OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE
MATHEMATICS (MEI) 4752
Concepts for Advanced Mathematics (C2)

Candidates answer on the Answer Booklet

OCR Supplied Materials:
- 8 page Answer Booklet
- Insert for Questions 5 and 12 (inserted)
- MEI Examination Formulae and Tables (MF2)

Other Materials Required:
None

Tuesday 13 January 2009
Morning

Duration: 1 hour 30 minutes

4752

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the spaces provided on the Answer Booklet.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- There is an **insert** for use in Questions **5** and **12**.
- You are permitted to use a graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- This document consists of **8** pages. Any blank pages are indicated.

Section A (36 marks)

1 Find $\int \left(20x^4 + 6x^{-\frac{3}{2}}\right) \mathrm{d}x$. **[4]**

2 Fig. 2 shows the coordinates at certain points on a curve.

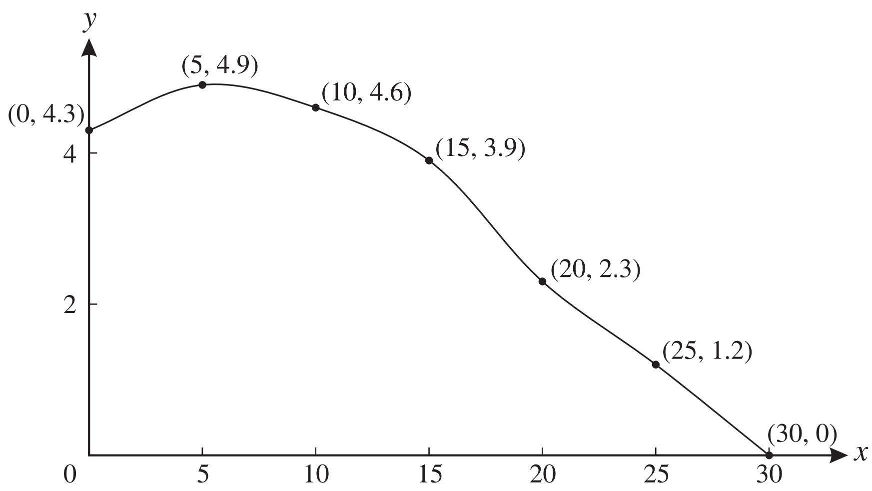

Fig. 2

Use the trapezium rule with 6 strips to calculate an estimate of the area of the region bounded by this curve and the axes. **[4]**

3 Find $\sum_{k=1}^{5} \frac{1}{1+k}$. **[2]**

4 Solve the equation $\sin 2x = -0.5$ for $0° < x < 180°$. **[3]**

5 **Answer this question on the insert provided.**

Fig. 5 shows the graph of $y = \mathrm{f}(x)$.

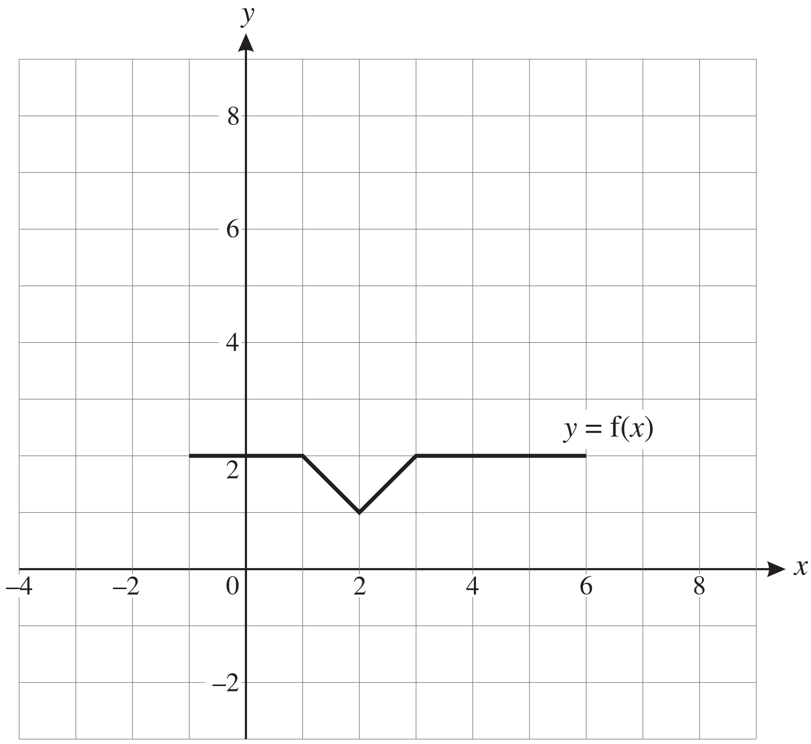

Fig. 5

On the insert, draw the graph of

(i) $y = \mathrm{f}(x - 2)$, **[2]**

(ii) $y = 3\mathrm{f}(x)$. **[2]**

6 An arithmetic progression has first term 7 and third term 12.

(i) Find the 20th term of this progression. **[2]**

(ii) Find the sum of the 21st to the 50th terms inclusive of this progression. **[3]**

7 Differentiate $4x^2 + \frac{1}{x}$ and hence find the x-coordinate of the stationary point of the curve $y = 4x^2 + \frac{1}{x}$. **[5]**

8 The terms of a sequence are given by

$$u_1 = 192,$$
$$u_{n+1} = -\tfrac{1}{2}u_n.$$

(i) Find the third term of this sequence and state what type of sequence it is. **[2]**

(ii) Show that the series $u_1 + u_2 + u_3 + \dots$ converges and find its sum to infinity. **[3]**

9 **(i)** State the value of $\log_a a$. **[1]**

(ii) Express each of the following in terms of $\log_a x$.

(A) $\log_a x^3 + \log_a \sqrt{x}$ **[2]**

(B) $\log_a \dfrac{1}{x}$ **[1]**

Section B (36 marks)

10 Fig. 10 shows a sketch of the graph of $y = 7x - x^2 - 6$.

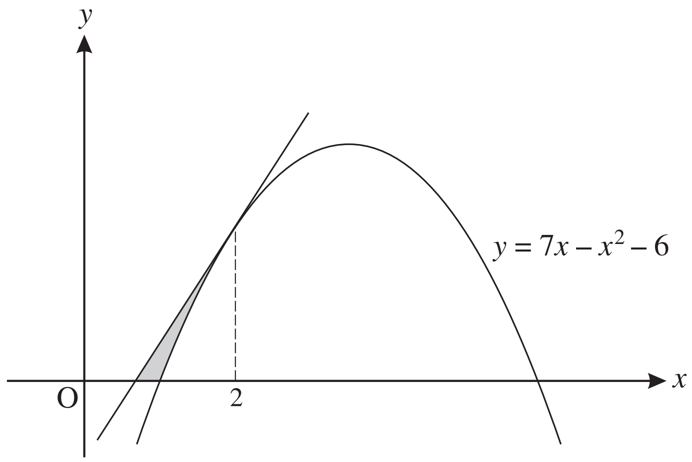

Fig. 10

(i) Find $\dfrac{dy}{dx}$ and hence find the equation of the tangent to the curve at the point on the curve where $x = 2$.

Show that this tangent crosses the x-axis where $x = \frac{2}{3}$. **[6]**

(ii) Show that the curve crosses the x-axis where $x = 1$ and find the x-coordinate of the other point of intersection of the curve with the x-axis. **[2]**

(iii) Find $\displaystyle\int_1^2 (7x - x^2 - 6)\,dx$.

Hence find the area of the region bounded by the curve, the tangent and the x-axis, shown shaded on Fig. 10. **[5]**

11 (i)

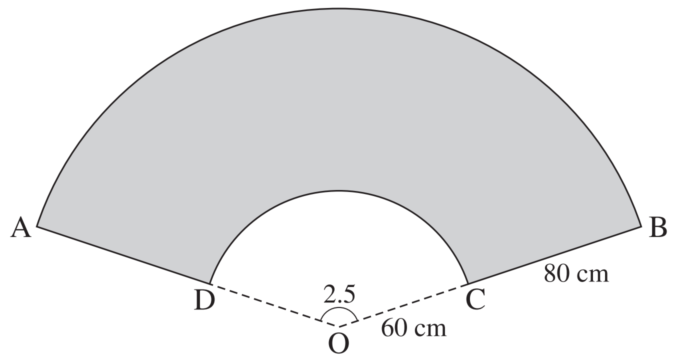

Fig. 11.1

Fig. 11.1 shows the surface ABCD of a TV presenter's desk. AB and CD are arcs of circles with centre O and sector angle 2.5 radians. OC = 60 cm and OB = 140 cm.

(*A*) Calculate the length of the arc CD. **[2]**

(*B*) Calculate the area of the surface ABCD of the desk. **[4]**

(ii) The TV presenter is at point P, shown in Fig. 11.2. A TV camera can move along the track EF, which is of length 3.5 m.

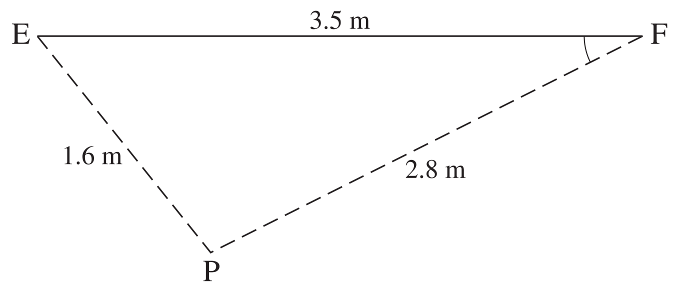

Fig. 11.2

When the camera is at E, the TV presenter is 1.6 m away. When the camera is at F, the TV presenter is 2.8 m away.

(*A*) Calculate, in degrees, the size of angle EFP. **[3]**

(*B*) Calculate the shortest possible distance between the camera and the TV presenter. **[2]**

[Question 12 is printed overleaf.]

12 Answer part (ii) of this question on the insert provided.

The proposal for a major building project was accepted, but actual construction was delayed. Each year a new estimate of the cost was made. The table shows the estimated cost, £y million, of the project t years after the project was first accepted.

Years after proposal accepted (t)	1	2	3	4	5
Cost (£y million)	250	300	360	440	530

The relationship between y and t is modelled by $y = ab^t$, where a and b are constants.

(i) Show that $y = ab^t$ may be written as

$$\log_{10} y = \log_{10} a + t \log_{10} b.$$ **[2]**

(ii) **On the insert**, complete the table and plot $\log_{10} y$ against t, drawing by eye a line of best fit. **[3]**

(iii) Use your graph and the results of part **(i)** to find the values of $\log_{10} a$ and $\log_{10} b$ and hence a and b. **[4]**

(iv) According to this model, what was the estimated cost of the project when it was first accepted? **[1]**

(v) Find the value of t given by this model when the estimated cost is £1000 million. Give your answer rounded to 1 decimal place. **[2]**

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ADVANCED SUBSIDIARY GCE

MATHEMATICS (MEI) 4752

Concepts for Advanced Mathematics (C2)
INSERT for Questions 5 and 12

Tuesday 13 January 2009
Morning

Duration: 1 hour 30 minutes

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

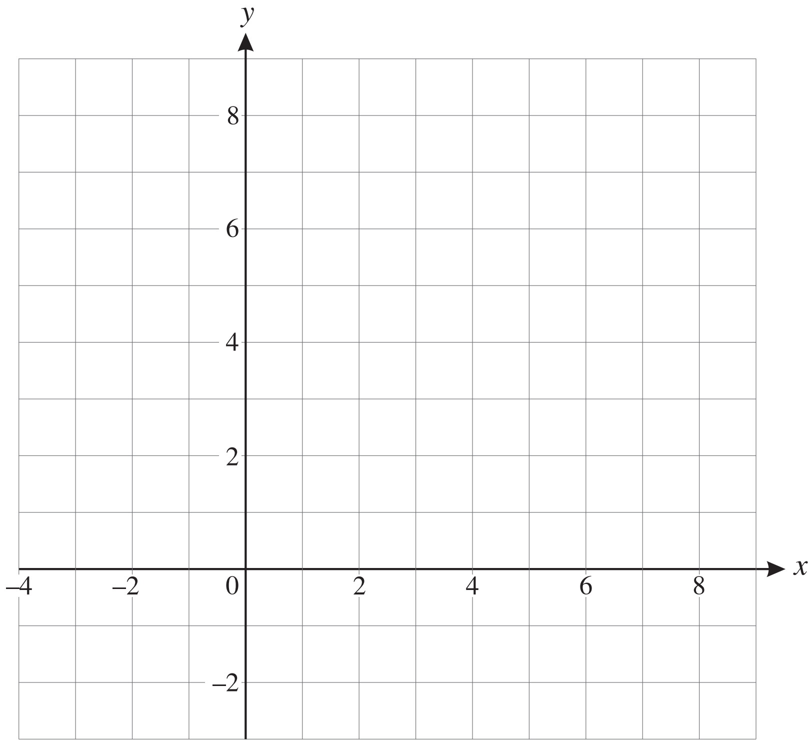
INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- This insert should be used to answer Question **5** and Question **12** part **(ii)**.
- Write your answers to Question **5** and Question **12** part **(ii)** in the spaces provided in this insert, and **attach it to your Answer Booklet**.

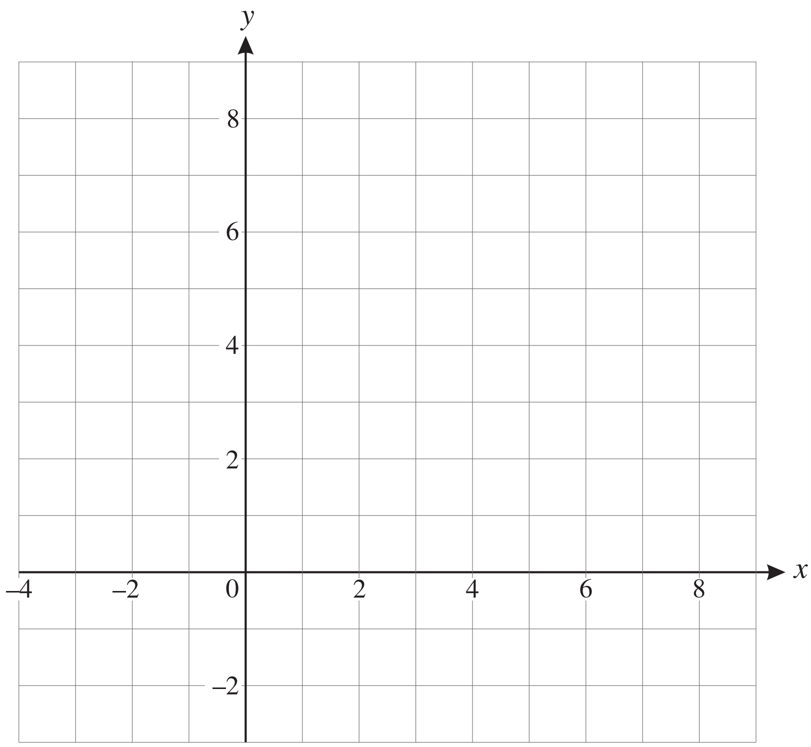
INFORMATION FOR CANDIDATES

- This document consists of **4** pages. Any blank pages are indicated.

5 **(i)** $y = f(x - 2)$

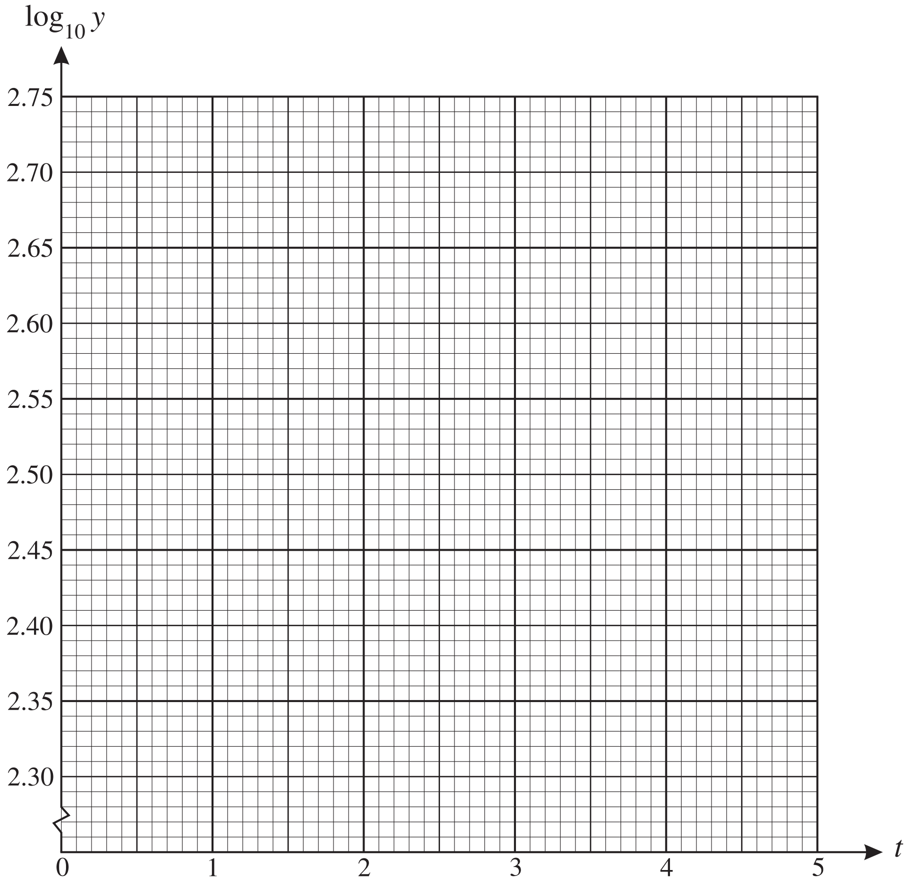


(ii) $y = 3f(x)$



12 (ii)

Years after proposal accepted (t)	1	2	3	4	5
Cost (£y million)	250	300	360	440	530
$\log_{10} y$	2.398				



4752 (C2) Concepts for Advanced Mathematics

Section A

1	$4x^5$ $-12x^{-\frac{1}{2}}$ $+ c$	1 2 1	M1 for other $kx^{-\frac{1}{2}}$	4
2	95.25, 95.3 or 95	4	M3 ½×5×(4.3+0+2[4.9+4.6+3.9+2.3+1.2]) M2 with 1 error, M1 with 2 errors. Or M3 for 6 correct trapezia.	4
3	1.45 o.e.	2	M1 for $\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}+\frac{1}{6}$ oe	2
4	105 and 165	3	B1 for one of these or M1 for $2x = 210$ or 330	3
5	(i) graph along $y = 2$ with V at (3,2) (4,1) & (5,2) (ii) graph along $y = 6$ with V at (1,6) (2,3) & (3,6)	2 2	M1 for correct V, or for f(x+2) B1 for (2,k) with all other elements correct	4
6	(i) 54.5 (ii) Correct use of sum of AP formula with n = 50, 20, 19 or 21 with their d and a = 7 eg S_{50} = 3412.5, S_{20} = 615 Their $S_{50} - S_{20}$ dep on use of ap formula 2797.5 c.a.o.	2 M1 M1 A1	B1 for $d = 2.5$ or M2 for correct formula for S_{30} with their d M1 if one slip	5
7	$8x - x^{-2}$ o.e. their $\frac{dy}{dx} = 0$ correct step $x = ½$ c.a.o.	2 M1 DM1 A1	B1 each term s.o.i. s.o.i.	5
8	(i) 48 geometric, or GP (ii) mention of $\|r\| < 1$ condition o.e. S = 128	1 1 1 2	M1 for $\frac{192}{1 - -\frac{1}{2}}$	5
9	(i) 1 (ii) (A) 3.5 $\log_a x$ (ii) (B) $-\log_a x$	1 2 1	M1 for correct use of 1st or 3rd law	4

Section B

10	**i**	$7 - 2x$ $x = 2$, gradient = 3 $x = 2, y = 4$ y – their 4 = their grad $(x - 2)$ subst $y = 0$ in their linear eqn completion to $x = \frac{2}{3}$ (ans given)	M1 A1 B1 M1 M1 A1	 differentiation must be used or use of y = their $mx + c$ and subst (2, their 4), dependent on diffn seen	 6
	ii	f(1) = 0 or factorising to $(x - 1)(6 - x)$ or $(x - 1)(x - 6)$ 6 www	1 1	or using quadratic formula correctly to obtain $x = 1$	 2
	iii	$\frac{7}{2}x^2 - \frac{1}{3}x^3 - 6x$ value at 2 − value at 1 $2\frac{1}{6}$ or 2.16 to 2.17 $\frac{1}{2}\times\frac{4}{3}\times 4$ − their integral 0.5 o.e.	M1 M1 A1 M1 A1	for two terms correct; ignore $+c$ ft attempt at integration only	 5
11	**i**(A)	150 (cm) or 1.5 m	2	M1 for 2.5 × 60 or 2.5 × 0.6 or for 1.5 with no units	2
	i(B)	½ × 60^2 × 2.5 or 4500 ½ × 140^2 × 2.5 or 24 500 subtraction of these 20 000 (cm^2) isw	M1 M1 DM1 A1	or equivalents in m^2 or 2 m^2	 4
	ii(A)	attempt at use of cosine rule $\cos \text{EFP} = \frac{3.5^2 + 2.8^2 - 1.6^2}{2\times 2.8\times 3.5}$ o.e. 26.5 to 26.65 or 27	M1 M1 A1	condone 1 error in substitution	 3
	ii(B)	2.8 sin (their EFP) o.e. 1.2 to 1.3 [m]	M1 A1		 2

12	**i**	log a + log (b^t) www clear use of log (b^t) = t log b dep	B1 B1	condone omission of base throughout question	 2
	ii	(2.398), 2.477, 2.556 , 2.643, 2.724 points plotted correctly f.t. ruled line of best fit f.t.	T1 P1 1	 On correct square	 3
	iii	log a = 2.31 to 2.33 a = 204 to 214 log b = 0.08 approx b = 1.195 to 1.215	M1 A1 M1 A1	ft their intercept ft their gradient	 4
	iv	eg £210 million dep	1	their £a million	1
	v	$\frac{\log 1000 - \text{their intercept}}{\text{their gradient}} \approx \frac{3-2.32}{0.08}$ = 8.15 to 8.85	M1 A1	 or B2 from trials	 2

4752 Concepts for Advanced Mathematics (C2)

General Comments

The paper was generally well received, with very few low-scoring scripts. Some high-scoring candidates lost marks by failing to show enough working when producing a given answer. There were some very good scores in section A; nevertheless, section B was generally better received, with a significant minority of candidates scoring full marks.

Comments on Individual Questions

Section A

1) Most candidates scored well on this question. Some strong candidates lost an easy mark by omitting "+c". Weak candidates failed to simplify $\frac{20}{5}$, or were unable to deal with $\frac{6}{-\frac{1}{2}}$. A small number of candidates differentiated instead of integrating.

2) This question was generally well done, although some candidates wasted time by calculating the areas of individual trapezia and then summing the areas, instead of using the composite rule. Candidates who omitted the first pair of brackets did not score at all.

3) This question was generally well done. Only a few candidates failed to sum the terms, even fewer made arithmetical slips. Some candidates attempted to use formulae for the sums of arithmetic or geometric series.

4) This question was not done well. An initial step for most was "sin*x* = - 0.25", which resulted in no marks. Often the better candidates failed to obtain a complete solution. 15° was often presented as part of the final answer.

5) There were many excellent responses to this question. In part (i) some candidates translated 2 units to the left; a few translated 2 up or 2 down. The usual error in part (ii) was to misplace (2, 3), but a small number of candidates stretched by a factor of ⅓ or misplaced the horizontal line.

6) Part (i) was accessible to most. Nearly all candidates obtained the correct answer, with a small minority making arithmetical slips.
There were some excellent answers to part (ii) However, many candidates didn't take the hint from part (i) and calculated $S_{50} – S_{21}$. Some missed the point and calculated $S_{50} – u_{21}$ or even $u_{50} – u_{21}$. Those who did use part (i) often evaluated S_{29} instead of S_{30}.

7) The differentiation was often well done, but only the best candidates dealt successfully with $8x - \frac{1}{x^2} = 0$. Some candidates differentiated to obtain 8*x* – 1 or even 8*x* – *x*.

8) Part (i) was very well done. "Geometric" was the required answer, "oscillating" was condoned; nothing else scored. In part (ii) very few candidates realised the need to quote the condition for convergence. Those that did often didn't relate it to the question. Many obtained the correct answer for the sum. A common error was to calculate $S = \frac{192}{1-\frac{1}{2}}$. A few candidates substituted r = 2 or -2 in the correct formula.

9) Part (i) was very well done. In part (ii) most scored M1 for a correct use of one of the log laws, but a surprisingly high number obtained the answer $\frac{3}{2}\log x$ in various different ways. Part (iii) was well done; log1 – log*x* and $\log x^{-1}$ did not score.

Section B

10) (i) This was done very well indeed, with many candidates scoring full marks. Some candidates set $\frac{dy}{dx} = 0$ and used “m = 3.5”, and some found 3 correctly, and then went on to use “m = ⅓ (or - ⅓)”. A few candidates tried to work back from the intercept without finding y = 4. This was rarely, if ever, successful.

(ii) This was done well. Many showed f(1) = 0, and then went on to use the Factor Theorem successfully to show that x = 6 is the other root. Many factorised successfully. The usual errors were (x- 1)(x – 7) and (x – 1)(x + 6).

(iii) Most candidates scored well on the integration, although dealing with the double negative defeated many. Surprisingly few calculated the area of the correct triangle, and those who attempted a solution by integration were rarely successful. A common error was to take the height of the triangle as 2 units.

11) (i) Part A was done well, with only a handful of candidates clearly having no idea what to do. Some wasted time by converting to degrees; of these some then lost accuracy through premature rounding. There were many fully correct answers to part B, but a sizeable minority of candidates calculated $\frac{1}{2}\times80^2\times2.5 - \frac{1}{2}\times60^2\times2.5$, and some candidates stopped at $\frac{1}{2}\times140^2\times2.5$.

(ii) This was done extremely well, with an overwhelming majority scoring full marks. Some candidates calculated the wrong angle, and a few rounded off before finding the angle, thus losing the accuracy mark.

(iii) This was generally well done, but many candidates presented convoluted solutions, penalising themselves by wasting time that could have been devoted elsewhere.

12) (i) This was usually well done. Occasionally *t*log*ab* or log*a* × log*b* were seen.

(ii) Three decimal places were required – and usually presented – in the table. Some candidates lost a mark through one or more incorrect plots and a few candidates lost the third mark by failing to use a ruler, but generally speaking this was answered very well.

(iii) Many candidates used the long winded method of solving two equations from their table or their graph simultaneously. More often than not they lost accuracy marks in the process. The expected approach of log*a* = intercept and log*b* = gradient generally yielded full marks, although some candidates were not able to produce a gradient within the expected range. Occasionally “log*a* = gradient and log*b* = intercept” was seen; rather less common was “*t* = gradient”.

(iv) Many candidates thought they had to start again here, instead of using the value obtained for *a,* and often lost the mark as a result. Many candidates omitted “million”, and thus didn’t score.

(v) A variety of approaches were seen. Many candidates were successful. In some cases obviously wrong answers (e.g. negative or ridiculously large numbers) were presented, but it did not usually seem to occur to the candidate that anything was amiss.