To what extent should online exams resemble written exams ?

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IMA Statement on Methods of Assessment in the Mathematical Sciences

The transition to online, and therefore, open-book assessment, has been a necessity, but its almost universal use has highlighted particular pedagogical concerns.

However, we are gravely concerned to hear of the increasing number of institutions who are indicating their intention to remove, either partially or entirely, the ability for university-level assessments to include proctored on-campus examinations and closed-book assessments.

We therefore ask all universities to support their individual departments, where the academic expertise and experience relating to disciplinary learning and teaching resides, in ensuring they continue to have unrestricted access to the full range of assessment methodologies and techniques that are pedagogically most appropriate to each discipline.

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Assess in a way relevant for maths.

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Some questions asked in exams recently.

How would we ask this electronically ?

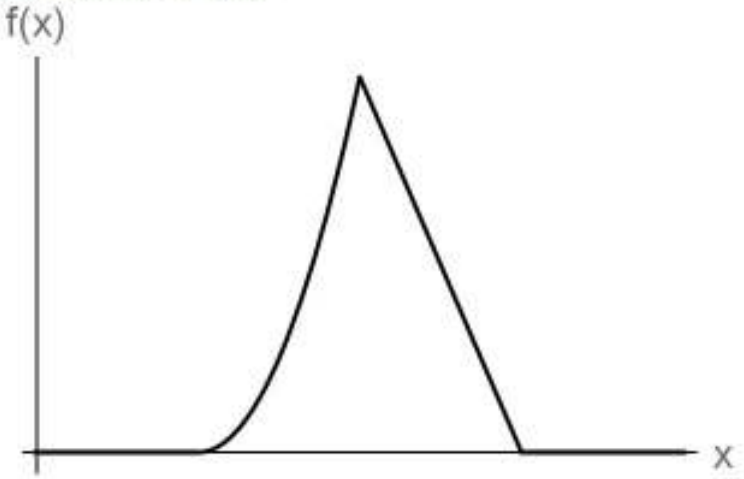
(b) A continuous odd function $f(x)$ has exactly two local maxima i.e. at $(-a, b)$ and $(2a, 2b)$ (where a and b are positive) and approaches zero for large positive x. Giving justification, draw a sketch of function $f(x)$ for $-4a \leq x \leq 4a$.

[5 marks]

How would we ask this electronically ?

2.

(a) Giving justifications, sketch the curve shown below for $f(x)$ in your answer-book along with the derivative $f'(x)$.



How would we ask this electronically ?

2.

(a) Write 4 points about cylindrical polar coordinates.

[4 marks]

(b) Convert the point $\rho = 8$, $\phi = \frac{\pi}{3}$, $z = -2$ to rectangular (cartesian) coordinates.

[2 marks]

(c) Convert the point $x = -3$, $y = -4$, $z = 9$ to cylindrical polar coordinates.

[4 marks]

How would we ask this electronically ?

Enter an even function $f(x)$ that satisfies $f(0) = -5$ and $f(7) = -4$.

How would we ask this electronically ?

The circle $x^2 + y^2 = 7921$ has a tangent of gradient $\frac{39}{80}$ which touches the circle at a positive value of y.

The tangent has equation $y = \frac{39}{80}x + c$. Find the value of c (give your answer as a fraction in its lowest terms.)

Find also the values of x and y where the tangent-line crosses the line $y = 2519 - 5 \cdot x$

$x =$

$y =$

Written, online or hybrid - pro/con for“written”

- A well-trodden and well-documented process. Seen as the default.
- Easier for exams offices to run
- Longer marking process against strict deadlines

Written, online or hybrid - pro/con for“online”

- A “threshold” for an individual
- Intensive on computer clusters and technical specialists
- More work before the exam
- Possibility of something going wrong.

Written, online or hybrid – types of hybrid

- 1. Separate exams at different times. No link between the questions.

Written, online or hybrid – types of hybrid

- 2. Components within the same exam. Separate means of collection. Questions can be linked.

Written, online or hybrid – types of hybrid

- 3. Text-box entry etc within online exam.

(c) By solving a differential equation of the form $\dot{y} = Dy$, where D is diagonal, find the solution of the differential equation

$$\dot{x} = Ax, \quad \text{with} \quad x(0) = \begin{bmatrix} -1 \\ 2 \end{bmatrix}.$$

$x(t) =$ [? / ?] (express your answer in terms of variable t)

Describe in words what happens as $t \to \infty$ [50 words maximum]:

REQUIRED*

[6 marks]

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Randomisation and Exams

- Invigilated Conditions
- Question Preparation

Thoughts on form of assessment

- Exams presented and answered on paper is something that has been carried out for centuries.
- This has happened due to availability of materials.
- But this does not make written assessment the form to aspire to be similar to.
- There are many aspects of written assessment that are worth aspiring to emulate but that is due to them being good aspects, not just being written.

Thoughts on form of assessment

- Cosmetics : developed on paper for a reasons

(v) Find the coordinates of the point S where L_1 intersects the plane $z = 2y + x$.

Give your answers as integers or fractions, **not** decimal values. **[5 marks]**

S has coordinates (, ,)

[Total: 17 marks]

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Thoughts on form of assessment

- Shorter or less-related questions.

A1. Four points A, B, D and C form a parallelogram $ABDC$.

The point A has position vector $\mathbf{a} = \mathbf{k} + 2\mathbf{j} - 3\mathbf{i}$, the vector $\overrightarrow{AB} = 2\mathbf{k} - 2\mathbf{j} + 2\mathbf{i}$ and the vector $\overrightarrow{AD} = 4\mathbf{i} - 5\mathbf{j}$.

(i) Find the position vectors of the points B, C and D in $\mathbf{i}$, $\mathbf{j}$, $\mathbf{k}$ notation. **[5 marks]**

SYNTAX NOTE: For a vector in i, j, k notation, use the letters i, j and k. For example, to write the vector $2\mathbf{i} + 3\mathbf{j}$, type 2i + 3j.

B has position vector [ ].

C has position vector [ ].

D has position vector [ ].

(ii) Calculate the distance d between the points A and C.

Either give the solution in exact form, or to to the nearest 2 decimal places. **[3 marks]**

SYNTAX NOTE: For the square root, use sqrt(). For example, to write $\sqrt{10}$, write sqrt(10).

$d =$ [ ].

(iii) Find the angle $B\hat{A}D$ in degrees to the nearest 1 decimal place. **[4 marks]**

$B\hat{A}D =$ [ ]°.

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Conclusions

- Various reasons to use written, online or hybrid
- Let the maths and the practicalities dictate what is examined where.
- But do not feel that, in the absence of clear reasons, you need to make it look like a written assessment.