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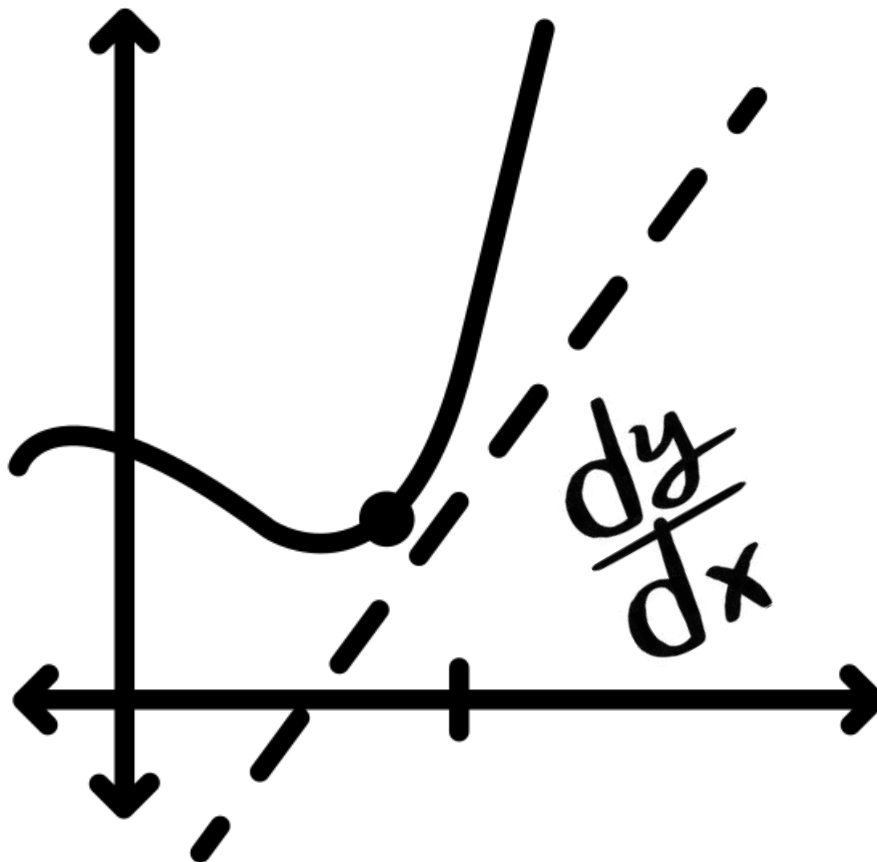
# EDEXCEL IGCSE MATHEMATICS

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PAPER 2H & 2HR (LINEAR)

## DIFFERENTIATION

QP & MS (2018 - 2025)



COMPILED BY:  
SIR MUHAMMAD ABDULLAH SHAH



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by Sir Muhammad Abdullah Shah

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# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

1. Nov 2025 2H/Q22

Curve C has equation  $y = x^3 - 16x + 7$

At two points on C, the gradient is 11

The tangents to C at these two points have equations of the form  $y = ax + b$

Work out the two possible values of  $b$

Show clear algebraic working.



(Total for Question 22 is 6 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

2. June 2025 2H/Q17

$$y = 4x^3 + 5x^2 + 2x$$

(a) Find  $\frac{dy}{dx}$

$$\frac{dy}{dx} = \dots\dots\dots (2)$$

(b) Find the coordinates of the turning points on the graph with equation  $y = 4x^3 + 5x^2 + 2x$   
Show clear algebraic working.



(4)

(Total for Question 17 is 6 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

3. June 2025 2HR/Q22

The diagram shows a solid cuboid.

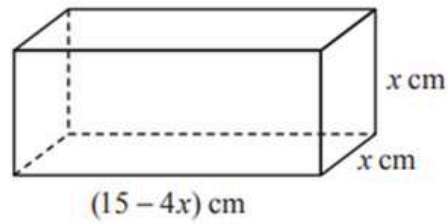


Diagram **NOT**  
accurately drawn

The volume of the cuboid is  $V$  cm<sup>3</sup>

Find the maximum value of  $V$



(Total for Question 22 is 5 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

4. Nov 2023 2H/Q18

A particle is moving along a straight line that passes through the fixed point  $O$   
The displacement,  $s$  metres, of the particle from  $O$  at time  $t$  seconds is given by

$$s = 2t^3 - 5t^2 + 6t - 5$$

Find the value of  $t$  when the acceleration of the particle is  $5 \text{ m/s}^2$



$t = \dots\dots\dots$

(Total for Question 18 is 4 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

5. Jan 2022 2H/Q24

A particle  $P$  moves along a straight line that passes through the fixed point  $O$

The displacement,  $x$  metres, of  $P$  from  $O$  at time  $t$  seconds, where  $t \geq 0$ , is given by

$$x = 4t^3 - 27t + 8$$

The direction of motion of  $P$  reverses when  $P$  is at the point  $A$  on the line.

The acceleration of  $P$  at the instant when  $P$  is at  $A$  is  $a \text{ m/s}^2$

Find the value of  $a$



$a = \dots\dots\dots$

(Total for Question 24 is 5 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

6. Oct 2021 2H/Q21

The curve **C** has equation  $y = f(x)$  where  $f(x) = 9 - 3(x + 2)^2$

The point **A** is the maximum point on **C**.

(a) Write down the coordinates of **A**.

(....., .....)  
(1)

The curve **C** is transformed to the curve **S** by a translation of  $\begin{pmatrix} 4 \\ 0 \end{pmatrix}$

(b) Find an equation for the curve **S**.



The curve **C** is transformed to the curve **T**.

The curve **T** has equation  $y = 3(x + 2)^2 - 9$

(c) Describe fully the transformation that maps curve **C** onto curve **T**.

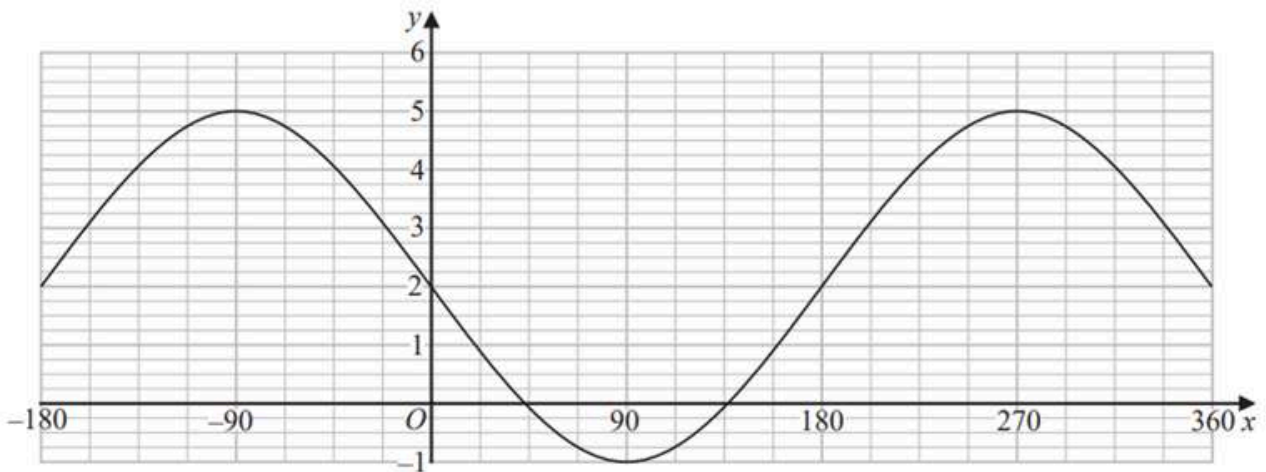
.....  
(1)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

The graph of  $y = a \cos(x - b)^\circ + c$  for  $-180 \leq x \leq 360$  is drawn on the grid below.



(d) Find the value of  $a$ , the value of  $b$  and the value of  $c$ .

$a = \dots\dots\dots$

$b = \dots\dots\dots$

$c = \dots\dots\dots$

(3)

(Total for Question 21 is 6 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

7. May 2021 2H/Q21

The point  $A$  is the only stationary point on the curve with equation  $y = kx^2 + \frac{16}{x}$   
where  $k$  is a constant.

Given that the coordinates of  $A$  are  $\left(\frac{2}{3}, a\right)$

find the value of  $a$ .

Show your working clearly.



$a = \dots\dots\dots$

(Total for Question 21 is 5 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

8. Jan 2021 2H/Q19

A particle  $P$  is moving along a straight line.

The fixed point  $O$  lies on this line.

At time  $t$  seconds where  $t \geq 0$ , the displacement,  $s$  metres, of  $P$  from  $O$  is given by

$$s = t^3 + 5t^2 - 8t + 10$$

Find the displacement of  $P$  from  $O$  when  $P$  is instantaneously at rest.

Give your answer in the form  $\frac{a}{b}$  where  $a$  and  $b$  are integers.



..... metres

(Total for Question 19 is 5 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

9. June 2019 2H/Q18

The diagram shows a solid cuboid.

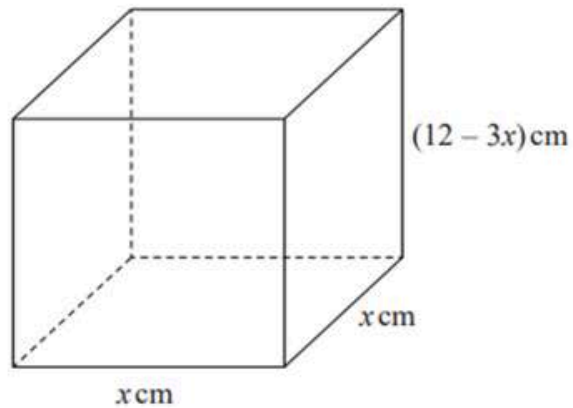


Diagram **NOT** accurately drawn

The total surface area of the cuboid is  $A$  cm<sup>2</sup>

Find the maximum value of  $A$ .



(Total for Question 18 is 5 marks)



EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

10. June 2018 2H/Q17

$$y = x^3 - 2x^2 - 15x + 5$$

(a) Find  $\frac{dy}{dx}$

$$\frac{dy}{dx} = \dots\dots\dots (2)$$

C is the curve with equation  $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of  $x$  for which C has a negative gradient.



.....  
(4)

(Total for Question 17 is 6 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

## 11. Sample 2018 2H/Q25

A particle moves along a straight line.

The fixed point  $O$  lies on this line.

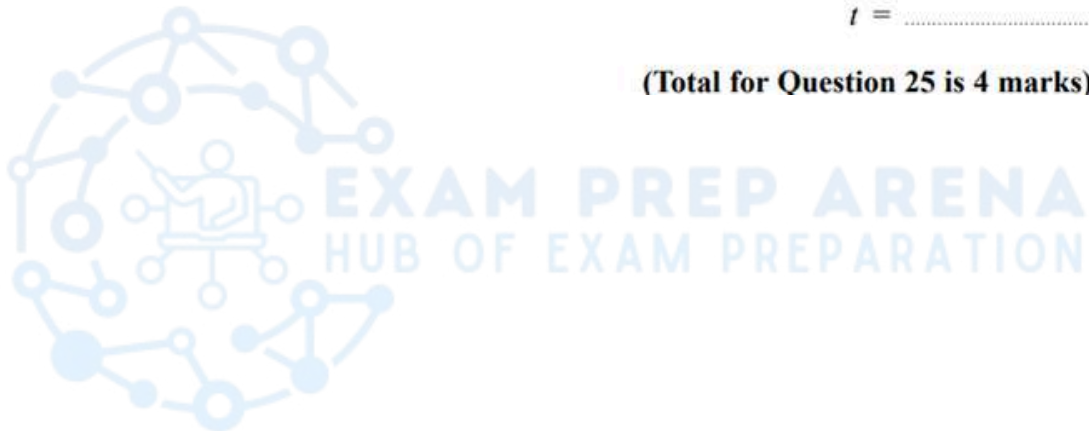
The displacement of the particle from  $O$  at time  $t$  seconds,  $t \geq 0$ , is  $s$  metres, where

$$s = t^3 - 5t^2 - 8t + 3$$

Find the value of  $t$  for which the particle is instantaneously at rest.

$t = \dots\dots\dots$

(Total for Question 25 is 4 marks)



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

## MARKING SCHEME

### 1. Nov 2025 2H/Q22

22	$\left(\frac{dy}{dx}\right) = 3 \times x^2 - 16 (= 3x^2 - 16)$		6	B2 for $3 \times x^2 - 16$ or $3x^2 - 16$ (with no other terms)  (B1 for one term, ie $3 \times x^2$ or $3x^2$ or $-16$ )
	$3x^2 - 16 = 11$ oe eg $3x^2 - 27 = 0$ (allow one of $x = 3$ or $x = -3$ )			M1 fit dep on B1  Derivative must be a two term <b>quadratic</b> in the form  $3x^2 - a = 11$ oe where $a \neq 0$ or $bx^2 - 16 = 11$ oe where $b \neq 0$ ( $a$ and $b$ are constants)  Allow $3x^2 - 16 + 7 = 11$ oe  <b>NB</b> $3x^2 - 16x = 11$ is M0
	$(y =) ("3")^3 - 16("3") + 7 (= -14)$ or $(y =) (" - 3")^3 - 16(" - 3") + 7 (= 28)$			M1 dep on previous M1 <b>and</b> for a correct rearrangement for $x$
	"-14" = $11("3") + b$ or $y - "-14" = 11(x - "3")$ or $\frac{y - "-14"}{x - "3"} = 11$ oe or "28" = $11(" - 3") + b$ or $y - "28" = 11(x - " - 3")$ or $\frac{y - "28"}{x - " - 3"} = 11$ oe			M1 dep on previous M1
	<i>Working required</i>	-47 and 61		A1 dep on B2M1 Answer of -47 or 61 award 5 marks dep on B2M1
				<b>Total 6 marks</b>

### 2. June 2025 2H/Q17

Question	Working	Answer	Mark	Notes
17(a)	Two of $12x^2 + 10x + 2$		2	M1 for differentiating 2 or 3 terms correctly
		$12x^2 + 10x + 2$		A1 for all 3 terms correct
(b)	$(3x + 1)(4x + 2) (= 0)$ or $(6x + 2)(2x + 1) (= 0)$ or $2(3x + 1)(2x + 1) (= 0)$ or $(3x + 1)(2x + 1) (= 0)$  $\frac{-10 \pm \sqrt{10^2 - 4 \times 12 \times 2}}{2 \times 12}$ or $\frac{-5 \pm \sqrt{5^2 - 4 \times 6 \times 1}}{2 \times 6}$ or  $12 \left[ \left( x + \frac{10}{24} \right)^2 - \left( \frac{10}{24} \right)^2 \right] + 2 (= 0)$ oe or  $6 \left[ \left( x + \frac{5}{12} \right)^2 - \left( \frac{5}{12} \right)^2 \right] + 1 (= 0)$ oe		4	M1 fit dep on M1 for a correct method to solve their <b>3 term quadratic</b> equation (with at least 2 correct coefficients) using any correct method (if factorising, allow brackets which expanded give 2 out of 3 terms correct) (if using formula allow one sign error and some simplification - allow as far as $\frac{-10 \pm \sqrt{100 - 96}}{24}$ ) Derivative must be a <b>3 term quadratic</b> for this M mark  NB Can be implied by answers of $(x =) -\frac{1}{2}$  <b>and</b> $(x =) -\frac{1}{3}$
		$-\frac{1}{2}, -\frac{1}{3}$		A1 oe dep on previous M1 Allow $-0.33(333)$ or $-0.\dot{3}$ for correct $x$ values
	$(y =) 4 \times \left( -\frac{1}{2} \right)^3 + 5 \left( -\frac{1}{2} \right)^2 + 2 \left( -\frac{1}{2} \right) \left( = -\frac{1}{4} \right)$ or $(y =) 4 \times \left( -\frac{1}{3} \right)^3 + 5 \left( -\frac{1}{3} \right)^2 + 2 \left( -\frac{1}{3} \right) \left( = -\frac{7}{27} \right)$			M1 fit dep on previous M1 for substituting at least one $x$ value into $y$  NB Can be implied by one correct value of $y$
	<i>Working required</i>	$\left( -\frac{1}{2}, -\frac{1}{4} \right)$ $\left( -\frac{1}{3}, -\frac{7}{27} \right)$		A1 oe dep on M1 for correct coordinates $(-0.5, -0.25), (-0.33, -0.25(9...))$
				<b>Total 6 marks</b>



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

## 3. June 2025 2HR/Q22

22	$(V =) x(x)(15 - 4x) (= 15x^2 - 4x^3)$		5	M1	for a correct expression for the volume (condone missing $V = \dots$ )
	$\left(\frac{dV}{dx} =\right) 30x - 12x^2$			M1ft	ft dep on a $V$ of the form $ax^3 + bx^2$ where $a, b \neq 0$  for a two-term derivative with at least one term correct for their $V$  eg $15(2)x$ or $30x$ or $-3(4)x^2$ or $-12x^2$
	$30x - 12x^2 = 0 \Rightarrow x = \dots$ or $(x =) 2.5$ oe			M1ft	dep on previous M mark  for equating their 2-term first derivative to 0 and solving to get a value of $x$ (the value of $x$ obtained must be greater than 0 and must not be where their second derivative is equal to 0) or the correct value of $x$
	$(V =) "2.5" \times "2.5" \times (15 - 4 \times "2.5")$ or $(V =) 15("2.5")^2 - 4("2.5")^3$			M1	dep on M3 for a full and correct substitution of their value of $x$
	<i>Correct answer only scores full marks (unless from obviously incorrect working)</i>	31.25		A1	oe eg $\frac{125}{4}$ ignore any units on the answer line
<b>Total 5 marks</b>					

## 4. Nov 2023 2H/Q18

Question	Working	Answer	Mark	Notes
18	$\left(\frac{ds}{dt} =\right) 6t^2 - 10t + 6$		4	M1 at least 2 terms correct
	$\left(\frac{dv}{dt} =\right) 12t - 10$			M1ft ft from a 3 term quadratic
	$"12t - 10" = 5$			M1ft ft dep on previous M1 awarded
	<i>Working not required, so correct answer scores full marks (unless from obvious incorrect working)</i>	1.25		A1oe
<b>Total 4 marks</b>				

## 5. Jan 2022 2H/Q24

24	$(v =) 12t^2 - 27 (= 0)$		5	M1 Correct differentiation
	$t^2 = \frac{27}{12} (= \frac{9}{4})$ oe or $(3)(2t + 3)(2t - 3) (= 0)$			M1 dep M1 first stage to solve $v = 0$ by rearranging, factorising, quadratic formula, or completing the square
	$\sqrt{\frac{9}{4}}$ oe $(= \frac{3}{2})$ or $\pm \sqrt{\frac{9}{4}}$ oe $(= \pm \frac{3}{2})$			A1 Correct value of $t$ (allow $\pm$ )
	$(a =) 24t$			M1 dep 1st M1 for differentiating $v$
		36		A1 correct answer
<b>Total 5 marks</b>				



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

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## 6. Oct 2021 2H/Q21

24	$(v =) 12t^2 - 27 (= 0)$		5	M1 Correct differentiation
	$t^2 = \frac{27}{12} (= \frac{9}{4})$ oe or $(3)(2t + 3)(2t - 3) (= 0)$			M1 dep M1 first stage to solve $v = 0$ by rearranging, factorising, quadratic formula, or completing the square
	$\sqrt{\frac{9}{4}}$ oe $(= \frac{3}{2})$ or $\pm \sqrt{\frac{9}{4}}$ oe $(= \pm \frac{3}{2})$			A1 Correct value of $t$ (allow $\pm$ )
	$(a =) 24t$			M1 dep 1st M1 for differentiating $v$
		36		A1 correct answer
<b>Total 5 marks</b>				

## 7. May 2021 2H/Q21

Question	Working	Answer	Mark	Notes
21	$\left[ \frac{dy}{dx} = \right] 2 \times kx - 16x^{-2}$ or $2kx - \frac{16}{x^2}$ oe		5	M2 for both terms differentiated correctly (M1) for one term differentiated correctly
	" $2kx - 16x^{-2} = 0$ " oe			M1 ft dep on M1
	eg $\frac{8}{27}k = 8$ or $\frac{4}{3}k = 36$ or $k = 27$ oe			M1 (not ft) for substituting $x = \frac{2}{3}$ into their correct equation for $k$ and getting as far as one step from the value of $k$ or the correct value of $k$
	<i>Working must be seen</i>	36		A1 dep on M4
<b>Total 5 marks</b>				

## 8. Jan 2021 2H/Q19

19	$(v =) 3t^2 + 10t - 8$ $3t^2 + 10t - 8 = 0$		5	M1 For at least 2 terms differentiated correctly
	$(3t - 2)(t + 4) (= 0)$ $(t =) \frac{2}{3}$ or $(t =) -4$			M1 Their $v = 0$ dep on M1 could be implied by correct values M1 dep on M1 for correct values for $t$ or for $t = \frac{2}{3}$ or correct method to solve their 3 term quadratic equation: If factorising, allow brackets which when expanded give 2 out of 3 terms correct (If using formula or completing the square allow one sign error and some simplification – allow as far as eg $\frac{-10 \pm \sqrt{100 + 96}}{6}$ oe $3(t + \frac{5}{3})^2 - \frac{48}{3} = 0$ )
	$(s =) \left(\frac{2}{3}\right)^3 + 5 \times \left(\frac{2}{3}\right)^2 - 8 \times \frac{2}{3} + 10$			M1 For $\frac{2}{3}$ (only) substituted into formula for $s$ or for selecting the value from this substitution or for an answer of 7.185...
		$\frac{194}{27}$		A1 oe but numerator and denominator must be integers.
<b>Total 5 marks</b>				



# EDEXCEL IGCSE MATHEMATICS LINEAR 2H & 2HR - DIFFERENTIATION

COMPILED BY SIR MUHAMMAD ABDULLAH SHAH

## 9. June 2019 2H/Q18

18	$x^2$ oe or $x(12 - 3x)$ oe			M1 for finding an expression for the area of <b>one</b> face
	$x^2 + x^2 + 48x - 12x^2 (= 48x - 10x^2)$			M1 for a complete expression for A ( <b>6</b> sides) with brackets expanded
	'48 - 20x' = 0	'-10'[(x - '2.4') <sup>2</sup> - '2.4' <sup>2</sup> ] oe		M1 for differentiating a correct expression for A (allow 1 error) <b>and</b> equating to zero  or completing the square
	(x = 2.4) 48 × '2.4' - 10 × '2.4' <sup>2</sup>	'-10' × - '2.4' <sup>2</sup> or '-10' × - '5.76'		M1 ft if previous M1 awarded  for isolating x and substituting into A  or finding max value of A from completing the square
			57.6	5
				A1 accept 58 from correct working
<b>Total 5 marks</b>				

## 10. June 2018 2H/Q17

Question	Working	Answer	Mark	Notes
17 (a)		$3x^2 - 4x - 15$	2	B2 Award B1 for any 2 or 3 of the 4 terms differentiated correctly.
(b)	$3x^2 - 4x - 15 < 0$ (or = 0) (3x + 5)(x - 3) (< 0) or $\frac{-(-4) \pm \sqrt{(-4)^2 - 4 \times 3 \times (-15)}}{2 \times 3}$		4	M1 ft from (a) ie "their (a)" = 0 (or < 0) M1 ft from "their (a)" (=0) for 3 term quadratic, for correct factorisation or correct use of quadratic formula to find the two critical values, allow 1 sign error. [-(-4) could be 4 and (-4) <sup>2</sup> could be 4 <sup>2</sup> ](condone missing brackets)
	$-\frac{5}{3}, 3$			M1 Both critical values correct Accept -1.66... rounded or truncated to 3SF.
		$-\frac{5}{3} < x < 3$		A1oe Inequality signs needed Allow $x > -\frac{5}{3}, x < 3$
<b>Total 6 marks</b>				

## 11. Sample 2018 2H/Q25

25	$(v = ) 3t^2 - 5 \times 2t - 8$ $3t^2 - 10t - 8 = 0$ $(3t + 2)(t - 4) = 0$	4	4	AO1	M1 for 2 out of 3 terms differentiated correctly A1 correct equation M1 for method to solve quadratic A1 t = 4 only
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