[core:maths] support programme

Education Development Trust

Core Maths 2016 examinations - CML perspectives:

AQA – Iram Hussain (Paper 1),
Nicola Smith (2A),
Nicola Letts (2B),
Tom Carpenter (2C)

OCR – Penri Thomas (QPS)

Pearson/ Edexcel – Tom Rainbow

AQA: Mathematical Studies – Paper 1

Iram Hussain

AQA

	Mathematical Studies
Paper 1	Mathematical Studies
Paper 2A	Statistical Techniques
Paper 2B	Critical Path and Risk Analysis
Paper 2C	Graphical Techniques

Question 6

Use **Income Tax and National Insurance 2015–2016** on pages 2 and 3 of the Preliminary Material.

Beth has an annual salary of £39 500 in her current job.
Her monthly net pay is £2495.64

She wants to apply for a new job, which has an annual salary of £43 500
She will have to pay an extra £150 per month in travel costs to get to the new job.

Beth's personal tax allowance is £10 600

She says,

"The increase in my net pay will be more than the increase in travel costs."

Is Beth correct?
You **must** show your working.

[9 marks]

Pre release material

Income Tax and National Insurance 2015–2016

Income tax 2015–2016

Everyone in the UK has a personal allowance. This is their annual amount of tax-free income. The standard personal allowance for 2015–2016 was £10 600

The rates of income tax you pay depend on how much **taxable income** you have above your personal allowance.

Income tax rates and taxable bands 2015–2016

Rate	Taxable Income
Basic: 20%	£0–£31 785
Higher: 40%	£31 786–£150 000
Additional: 45%	Over £150 000

To calculate your income tax if your annual income is £100 000 or less

Find your taxable income by subtracting your personal tax allowance from your annual gross income.

You pay income tax at 20% on the first £31 785 of your taxable income.

You pay income tax at 40% on your taxable income over £31 785

National Insurance (NI) 2015–2016

Percentage NI Due	Minimum Weekly Income	Maximum Weekly Income	Minimum Monthly Income	Maximum Monthly Income	Minimum Yearly Income	Maximum Yearly Income
Nil		below £112		below £486		below £5832
0%	£112	£155	£486	£672	£5832	£8064
12%	£155.01	£815	£672.01	£3532	£8064.01	£42 385
2%	above £815		above £3532		above £42 385	

Examples

A person who had a weekly income of £350 a week paid 12% on the amount above £155

A person who had a weekly income of £950 paid 12% on the amount between £155.01 and £815 plus 2% of the amount above £815

Gross pay

Your gross pay is your wage or salary before any deductions are made.

Net pay

Your net pay (or take-home pay) is the amount of money you receive after income tax, National Insurance and other deductions have been taken off your gross pay.

Question 3

A Healthy Living campaign encourages everyone to eat more fruit and vegetables.

Estimate the amount of fruit and vegetables an average person eats in a year.
State any assumptions you make.
You **must** show working to justify your answer.

[4 marks]

AQA: Mathematical Studies
Paper 2A – Statistical Techniques

Nicola Smith

Student Perceptions

- After enjoying Paper 1, most found this paper more challenging
- Some of the students enjoyed being able to work on extended questions which allowed them to express their ideas

Teachers' Perceptions

- Much harder than Paper 1
- More like the level of paper they were expecting from Core Maths (although they would have preferred another Paper 1)

[c:m]

Interesting Questions

Charles travels to work by bus.

The time he leaves home depends on which of two buses, A and B, he decides to travel on.

Bus A

Time he leaves home	8.30 am
The mean time he takes to get to work	26 minutes
The standard deviation of the time to get to work	4 minutes

Bus B

He leaves home at 8.35 am

Here are the times, in minutes, he takes to get to work on 10 randomly selected days using bus B.

23	22	26	20	20
23	27	20	23	26

(a) Compare the times he arrives at work using bus A and bus B.

[6 marks]

(b) Charles aims to get to work between 8.55 am and 9.00 am

Which bus should he travel on to have a better chance of doing this?

You **must** show your working, using a suitable probability distribution.

State **one** assumption you make.

[9 marks]

Ten students are selected to take a Maths test, an English test and a Science test.

Kenny is absent for the Science test.

Here are the test scores.

	Maths	English	Science
Cathy	14	50	28
Seema	30	42	26
Olena	39	68	30
Joanne	45	45	37
Kenny	95	65	*absent*
Beth	50	35	45
Shazia	57	85	39
John	67	50	58
Harry	79	44	59
Abdul	63	72	74

A teacher wants to estimate Kenny's score in the Science test.

Using statistical analysis and reasoning, advise the teacher whether she should use scores from the Maths test or the English test to help her.

You must comment on the validity of the score the teacher will award Kenny in the Science test if she follows your advice.

You do not need to estimate Kenny's score in the Science test.

[5 marks]

[c:m]

Overall

- After the initial knee-jerk reaction to the paper, most people seem quite happy with the content
- The most common reaction has been that teachers will adapt their teaching next year for the second paper as this was perhaps not done in as much detail as Paper 1, which turned out in all three cases to be more straightforward.

AQA: Mathematical Studies Paper 2B – Critical Path and Risk Analysis

Nicola Letts

3 After a passenger plane lands at an airport there is a limited amount of time to get the plane ready for its next flight.

The table shows the activities after a plane lands at an airport.

It also shows

- the length of time taken for each activity
- the earliest start time for each activity
- the latest finish time for each activity.

Task	Activity	Length of time taken (minutes)	Earliest start time	Latest finish time
A	Plane taxis from runway after landing	12	0	12
B	Arriving passengers disembark	20	12	32
C	Arriving luggage is taken from hold	30	12	48
D	Plane is refuelled	18	12	42
E	Rubbish is collected and trays wiped	10	32	42
F	Departing luggage transported to hold	40	42	82
G	Drinks and snacks trolley re-stocked	7	42	49
H	Technical safety checks performed	30	42	92
I	Departing passengers embark	35	49	84
J	Luggage hold checked and sealed	4	82	92
K	Passenger safety checks	8	84	92
L	Plane taxis to runway for take off	12	92	104

3 (a) Draw a Gantt chart for the process.

[4 marks]

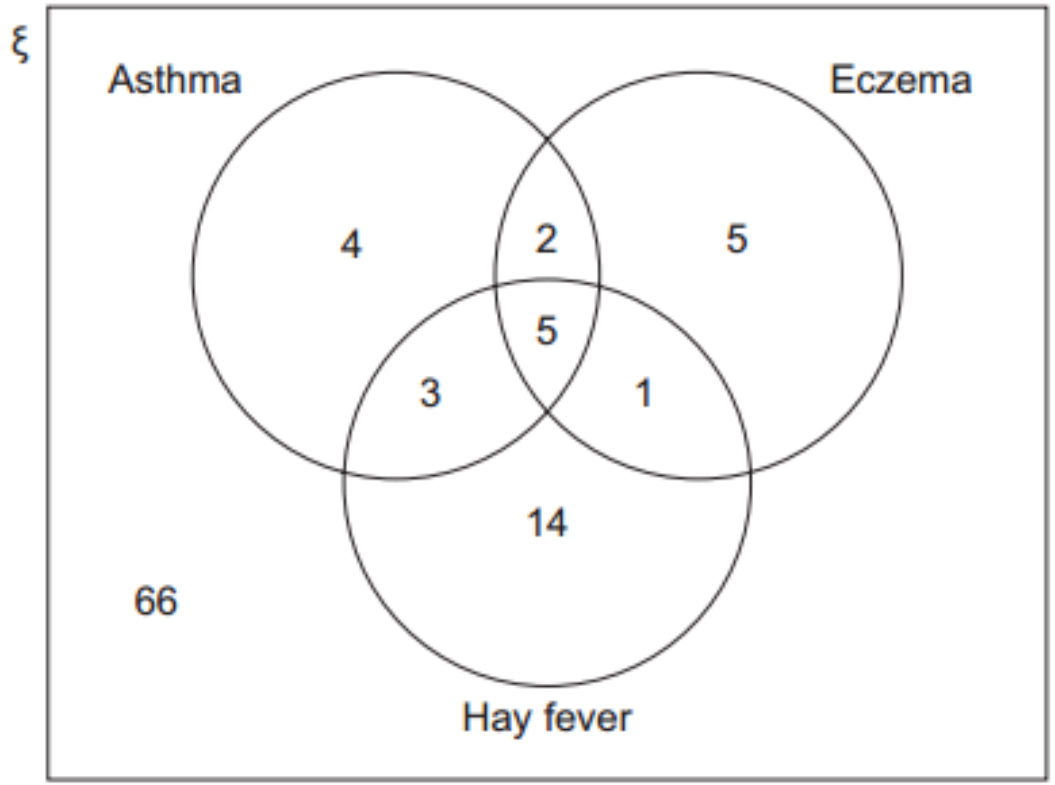
3 (b) Which task has the largest float time?
Circle your answer.

[1 mark]

C D H J

4 A person may suffer from one or more of the linked medical conditions asthma, eczema and hay fever.

The Venn diagram shows the percentages of people in the UK who suffer from these conditions.



4 (a) Calculate the probability that a person who suffers from eczema also suffers from hay fever.

[2 marks]

A new brand of indigestion medication is made.

This indigestion medication cannot be taken with hay fever medication.

4 (b) Use the Venn diagram to calculate the probability that a person in the UK, chosen at random, can take the indigestion medication.

[2 marks]

Answer _____

4 (c) Give a reason why the actual probability might be higher than the probability calculated in part **(b)**.

[1 mark]

5 Customers can try to buy items from a shopping channel by internet or by telephone.

The probability that a customer tries to order by internet is 0.69

If a customer tries to order by internet the probability that the item is in stock is 0.85

If a customer tries to order by telephone the probability that the item is in stock is 0.95

5 (a) Calculate the probability that a customer, chosen at random, tried to order by telephone **and** found that the item was in stock.

[2 marks]

5 (b) 200 people try to order an item that costs £40 from the shopping channel.

Work out the expected value of sales for that item.

[5 marks]

6 Lila is going to sell food from a stall on 23 July.

She can sell food at either an agricultural show or a computer fair.

The table shows, for each event, the fee that Lila has to pay and her expected takings, based on sales in previous years.

In the last 10 years it has rained on 93 out of 310 days in July.

Event	Fee	Expected takings
Computer fair	£200	£450
Agricultural show	£800	£600 if it rains
		£1500 if it does not rain

6 (a) At which event should Lila expect to make the greater profit?
You **must** show working to justify your answer.

[6 marks]

6 (b) If Lila decides to sell food at the agricultural show she can buy rain insurance.

The insurance costs £100

If Lila buys the insurance and it rains on 23 July she will receive a payment of £300

Give a reason why Lila should **not** buy the insurance.
You **must** show working to justify your answer.

[3 marks]

7 Dan and his friends are planning a one-day music festival.

They have divided the work into a number of activities.

The table below shows

- the activities
- the immediate predecessors of each activity
- the number of days needed to complete each activity.

Task	Activity	Immediate predecessors	Number of days
A	Choose and book the venue	–	3
B	Apply for a licence	A	21
C	Book musicians	B	20
D	Make publicity material	C	5
E	Print and give out flyers	D	2
F	Print tickets	B	3
G	Advertise on social media	D	1
H	Sell tickets	E, F, G	10

7 (a) Construct an activity network for this project.

Show the earliest start time and latest finish time for each activity.

[10 marks]

7 (b) List the critical path.

[1 mark]

Answer _____

7 (c) Dan finds out that organising transport and hospitality takes 20 days instead of 15 days.

Work out the new minimum completion time for the project.

[3 marks]

AQA: Mathematical Studies
Paper 2C - Graphical Techniques

Tom Carpenter

3 Consumers of electricity have to decide which payment plan, or tariff, to follow each year.

Tariffs usually consist of a charge per kilowatt hour (kWh) of electricity used and an annual standing charge (a fixed fee that is payable no matter how much electricity is used).

The table below shows three tariffs that are offered to consumers.

	Charge per kWh	Annual standing charge
Tariff A	16p	£0
Tariff B	14p	£40
Tariff C	12p	£100

(b) Ava is employed to advise consumers about the cheapest tariff for them.

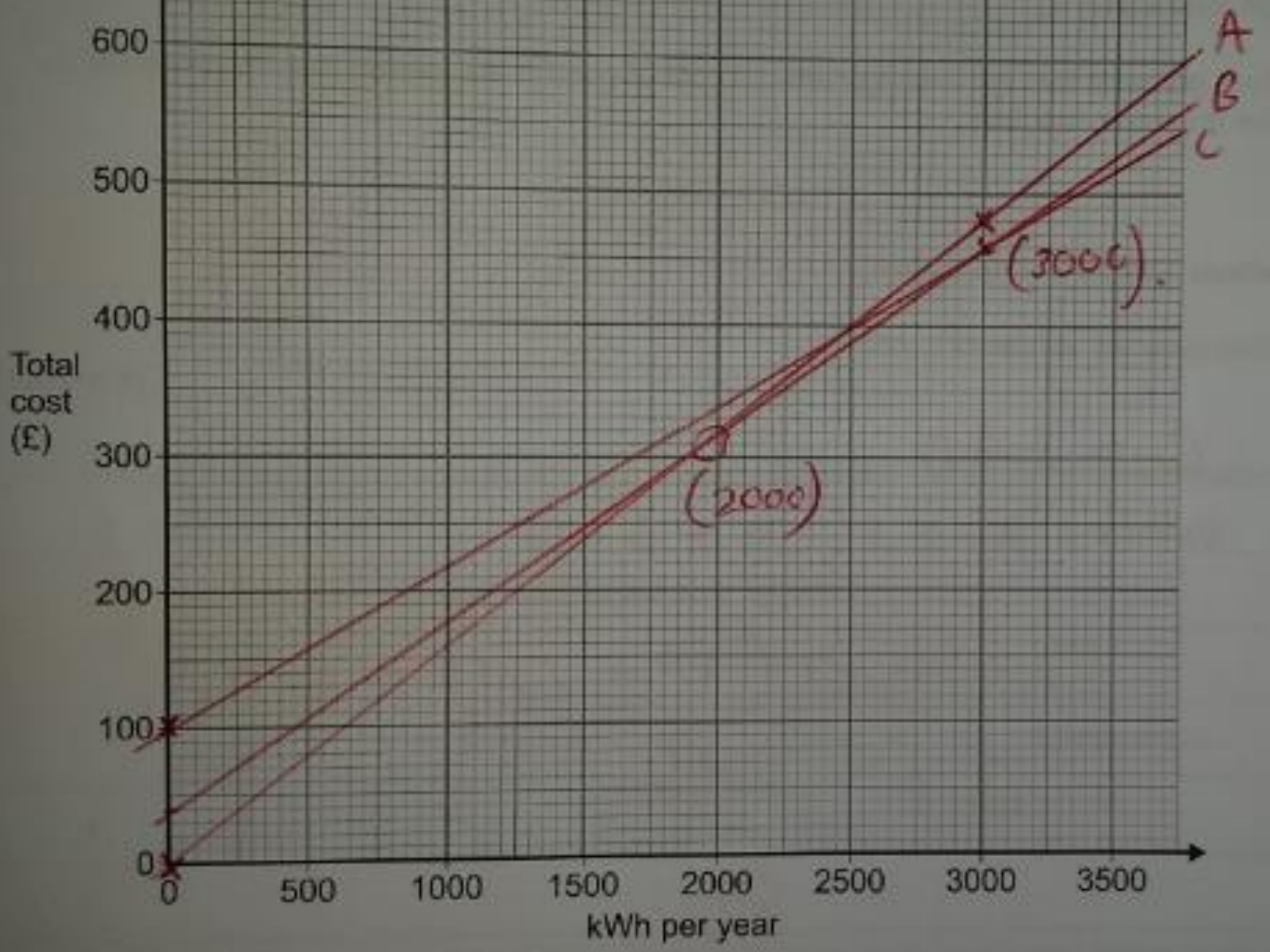
The consumers she advises use between 1500 kWh and 3500 kWh per year.

She needs to know which tariff will be cheapest for different amounts of electricity used.

Advise Ava on which tariff to suggest to consumers, depending on how many kWh of electricity they expect to use in the next year.

You may use the grid on the opposite page to help you if you wish.

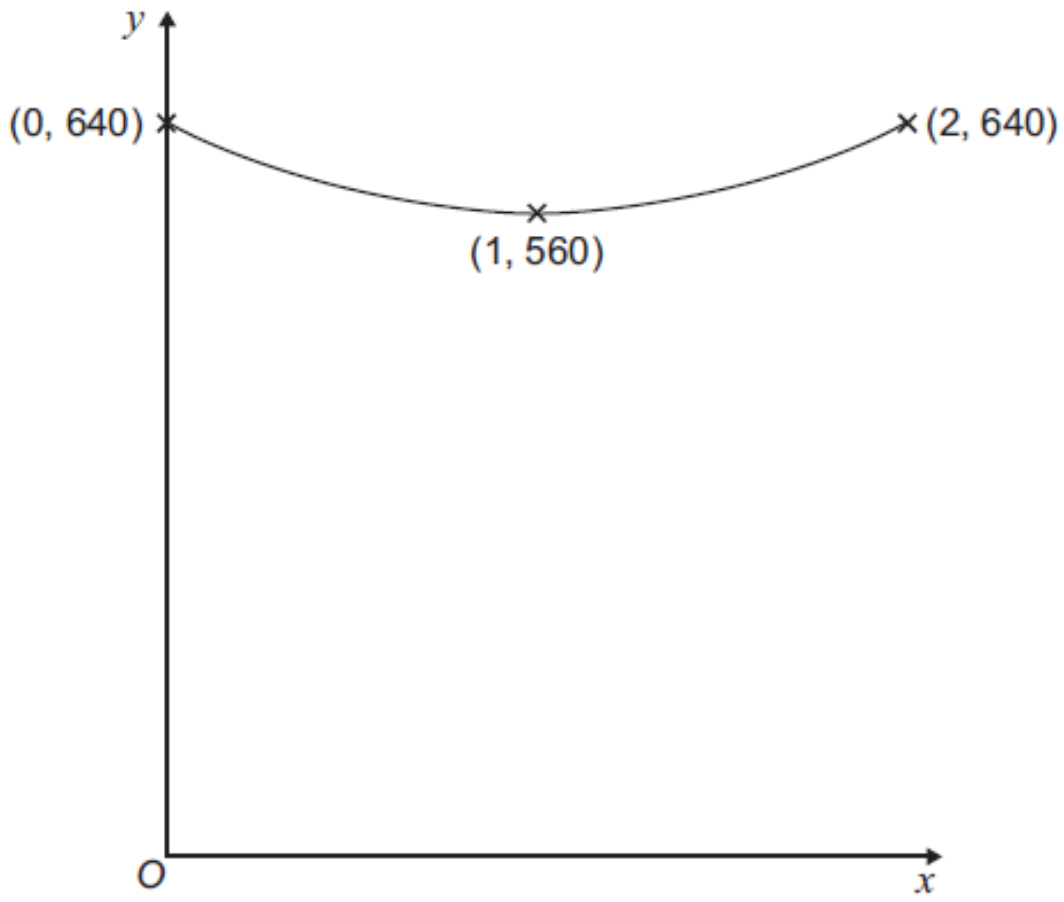
[9 marks]


600
500
400
300
200
100
0
Total cost (£)
0
500
1000
1500
2000
2500
3000
3500
kWh per year
A
B
C
(3000)
(2000)

4 (a) The graph below shows the average annual cost of gas per household in the UK from 1 January 2006 to 1 January 2008, calculated daily.

y is the average annual cost of gas, in pounds, per household in the UK.

x is the number of years after 1 January 2006



For example, on 1 January 2007 the average annual cost of gas per household in the UK was £560

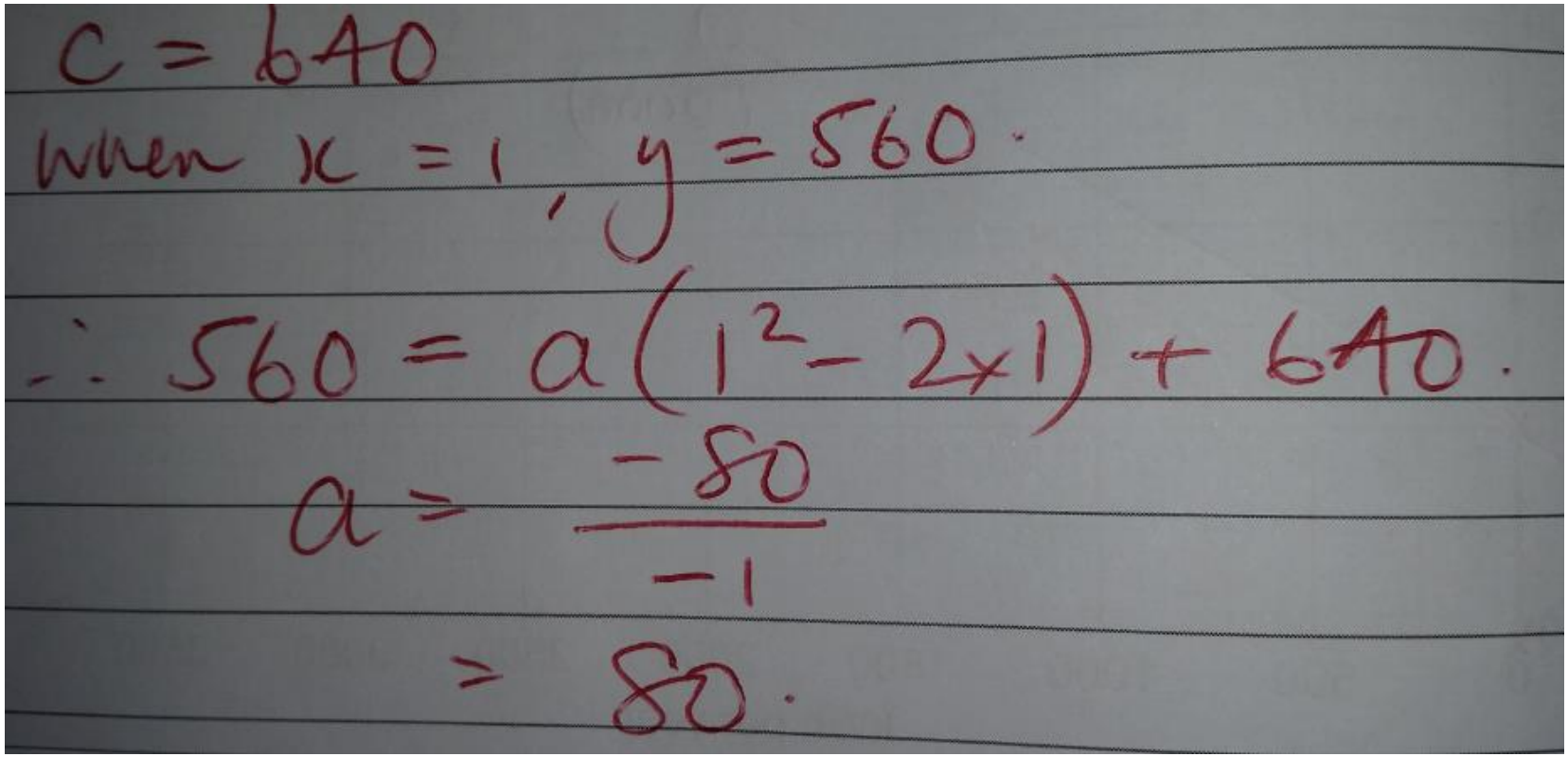
Sam believes that the average annual cost of gas for this period can be modelled by the quadratic function

$$y = a(x^2 - 2x) + c$$

where a and c are constants.

Calculate the values of a and c

[4 marks]



7 Lily is a parachutist.

She jumps from a static balloon and falls vertically through the air.

Before her parachute is opened, Lily's speed, v m s^{-1}, at time t seconds after leaving the balloon, is modelled by the equation

$$v = 54(1 - e^{-0.2t})$$

Lily opens her parachute after 3 seconds.

7 (a) Work out Lily's speed as she opens her parachute.

[2 marks]

7 (b) After the parachute has opened, Lily's speed reduces rapidly and can be modelled by an exponential function.

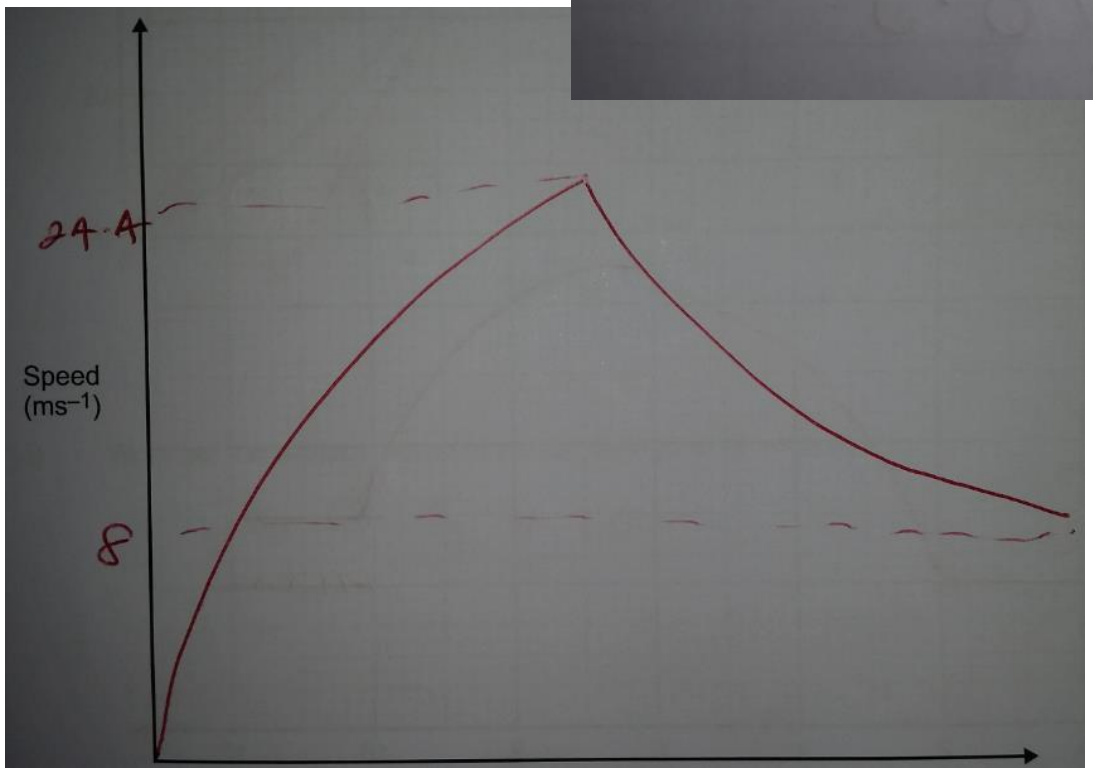
Eventually Lily's speed approaches 8 m s^{-1}

Sketch a graph to show Lily's speed after she leaves the balloon.

[3 marks]

$$v = 54\left(1 - e^{-0.2 \times 3}\right)$$
$$= 24.4$$

Answer 24.4



(c) When the parachute has been open for 2 seconds Lily's speed is 10 m s^{-1}

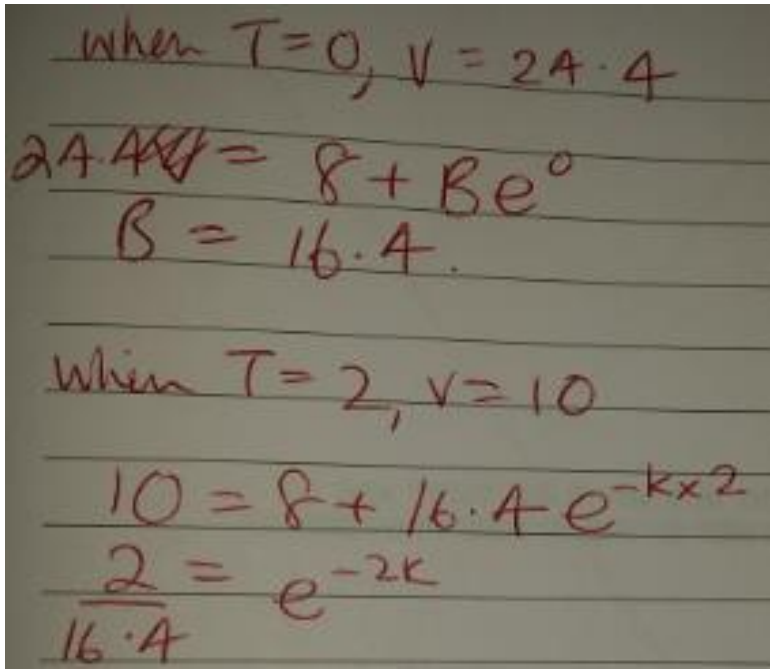
Her speed, $V\,\text{m s}^{-1}$, at time T seconds **after the parachute is opened**, is modelled by the equation

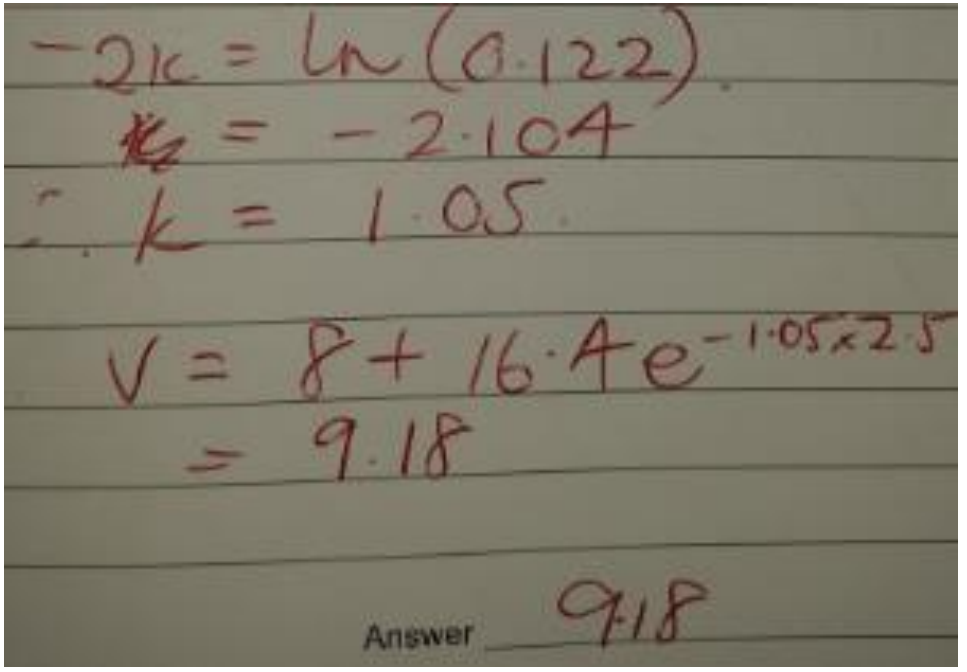
$$V = 8 + Be^{-kT}$$

where B and k are constants.

Work out Lily's speed 2.5 seconds after the parachute is opened.
Give your answer to two decimal places.

[7 marks]





OCR: Quantitative Reasoning and Quantitative Problem Solving

Penri Thomas

OCR

	Quantitative Reasoning (MEI)	Quantitative Problem Solving (MEI)
Paper 1	Introduction to Quantitative Reasoning	Introduction to Quantitative Reasoning
Paper 2	Critical Maths	Statistical Problem Solving

Quantitative Problem Solving (MEI)

- Paper 1 Introduction to Quantitative Reasoning
- Paper 2 Statistical Problem Solving

- Quantitative Reasoning

OCR - Quantitative Problem Solving

- **Paper 1: Introduction to Quantitative Reasoning (2 Hours 72 Marks)**
- Has the look and feel of maths exams that the students have seen/sat before.
-
- Questions are broken down into sections. Answer space is provided at the end of each section. This format (and students familiarity with it) makes it easier (in my opinion) to get into the question.
- It does however tend to break the flow and consequently the synoptic element of a question.
-

OCR - Quantitative Problem Solving

- **Paper 1: Introduction to Quantitative Reasoning (2 Hours 72 Marks)**
- Questions were generally quite directed. There was an attempt to make some parts of the questions more open ended/problem solving in nature.
- The vast majority of the paper could have been done on some GCSE knowledge and a bit of thinking (which is as per specifications).

OCR - Quantitative Problem Solving

- **Paper 1: Introduction to Quantitative Reasoning (2 Hours 72 Marks)**
-
- Questions on the **pre-release** (tax/national insurance rates) were quite varied and seemed a good way of testing their understanding. They accounted for 16/72 22% of the total marks (although some of these were based on the students understanding of how to use spreadsheets). There had been sufficient time to prepare the students with the material and they should have been able to score heavily on these questions.
-
- Students and staff were comfortable with the exam and what was asked.

OCR - Quantitative Problem Solving

- **Paper 2: Statistical Problem Solving (2 Hours 60 Marks)**

- I choose to follow this side of the specification because it covers statistical methods that the students encounter in their other studies (Chi squared, Correlation, and Hypothesis testing, Normal distribution-to a greater depth than in paper 1).

- It was easier to predict and consequently practice questions for this exam.

OCR – Quantitative Problem Solving

- **Paper 2: Statistical Problem Solving (2 Hours 60 Marks)**

- Again questions were divided up into stages. Particularly useful/helpful when undertaking methods with several clearly defined steps. Questions were generally quite directed. Again some attempt had been made to make some parts of the questions more open ended/problem solving in nature.

- The **Pre-release** was a large data set available from the start of the course (not true for those who started in 2014). Ideally the data set is used throughout the course and the students become very familiar with its layout and content.

OCR – Quantitative Problem Solving

- **Paper 2: Statistical Problem Solving (2 Hours 60 Marks)**

- Student response was more varied with this paper. Those who had (in my opinion) practiced the methods/techniques seemed to prefer this paper. However no students complained that the paper was unfair or contained unexpected components.

- I think that both papers will discriminate sufficiently and allow for a range of grades to be awarded (assuming a range of abilities took the examinations).

OCR - Quantitative Reasoning

- **Quantitative Reasoning** shares the same first paper with Quantitative Problem Solving (introduction to Quantitative Reasoning). The second exam is **Critical Maths**

- Comments I have received about this exam; People, both teachers and students, were happy with it; it was fair with nothing unexpected coming up.

- There is not very much in the way of extra material to be covered in the second paper which is a real benefit as regards delivery time.

Further thoughts

- With greater emphasis on problem solving and understanding in both the new GCSE and A level there may (admittedly based on limited material) be little difference between the style of core papers and other maths exams (which may or may not be a good thing).

- Time, or lack of it, has been commented on by students. Personally I think there was ample time. I think the problem was more likely to be the student's inexperience tackling long questions under exam conditions.

Further thoughts

- I thought the exams were fair and accessible but without grade boundaries it is difficult to be certain.

- Difficult to be too critical of the boards given the time frame in which the core course was introduced, and this was their first attempt, but there is nothing in the assessment to force schools/colleges to teach the course in anyway differently to any other maths course, particularly if for funding reasons the time allocation for delivery of the course is squeezed.

Pearson Edexcel: Mathematics In Context

Tom Rainbow

Pearson Edexcel

	Mathematics in Context
Paper 1	Comprehension
Paper 2	Applications

Examination Feedback

- Students felt the exams were fair in terms of their content. No questions involved using mathematics that they hadn't been taught.
- Most students (8 out of 9) ran out of time on the Comprehension Paper. The 9th student admitted that time 'was tight'.
- Spearman's Rank involved ranking 15 cars – could there have been less to do?
- PMCC involved $\sum y^2$ in the tens of billions and $\sum xy$ in the billions – did the numbers need to be so cumbersome?
- Students had to plot 15 points on a scatter graph (for 2 marks).

Positives

- Themes were interesting throughout and felt authentic. Students wanted to know the answers and were keen to work on the themes.
- Data within preliminary material was mainly in table form (in sample assessments there was much more written information).
- Assessments were more accessible than specimen papers/sample assessments.
- Reference to data sources meant that students weren't wasting time seeking out the data.
- Really well designed questions (although lots were to do with working out percentages).

Further reflections