

MATHEMATICAL STUDIES
STANDARD LEVEL
PAPER 2

Tuesday 6 November 2007 (morning)

1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

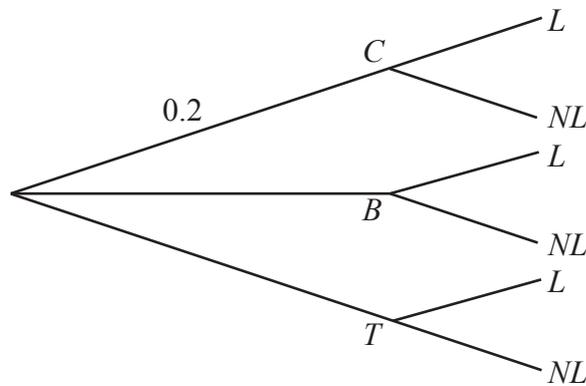
- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- Unless otherwise stated in the question, all numerical answers must be given exactly or correct to three significant figures.

Please start each question on a new page. You are advised to show all working, where possible. Where an answer is wrong, some marks may be given for correct method, provided this is shown by written working. Solutions found from a graphic display calculator should be supported by suitable working, e.g. if graphs are used to find a solution, you should sketch these as part of your answer.

1. [Maximum mark: 20]

(i) When Geraldine travels to work she can travel either by car (C), bus (B) or train (T). She travels by car on one day in five. She uses the bus 50% of the time. The probabilities of her being late (L) when travelling by car, bus or train are 0.05, 0.12 and 0.08 respectively.

(a) Copy the tree diagram below and fill in all the probabilities, where NL represents not late, to represent this information. [5 marks]



(b) Find the probability that Geraldine travels by bus and is late. [1 mark]

(c) Find the probability that Geraldine is late. [3 marks]

(d) Find the probability that Geraldine travelled by train, given that she is late. [3 marks]

(ii) It is **not** necessary to use graph paper for this question.

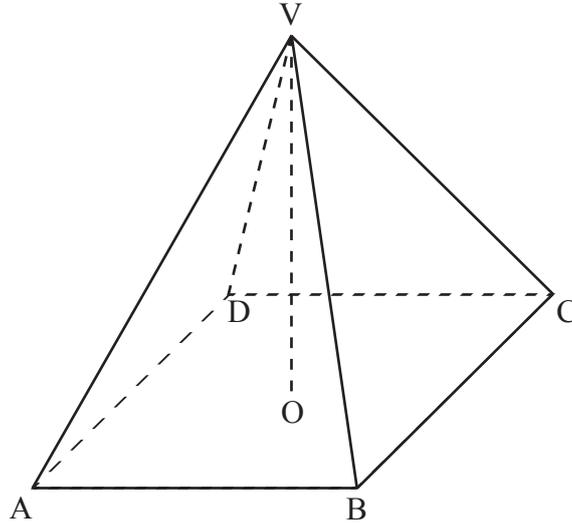
(a) Sketch the curve of the function $f(x) = x^3 - 2x^2 + x - 3$ for values of x from -2 to 4 , giving the intercepts with both axes. [3 marks]

(b) On the same diagram, sketch the line $y = 7 - 2x$ and find the coordinates of the point of intersection of the line with the curve. [3 marks]

(c) Find the value of the gradient of the curve where $x = 1.7$. [2 marks]

2. [Maximum mark: 15]

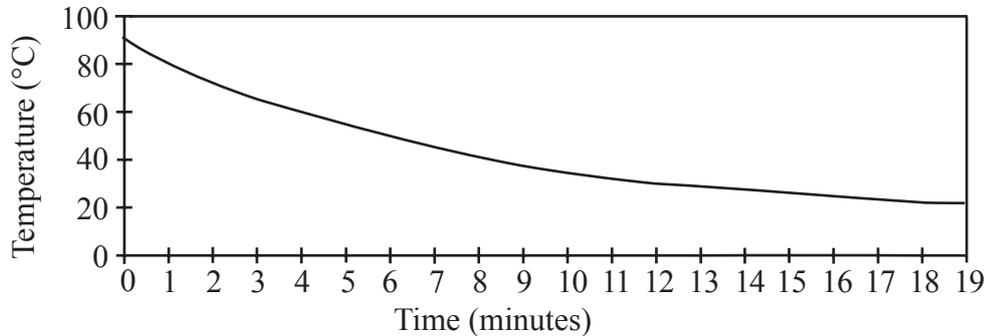
ABCDV is a solid glass pyramid. The base of the pyramid is a square of side 3.2 cm. The vertical height is 2.8 cm. The vertex V is directly above the centre O of the base.



- (a) Calculate the volume of the pyramid. [2 marks]
- (b) The glass weighs 9.3 grams per cm^3 . Calculate the weight of the pyramid. [2 marks]
- (c) Show that the length of the sloping edge VC of the pyramid is 3.6 cm. [4 marks]
- (d) Calculate the angle at the vertex, \widehat{BVC} . [3 marks]
- (e) Calculate the total surface area of the pyramid. [4 marks]

3. [Maximum mark: 17]

- (i) The following graph shows the temperature in degrees Celsius of Robert’s cup of coffee, t minutes after pouring it out. The equation of the cooling graph is $f(t) = 16 + 74 \times 2.8^{-0.2t}$ where $f(t)$ is the temperature and t is the time in minutes after pouring the coffee out.



- (a) Find the initial temperature of the coffee. [1 mark]
- (b) Write down the equation of the horizontal asymptote. [1 mark]
- (c) Find the room temperature. [1 mark]
- (d) Find the temperature of the coffee after 10 minutes. [1 mark]

If the coffee is not hot enough it is reheated in a microwave oven. The liquid increases in temperature according to the formula

$$T = A \times 2^{1.5t}$$

where T is the final temperature of the liquid, A is the initial temperature of coffee in the microwave and t is the time in minutes after switching the microwave on.

- (e) Find the temperature of Robert’s coffee after being heated in the microwave for 30 **seconds** after it has reached the temperature in part (d). [3 marks]
- (f) Calculate the length of time it would take a similar cup of coffee, initially at 20°C, to be heated in the microwave to reach 100°C. [4 marks]

(This question continues on the following page)

(Question 3 continued)

- (ii) Robert, who lives in the UK, travels to Belgium. The exchange rate is 1.37 euros to one British Pound (GBP) with a commission of 3 GBP, which is subtracted before the exchange takes place. Robert gives the bank 120 GBP.

(a) Calculate **correct to 2 decimal places** the amount of euros he receives. *[3 marks]*

He buys 1 kilogram of Belgian chocolates at 1.35 euros per 100 g.

(b) Calculate the cost of his chocolates in GBP **correct to 2 decimal places**. *[3 marks]*

4. [Maximum mark: 20]

- (i) A random sample of 167 people who own mobile phones was used to collect data on the amount of time they spent per day using their phones. The results are displayed in the table below.

Time spent per day (t minutes)	$0 \leq t < 15$	$15 \leq t < 30$	$30 \leq t < 45$	$45 \leq t < 60$	$60 \leq t < 75$	$75 \leq t < 90$
Number of people	21	32	35	41	27	11

- (a) State the modal group. [1 mark]
- (b) Use your graphic display calculator to calculate approximate values of the mean and standard deviation of the time spent per day on these mobile phones. [3 marks]
- (c) On graph paper, draw a fully labelled histogram to represent the data. [4 marks]
- (ii) Manuel conducts a survey on a random sample of 751 people to see which television programme type they watch most from the following: Drama, Comedy, Film, News. The results are as follows.

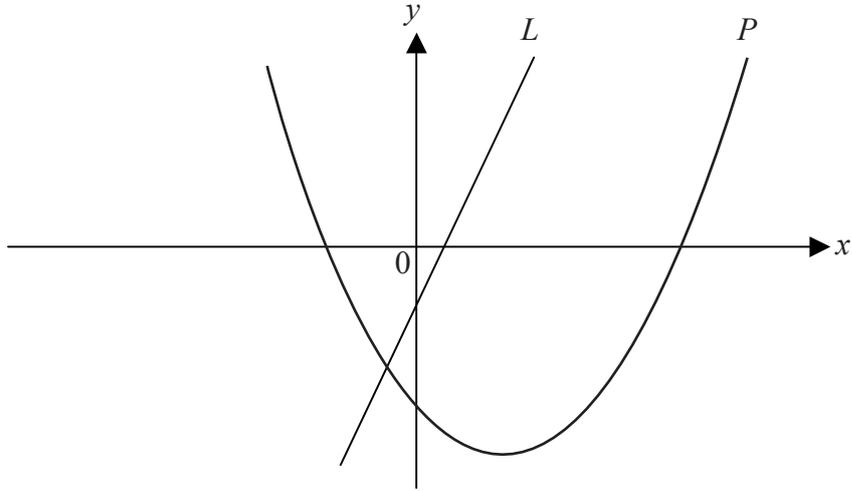
	Drama	Comedy	Film	News
Males under 25	22	65	90	35
Males 25 and over	36	54	67	17
Females under 25	22	59	82	15
Females 25 and over	64	39	38	46

Manuel decides to ignore the ages and to test at the 5 % level of significance whether the most watched programme type is independent of **gender**.

- (a) Draw a table with 2 rows and 4 columns of data so that Manuel can perform a chi-squared test. [3 marks]
- (b) State Manuel’s null hypothesis and alternative hypothesis. [1 mark]
- (c) Find the expected frequency for the number of females who had ‘Comedy’ as their most-watched programme type. Give your answer to the nearest whole number. [2 marks]
- (d) Using your graphic display calculator, or otherwise, find the chi-squared statistic for Manuel’s data. [3 marks]
- (e) (i) State the number of degrees of freedom available for this calculation.
- (ii) State the critical value for Manuel’s test.
- (iii) State his conclusion. [3 marks]

5. [Maximum mark: 18]

The diagram below shows the graph of a line L passing through $(1, 1)$ and $(2, 3)$ and the graph P of the function $f(x) = x^2 - 3x - 4$



- (a) Find the gradient of the line L . [2 marks]
- (b) Differentiate $f(x)$. [2 marks]
- (c) Find the coordinates of the point where the tangent to P is parallel to the line L . [3 marks]
- (d) Find the coordinates of the point where the tangent to P is perpendicular to the line L . [4 marks]
- (e) Find
 - (i) the gradient of the tangent to P at the point with coordinates $(2, -6)$.
 - (ii) the equation of the tangent to P at this point. [3 marks]
- (f) State the equation of the axis of symmetry of P . [1 mark]
- (g) Find the coordinates of the vertex of P and state the gradient of the curve at this point. [3 marks]