Register No.	Class

Name : ____________________

BENDEMEER SECONDARY SCHOOL
2021 Preliminary Examination
Secondary Four Express
Additional Mathematics Paper 1
4049/ 01

DATE : 25 August 2021
DURATION : 2 hours 15 minutes
TOTAL : 90 Marks

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a 2B pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Answer **all** questions.
Write your answers in the spaces provided on the question paper.
All the diagrams in this paper are **not** drawn to scale.
If working is needed for any question, it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

FOR EXAMINER'S USE
90

This question paper consists of 18 printed pages including this cover page.

[Turn over

MATHEMATICAL FORMULAE

1. ALGEBRA

Quadratic Equation

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Binomial Theorem

$$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \ldots + \binom{n}{r}a^{n-r}b^r + \ldots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!} = \frac{n(n-1)\ldots(n-r+1)}{r!}$

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\cos ec^2 A = 1 + \cot^2 A$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$

$$\tan 2A = \frac{2\tan A}{1 - \tan^2 A}$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.$$

$$a^2 = b^2 + c^2 - 2bc\cos A.$$

$$\Delta = \frac{1}{2}bc\sin A.$$

1 **(i)** Find the value of 10^x, given that $4^{x+1} \times 5^{2x-3} = 10^{3x}$. [3]

(ii) Hence, solve $4^{x+1} \times 5^{2x-3} = 10^{3x}$. [1]

2 **(a)** The equation of a curve is $y = 3x^2 + 5x + 1$. Find the set of values of x for which the curve lies completely above the line $y - 3x = 2$. [3]

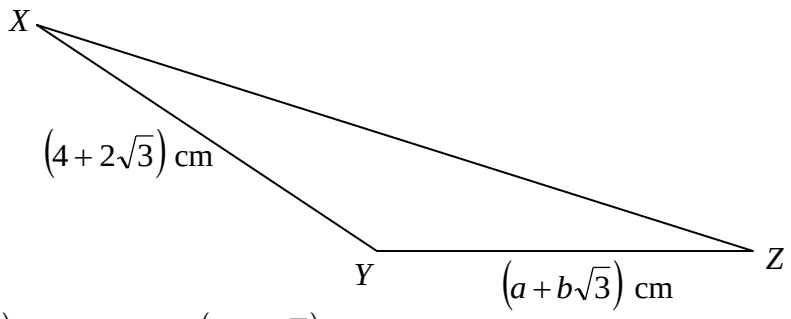
(b) Find the range of values of m for which the equation $mx^2 + 2m = 3x(4 - x)$ has real roots. [3]

3 **(i)** Express $\frac{8x^2 - x}{4x^2 - 1}$ in partial fractions. [4]

(ii) Use your results in part (i) to find $\int \frac{8x^2 - x}{4x^2 - 1}\, dx$. [2]

4 **(i)** Express $\frac{30+18\sqrt{3}}{2+\sqrt{3}}$ in the form $r + s\sqrt{3}$, where r and s are integers. [3]

(ii) The diagram shows a triangle XYZ.



XY is $(4 + 2\sqrt{3})$ cm and YZ is $(a + b\sqrt{3})$ cm, where a and b are integers.
The included angle XYZ is 150°.
Given that the area of the triangle is $(15 + 9\sqrt{3})$ cm^2, find the value of a and of b. [5]

5 **(a)** The equation $\log_2 x + \log_8 x = \log_7 49$ has the solution $x = 2^a$. [4]
Find the value of a.

(b) Show that the equation $\log_3(4x - 11) - \log_3(x - 3) = 1$ has no solution. [4]

6 The equation of a curve is $y = 3 - 4sin2x$.

(i) State the minimum and maximum value of y. [2]

(ii) Sketch the curve $y = 3 - 4sin2x$ for $0 \leq x \leq 2\pi$ [3]

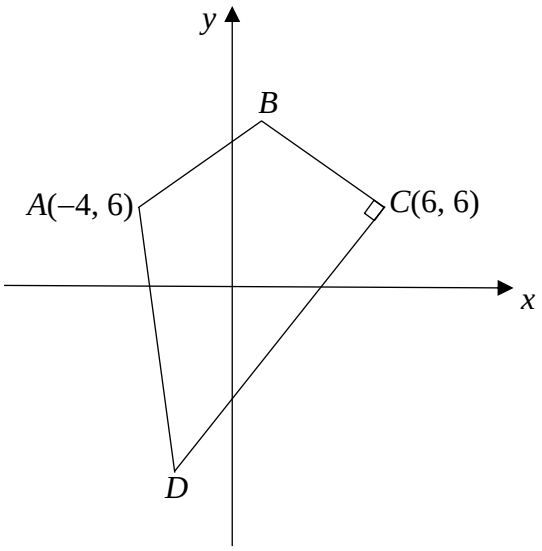
7 The function is defined by $(x) = \frac{x^2-4}{x^2+6}$, $x > 0$.

(i) Explain, with working, whether *g(x)* is an increasing or decreasing function. [4]

(ii) A point *P* moves along the curve g(*x*), such that the *y* – coordinate of *P* is increasing at a rate of 0.04 unit per second. Find the rate of increase of the *x* – coordinate of *P* when $x = 2$. [2]

8 The gradient function of a curve is given by $\frac{dy}{dx} = \frac{16}{x^3} - 4$. Given that the line $2y - x - 6 = 0$ is a normal to the curve, find the equation of the curve. [6]

9 The diagram (not drawn to scale) shows a quadrilateral *ABCD* such that *AB* = *BC* and angle *BCD* = 90°. The point *A* is $(-4, 6)$ and the point *C* is $(6, 6)$. Given that the area of triangle *ABC* is 15 square units and the point *D* lies on the line $3y + 5x + 42 = 0$.



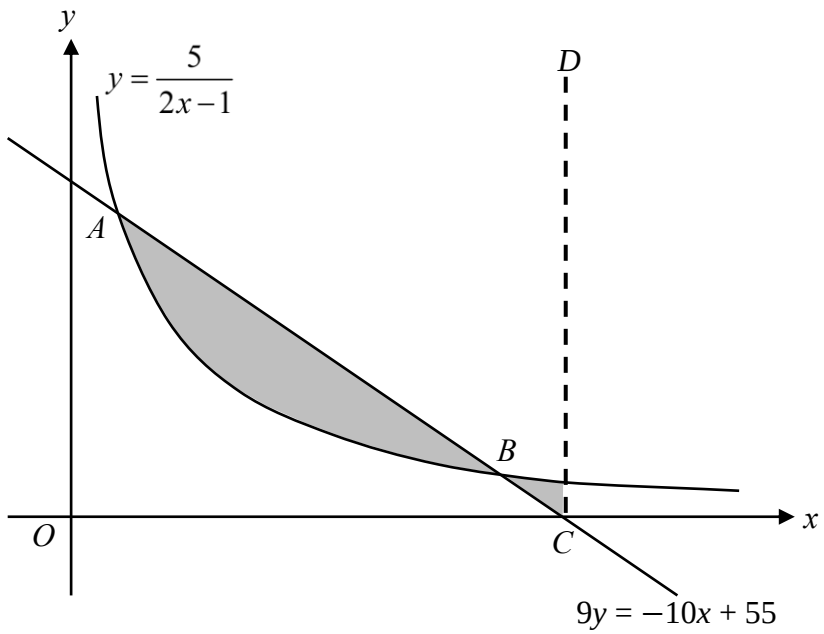
(i) Find the coordinates of *B*. [2]

(ii) Find the coordinates of *D*. [4]

9 **(iii)** Find the area of the quadrilateral $ABCD$. [3]

(iv) The point X lies on the line AB produced such that $AB : BX$ is 2 : 3. Find the coordinates of X. [2]

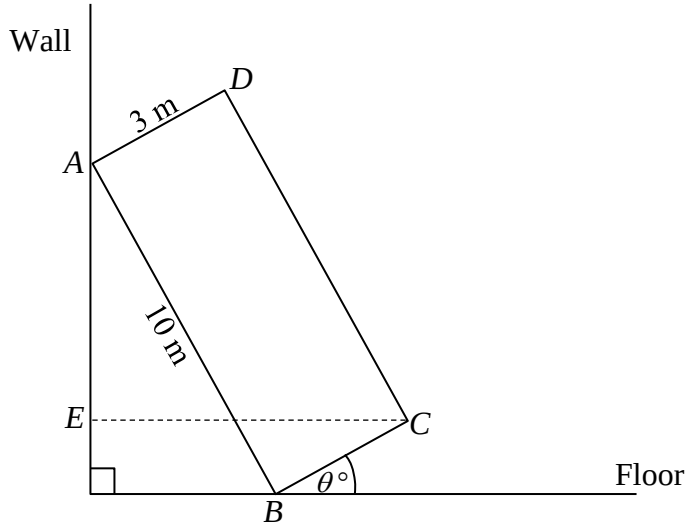
10 The diagram shows part of the curve $y = \frac{5}{2x-1}$. The line $9y = -10x + 55$ intersects the curve at points A and B and meets the x-axis at point C. CD is a straight line parallel to the y – axis.



(i) Find the coordinates of A, B and C. [4]

10 **(ii)** Find the area of the shaded region. [4]

11 The diagram shows a rectangle *ABCD* that is leaning against a vertical wall.



AB is 10 metres, *AD* is 3 metres and the side *BC* makes an angle $\theta°$ with the floor.
EC is horizontal distance of *C* from the wall.

(i) Show that *EC* can be expressed in the form $a \sin \theta + b \cos \theta$, where *a* and *b* are constants to be found. [2]

(ii) Express *EC* in the form $R \sin (\theta + \alpha)$ where $R > 0$ and α is an acute angle. [4]

11 The rectangle *ABCD* will remain leaning against the wall provided *EC* lies between 7.5 metres and 9.5 metres.

(iii) Find the range of values of θ for the rectangle *ABCD* to remain leaning against the wall. [4]

12 The points P and Q both lie on a circle and have coordinates (-10, 15) and (10, 0) respectively. The centre of the circle lies on the line $4y = 3x + 37$.

(i) Find the equation of the perpendicular bisector of PQ. [5]

(ii) Find the equation of the circle in the general form. [5]

12 The point R is such that PR is a diameter of the circle.

(iii) Find the coordinates of R. [2]

End of Paper

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Additional Mathematics Answer Key

1(i)	$\frac{4}{125}$	**8**	$y = -\frac{8}{x^2} - 4x + 14$
1(ii)	-1.49	**9(i)**	B (1, 9)
2(a)	$x < -1$ or $x > \frac{1}{3}$	**9(ii)**	D (-3, -9)
2(b)	$-6 \leq m \leq 3$	**9(iii)**	Area = 90 units^2
3(i)	$\frac{8x^2 - x}{4x^2 - 1} = 2 + \frac{3}{4(2x-1)} - \frac{5}{4(2x+1)}$	**9(iv)**	X (8.5, 13.5)
3(ii)	$2x + \frac{3}{8}\ln(2x-1) - \frac{5}{8}\ln(2x+1) + c$	**10(i)**	A (1, 5), B (5, $\frac{5}{9}$), C (5.5, 0)
4(i)	$6 + 6\sqrt{3}$	**10(ii)**	5.74 units^2
4(ii)	a = b = 6	**11(i)**	EC = $10sin\theta + 3cos\theta$
5(a)	a = 1.5	**11(ii)**	EC = $\sqrt{109}\sin(\theta + 16.7^o)$
5(b)	*No solution*	**11(iii)**	$29.2^0 < \theta < 48.8^o$
6(i)	Min = -1, max = 7	**12(i)**	$y = \frac{4}{3}x + \frac{15}{2}$
6(ii)	graph	**12(ii)**	$x^2 - 6x + y^2 - 23y - 40 = 0$
7(i)	Increasing function	**12(iii)**	R (16, 8)
7(ii)	0.1unit/s		