Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Thursday 08 October 2020

Afternoon	Paper Reference **8FM0/21**

Further Mathematics

Advanced Subsidiary
Further Mathematics options
21: Further Pure Mathematics 1
(Part of options A, B, C and D)

Shadow Set 1

You must have:
Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 40. There are 5 questions.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

1 The variables x and y satisfy the differential equation

$$\frac{d^2y}{dx^2} = x^2 - y + 3$$

where $\frac{dy}{dx} = 2$ and $y = 1$ when $x = 1$

Use the approximations

$$\left(\frac{d^2y}{dx^2}\right)_n \approx \frac{(y_{n+1} - 2y_n + y_{n-1})}{h^2} \quad \text{and} \quad \left(\frac{dy}{dx}\right)_n \approx \frac{(y_{n+1} - y_{n-1})}{2h}$$

with $h = 0.1$ to find an estimate for the value of y when $x = 1.2$

(7)

(Total for Question 1 is 7 marks)

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2 Use algebra to determine the values of x for which

$$\frac{x}{3x^2 + 10x - 8} < \frac{x - 2}{9x^2 - 4}$$

(5)

(Total for Question 2 is 5 marks)

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3 (i) Use the substitution $t = \tan\left(\frac{\theta}{2}\right)$ to prove that

$$\sec\theta + \tan\theta = \frac{1+\tan\left(\frac{\theta}{2}\right)}{1-\tan\left(\frac{\theta}{2}\right)} \qquad \theta \neq \frac{n\pi}{2}, \quad n \in \mathbb{Z}$$

(2)

(ii)

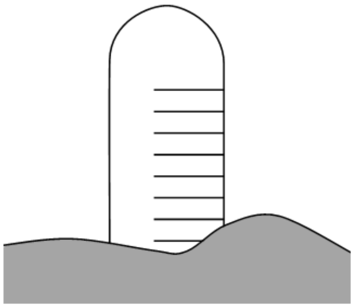

Figure 1

A post marked with a scale and secured to the sea bed is used to measure h feet, the vertical level above the sea bed reached by water in a harbour.

The value of h is modelled by the equation

$$h = 7.2 - 0.8\cos\left(\frac{m°}{4}\right) + 1.2\sin\left(\frac{m°}{4}\right)$$

where m is the number of minutes after midnight.

(*a*) Show that $h = 6.4$ when $m = 0$

(1)

(b) Given the substitution $t = \tan\left(\frac{m°}{8}\right)$, show that

$$h = \frac{8t^2 + 2.4t + 6.4}{1+t^2}$$

(3)

(*c*) Hence find, according to the model, the time at which the measurement of the depth of water first passes 6.8 feet.

(5)

(Total for Question 3 is 11 marks)

4

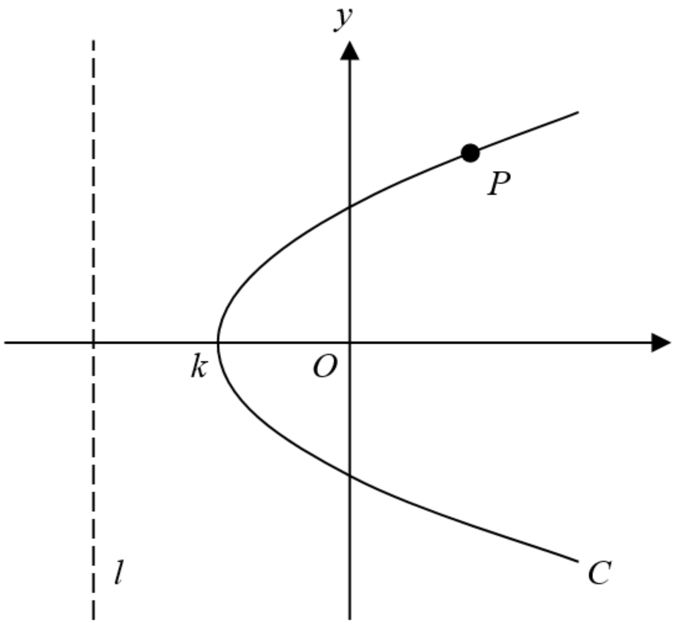

Figure 2

Figure 2 shows a sketch of the parabola C with equation

$$y^2 = 4a(x - k)$$

where a and k are constants.

The focus of C is at the origin O
l is the directrix of C

The point $P\left(a\left(p^2 - 1\right), 2ap\right)$ lies on C

(a) Write down, in terms of a, the value of k

(1)

(b) Write down the equation of l

(1)

The point $Q\left(a\left(q^2 - 1\right), 2aq\right)$, where $p \neq q$, also lies on C

The point M is the midpoint of PQ
P and Q move in such a way that $pq = c$ where c is a constant.
The locus of M has equation $y^2 = 2ax$

(c) Prove that $c = -1$

(5)

(Total for Question 4 is 7 marks)

5

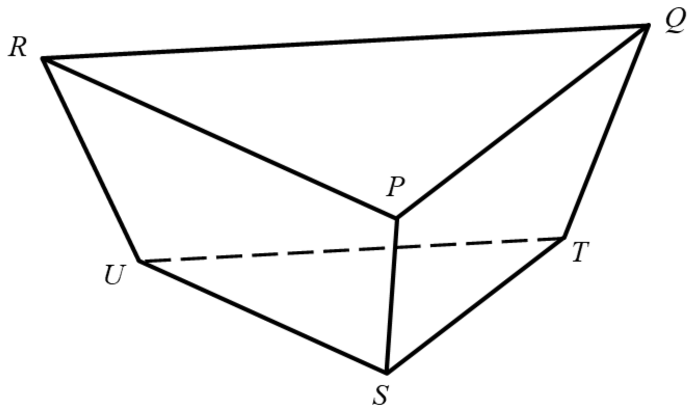

Figure 3

Figure 3 shows an ornamental dish.
The top of the dish is formed by triangle *PQR* and the base of the dish by triangle *STU*
The edges *SP*, *TQ* and *UR* are all straight lines.

The triangles *PQR* and *STU* are parallel.
Triangle *PQR* is similar to triangle *STU*.

With respect to a fixed origin *O*:

Points *P*, *Q* and *R* have coordinates (−3, –8, 3), (3, −2, 0) and (15, 1, −3) respectively and
Points *S*, *T* and *U* have coordinates (0, –10, 5), (4, −6, 3) and (12, −4, 1) respectively.

All lengths are measured in centimetres.

(*a*) Show that the area of the triangular base *STU* is $2\sqrt{41}\,\text{cm}^2$

(3)

(*b*) Find, in cm^3, the exact volume of the dish.

(7)

(Total for Question 5 is 10 marks)

TOTAL FOR FURTHER PURE MATHEMATICS 1 IS 40 MARKS