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Specialist Mathematics

2007

Trial Examination 1

Instructions

Answer **all** questions. Do **not** use calculators.

A decimal approximation will not be accepted if an **exact** answer is required to a question.

In questions where more than one mark is available, appropriate working must be shown.

Unless otherwise indicated, the diagrams in this exam are **not** drawn to scale.

Take the **acceleration due to gravity** to have magnitude $g \text{ ms}^{-2}$, where $g = 9.8$.

Question 1 Given $\frac{x^2}{3} - \frac{y^2}{2} = 1$, $x, y \in R$,

a. show that $\frac{dy}{dx} = \frac{2x}{3y}$.

b. Find the coordinates of a point on the curve where the gradient is -1 .

1 + 3 = 4 marks

Question 2 A 2-kg particle has an acceleration (in ms^{-2}) $\mathbf{a} = 12\mathbf{i} - 5\mathbf{j}$ for $t \geq 0$.

a. Find the exact magnitude and direction of the resultant force on the particle.

b. Find the displacement of the particle at $t = 2$ s if it is initially at rest.

2 + 2 = 4 marks

Question 3 The position of a particle at time $t \geq 0$ is given by $\mathbf{r}(t) = 2t\mathbf{i} - (5t + 1)\mathbf{j} + 2\mathbf{k}$.

a. Show that the particle moves in a straight line.

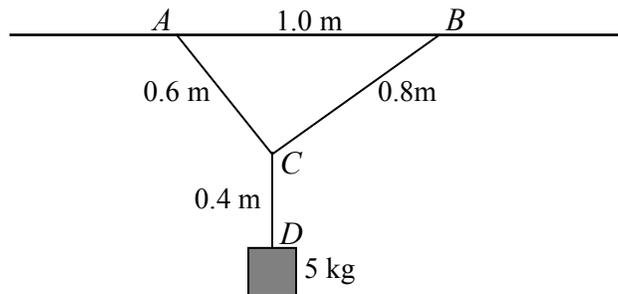
b. Find the speed of the particle.

2 + 1 = 3 marks

Question 4 Find $y = f(x)$ such that $x \frac{dy}{dx} - \log_e(2x) = 0$ and $f\left(\frac{1}{2}\right) = 0$.

3 marks

Question 5 A 5-kg load is suspended by three cords AC , BC and CD of negligible mass.



a. Find the tension in cord CD .

b. Hence find the tension in cord BC .

1 + 2 = 3 marks

Question 6 Consider the three points $P(-1,0,1)$, $Q(1,-2,2)$ and $R(2,1,0)$.

a. Find vector \overrightarrow{PQ} in terms of \mathbf{i} , \mathbf{j} and \mathbf{k} .

b. Find the shortest distance from point R to the line through points P and Q .

1 + 3 = 4 marks

Question 7 Given $f(x) = \frac{10\sqrt{3}}{x^2 - 4x + 7}$.

a. Show that $f(x)$ can be rewritten as $\frac{10\sqrt{3}}{3 + (x - 2)^2}$.

b. Sketch the graph of $f(x)$. Label the axis intercept(s), asymptote(s) and turning point(s) in exact form.

c. Hence find the area bounded by $y = f(x)$, $x = -1$, $x = 3$ and the x -axis.

1 + 3 + 3 = 7 marks

Question 8

a. Factorise $x^2 + i2\sqrt{3}x - 4$. Show working.

b. Find the square roots of $1 - i\sqrt{3}$ and $-1 - i\sqrt{3}$.

c. Hence factorise $x^4 + i2\sqrt{3}x^2 - 4$.

2 + 3 + 2 = 7 marks

Question 9 The velocity of a particle moving in a straight line is given by $v(t) = \frac{5(1-2t)}{1+2t}$, $t \geq 0$.

a. Find the time when the particle comes to a stop momentarily.

b. Find the exact total distance traveled by the particle at $t = 1$.

1 + 4 = 5 marks

End of Exam 1