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Mathematics: applications and interpretation
Higher level
Paper 1

Friday 6 May 2022 (afternoon)

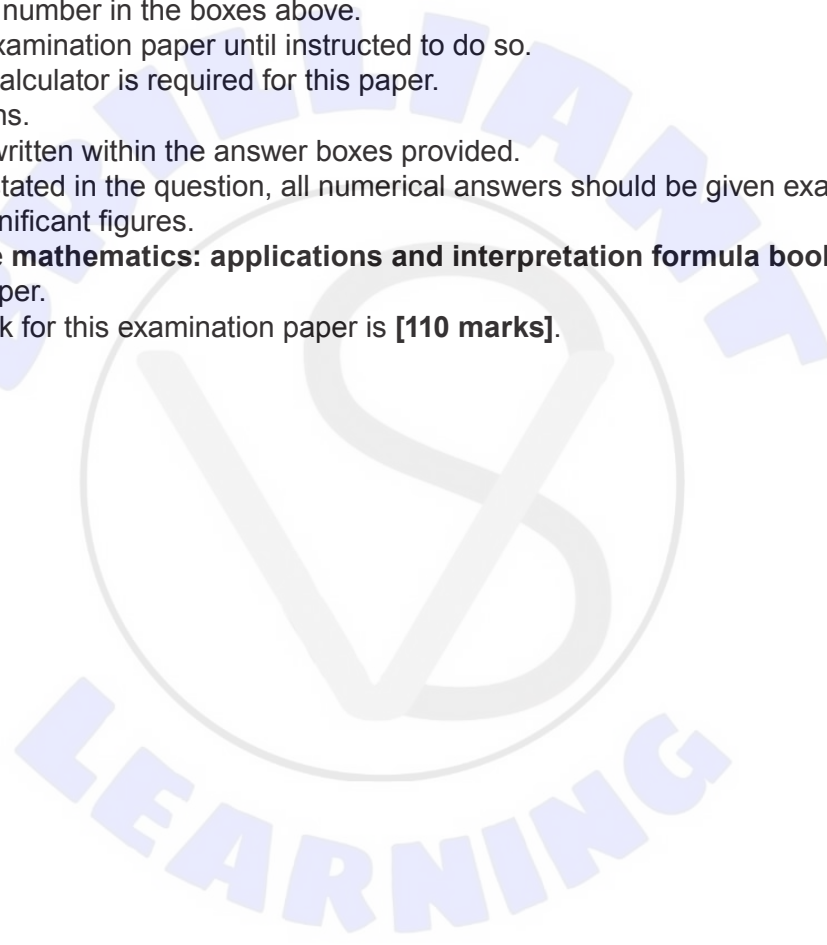
Candidate session number

2 hours

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: applications and interpretation formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[110 marks]**.

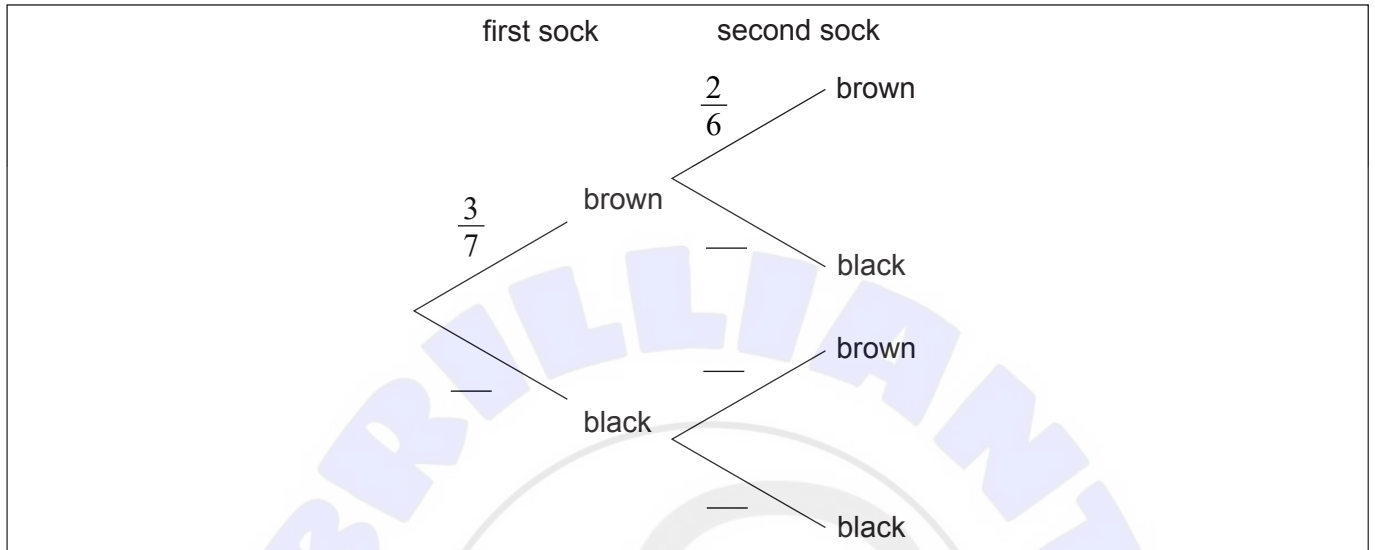


4. [Maximum mark: 7]

Karl has three brown socks and four black socks in his drawer. He takes two socks at random from the drawer.

(a) Complete the tree diagram.

[2]



(b) Find the probability that Karl takes two socks of the same colour.

[2]

(c) Given that Karl has two socks of the same colour find the probability that he has two brown socks.

[3]

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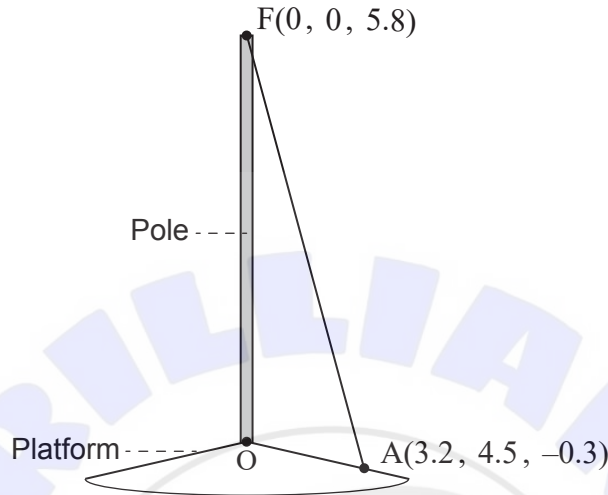
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6. [Maximum mark: 8]

A vertical pole stands on a sloped platform. The bottom of the pole is used as the origin, O , of a coordinate system in which the top, F , of the pole has coordinates $(0, 0, 5.8)$. All units are in metres.

diagram not to scale



The pole is held in place by ropes attached at F .

One of these ropes is attached to the platform at point $A(3.2, 4.5, -0.3)$. The rope forms a straight line from A to F .

- (a) Find \vec{AF} . [1]
- (b) Find the length of the rope. [2]
- (c) Find \hat{FAO} , the angle the rope makes with the platform. [5]

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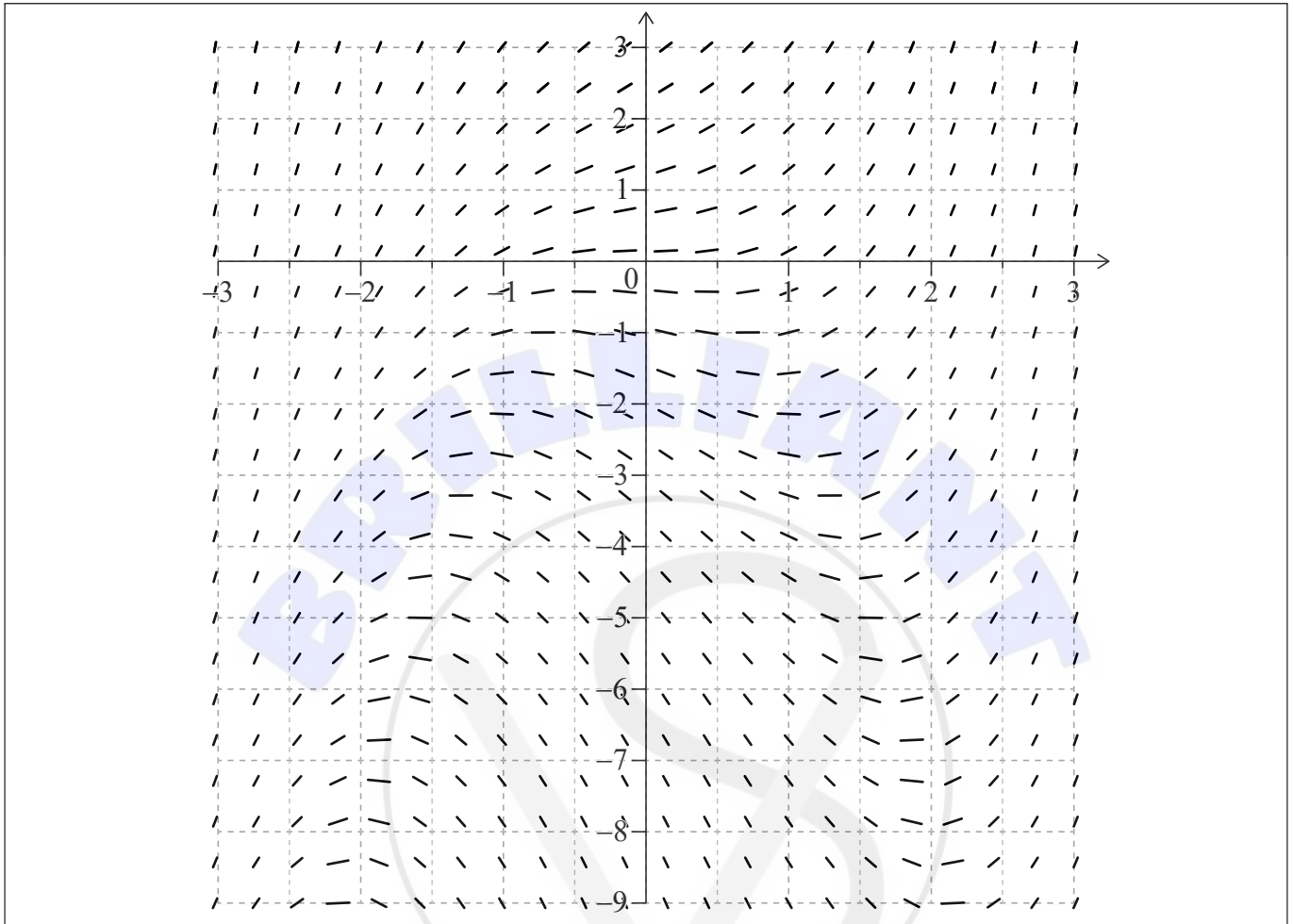
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7. [Maximum mark: 4]

A slope field for the differential equation $\frac{dy}{dx} = x^2 + \frac{y}{2}$ is shown.



Some of the solutions to the differential equation have a local maximum point and a local minimum point.

- (a) (i) Write down the equation of the curve on which all these maximum and minimum points lie.
- (ii) Sketch this curve on the slope field. [2]

The solution to the differential equation that passes through the point (0, -2) has both a local maximum point and a local minimum point.

- (b) On the slope field, sketch the solution to the differential equation that passes through (0, -2). [2]

(This question continues on the following page)



8. [Maximum mark: 6]

Consider the curve $y = 2x(4 - e^x)$.

(a) Find

(i) $\frac{dy}{dx}$.

(ii) $\frac{d^2y}{dx^2}$.

[4]

The curve has a point of inflexion at (a, b) .

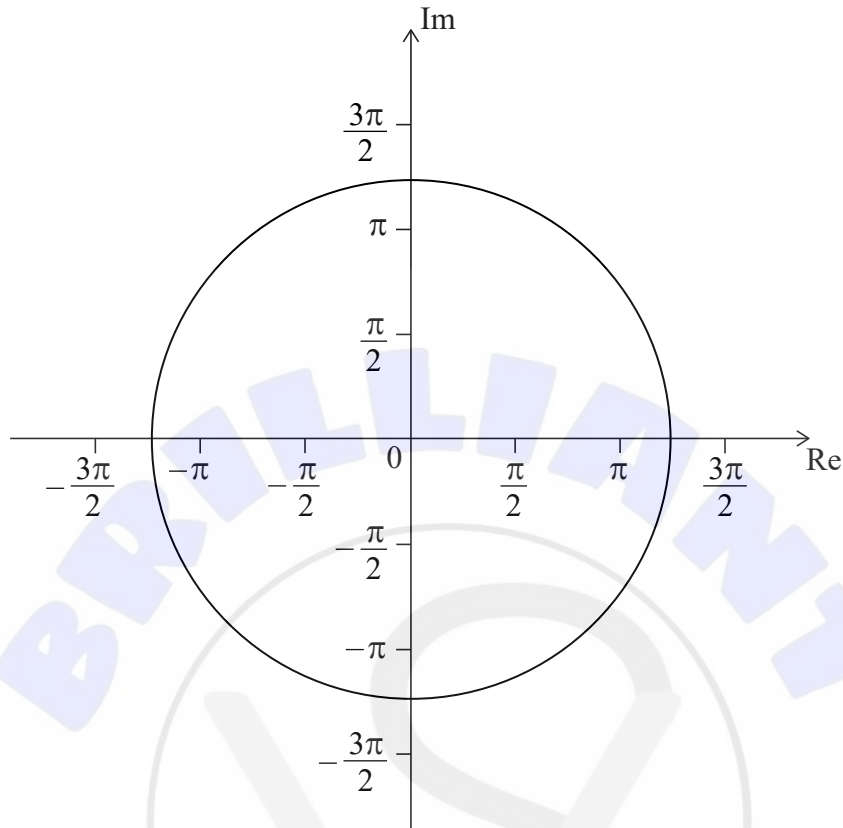
(b) Find the value of a .

[2]



10. [Maximum mark: 7]

The following Argand diagram shows a circle centre 0 with a radius of 4 units.



A set of points, $\{z_\theta\}$, on the Argand plane are defined by the equation

$$z_\theta = \frac{1}{2}\theta e^{i\theta}, \text{ where } \theta \geq 0.$$

(a) Plot on the Argand diagram the points corresponding to

(i) $\theta = \frac{\pi}{2}$.

(ii) $\theta = \pi$.

(iii) $\theta = \frac{3\pi}{2}$.

[3]

Consider the case where $|z_\theta| = 4$.

(b) (i) Find this value of θ .

(ii) For this value of θ , plot the approximate position of z_θ on the Argand diagram.

[4]

(This question continues on the following page)



