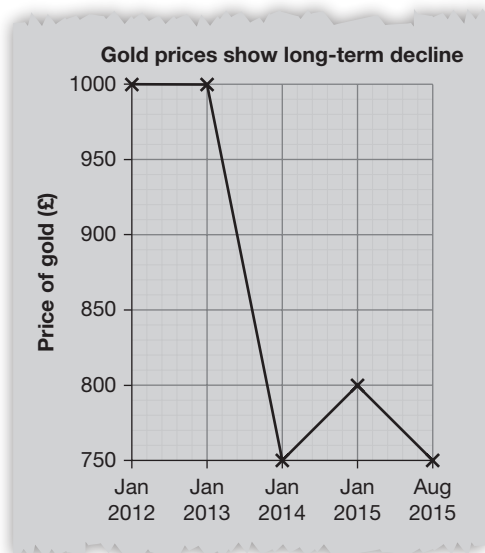**6** Three newspaper cuttings which illustrate different aspects of the changing price of an ounce of gold are shown below.

A

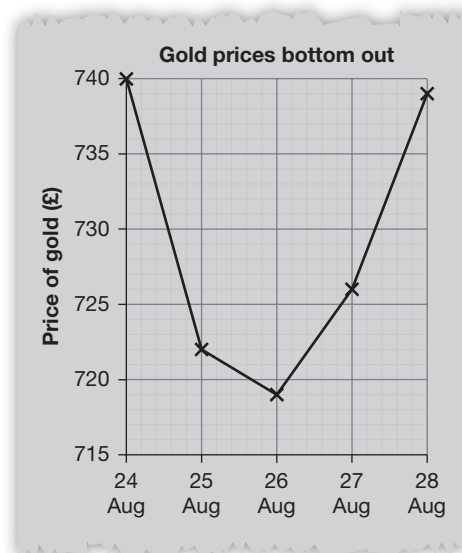Gold proves to be an excellent long-term investment

B

Gold prices show long-term decline

C

Gold prices bottom out

a) State one way in which Graph A could be said to be misleading about changes in the price of gold.

[1 mark]

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b) Make two criticisms of Graph B.

[2 marks]

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c) **i** For the data shown in Graph C, explain why a quadratic graph could be expected to give a good model of the prices over these few days.

[1 mark]

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ii For these few days, find constants a and b such that the price per ounce, £P, of gold is approximately modelled by

$$P = a + bt^2,$$

where t is the number of days after (and before) 26th August. Compare the values given by your model with the data shown in Graph C.

[4 marks]

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7 Usain Bolt's times for each 20 m in a 100 m race were as follows.

Distance (m)	0–20	20–40	40–60	60–80	80–100
Time (seconds)	2.93	1.76	1.66	1.61	1.67

a) Describe how Bolt's speed changes during the race and support your statements with numerical calculations. What was Bolt's maximum speed?

[4 marks]

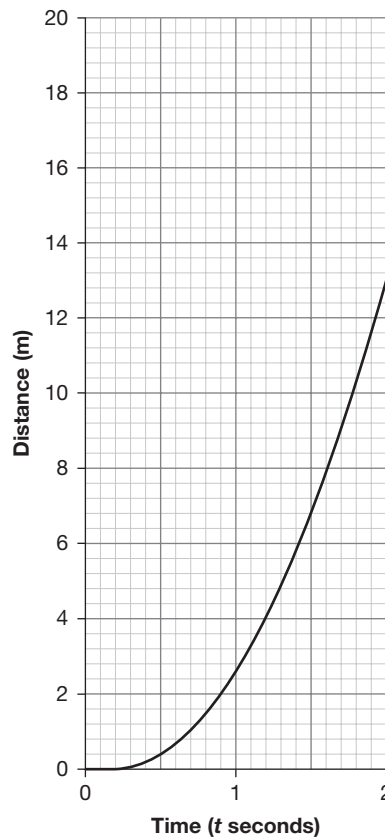A distance–time graph modelling the first two seconds of the race is as follows.

b) What was Bolt's speed at each of the following times?

i $t = 0.1$

[1 mark]

ii $t = 1$

[3 marks]

c) Showing details of your calculation, find Bolt's acceleration at time $t = 1$.
You may wish to use the grid.

[5 marks]