



امتحان دبلوم التعليم العام

لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)

الفصل الدراسي الثاني - الدور الأول - للعام الدراسي ١٤٤٧/١٤٤٦هـ - ٢٠٢٤ / ٢٠٢٥م

تنبيه:
- المادة: الرياضيات.
- الأسئلة في (١٢) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (⬭) وفق النموذج الآتي:

س – عاصمة سلطنة عمان هي:

⬭ القاهرة ⬭ الدوحة

⬬ مسقط ⬭ أبوظبي

ملاحظة: يتم تظليل الشكل (⬬) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ⬬ **غير صحيح** ⬭ ◉ ◒ ⊗ ✓

مُسَوَّدَة، لا يتم تصحيحها

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1. list of formulae is given in the last page.
2. Write all answers in the space provided in this question paper show all your work.
3. Non-programmable calculators are allowed.

1) (Shade in the bubble ⬭ next to the value of $\lim_{x \to 7} (3x - 2)$)

⬭ 1 ⬭ 8

⬭ 19 ⬭ 21 [1]

2) (Shade in the bubble ⬭ next to the derivative of $5x^{-2}$)

⬭ $5x^{-1}$ ⬭ $5x^{-3}$

⬭ $-10x^{-1}$ ⬭ $-10x^{-3}$ [1]

3) $f(x) = x^2 \sin x$

Differentiate $f(x)$ with respect to x by using the product rule.

[4]

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4) (Shade in the bubble ⬭ next to $\int 8x^3 \, dx$)

⬭ $24x^2 + c$ ⬭ $2x^4 + c$

⬭ $4x^2 + c$ ⬭ $32x^4 + c$ [1]

5) (Shade in the bubble ⬭ next to $\int \frac{1}{x^2 + 16} dx$)

⬭ $\tan^{-1}(\frac{x}{4}) + c$ ⬭ $\ln|x^2 + 16| + c$

⬭ $\frac{1}{4}\tan^{-1}(\frac{x}{4}) + c$ ⬭ $\frac{1}{4}\ln|x^2 + 16| + c$

[1]

6) Evaluate $\int_1^3 (-10t^4 + t) \, dt$

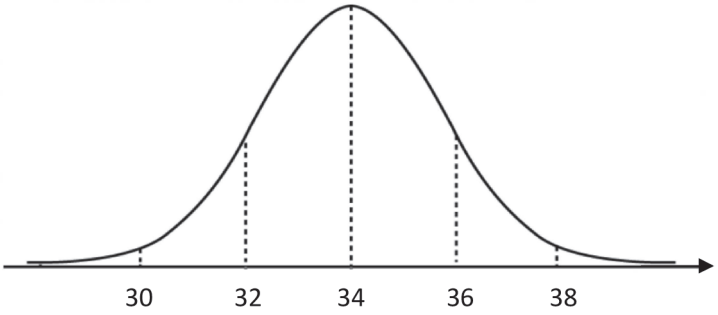
[3]

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7) The diagram below shows a normal distribution curve



Find the mean, the standard deviation and the variance from the diagram.

[3]

8) Evaluate $\lim_{x \to 9} \frac{x^2 - 81}{x - 9}$

[3]

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9) $f(x) = \ln x^6$

(Shade in the bubble ⬭ next to $f'(x)$)

⬭ $\frac{1}{x}$ ⬭ $\frac{1}{x^6}$

⬭ $\frac{6}{x}$ ⬭ $\frac{6}{x^6}$

[1]

10) $f(x) = 10 \tan^{-1}(3x^2 + 1)$

Find an expression for $f'(x)$

[4]

11) (Shade in the bubble ⬭ next to $\int \frac{e^x}{e^x + 1} dx$)

⬭ $x + e^x + c$ ⬭ $e^x + c$

⬭ $\ln|e^x + 1| + c$ ⬭ $\ln|e^x| + c$

[1]

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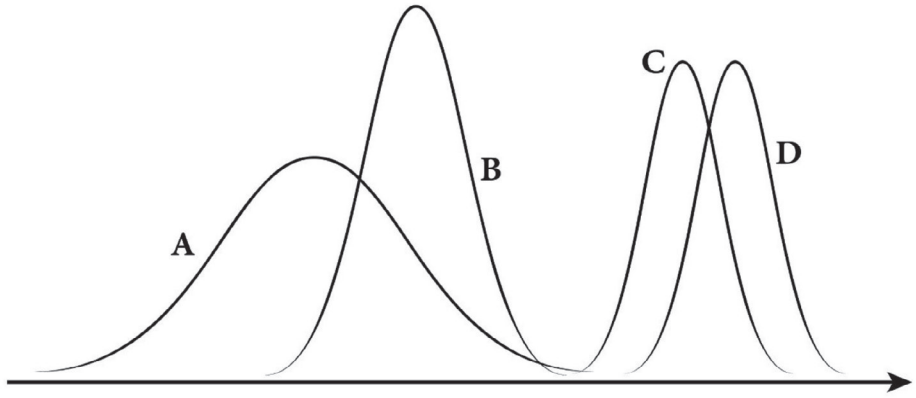
12) The table below gives the values of $x^2 e^{-x}$

x	0	0.5	1	1.5	2
$x^2 e^{-x}$	0	0.15	0.37	0.50	0.54

Estimate $\int_0^2 x^2 e^{-x} \, dx$

[4]

13) The diagram below shows the curves of normal distribution



(Shade in the bubble ⬭ next to the curve that has the largest standard deviation)

⬭ A ⬭ B

⬭ C ⬭ D

[1]

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14) The implicit equation of a curve is $2x^2 + y^2 + 3xy = 8$

Find $\frac{dy}{dx}$

[4]

15) Find $\int x(x^2 + 7)^5 \, dx$

[3]

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16) Evaluate $\lim_{x \to \infty} \frac{3x + 1}{5 - x}$

[2]

17) The distance x metres is moved by a body in a time t seconds is given by $x = t^3 - 9t^2 + 5$

(Shade in the bubble ⬭ next to the expression of the acceleration in terms of t)

⬭ $\frac{1}{4}t^4 - 3t^3 + 5t$

⬭ $3t^2 - 18t$

⬭ $3t^2 - 18t + 5$

⬭ $6t - 18$

[1]

18) $y = x^4 + e^{2x}$

(Shade in the bubble ⬭ next to the gradient of y when $x = 0$)

⬭ 0

⬭ 1

⬭ 2

⬭ 3

[1]

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19) $y = \dfrac{x^2}{x + 1}$

Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$

[4]

20) (Shade in the bubble ⬭ next to $\int \sin 5x \cos 5x \, \mathrm{d}x$)

⬭ $\frac{1}{2} \cos 10x + c$

⬭ $\frac{1}{20} \cos 10x + c$

⬭ $-\frac{1}{20} \cos 10x + c$

⬭ $-\frac{1}{2} \cos 10x + c$

[1]

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21) Find $\int \frac{-2}{x(x-2)}\,dx$

[5]

22) $y = \frac{1}{2}x^2 + x$

(Shade in the bubble ⬭ next to the turning-point on the curve of y)

⬭ $\left(1, \frac{3}{2}\right)$ ⬭ $\left(-1, -\frac{1}{2}\right)$

⬭ $(1, 2)$ ⬭ $(-1, 0)$

[1]

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23) A wire of 90 m length is bent into a rectangular shape.

Find the largest area that can be enclosed.

[5]

24) $\int_a^6 \frac{t^3}{t}\,dt = 81$

(Shade in the bubble ⬭ next to the value of a)

⬭ -27 ⬭ -3

⬭ 3 ⬭ 0

[1]

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25) $y = \int (\sin 2x - \cos 2x)\, dx$

Find the value of the arbitrary constant of integration y if $y = \frac{1}{2}$ when $x = \frac{\pi}{4}$

[3]

26) The random variable X can be modelled by a normal distribution $X \sim N(52, 9)$

Find the Percentage of the values between 46 and 55

[4]

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27) $f(x) = \operatorname{cosec} x$

Use the above function to prove that $f'(x) = -\cot x \operatorname{cosec} x$

[3]

28) Show that $\int x^2 \ln x \, dx = \frac{x^3}{3} \ln x - \frac{x^3}{9} + c$

[4]

[End of Examination]

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List of Formulae

$f(x)$	$f'(x)$
$y = x^n$	$\frac{dy}{dx} = nx^{n-1}$
$y = \sin ax$	$\frac{dy}{dx} = a.\cos ax$
$y = \cos ax$	$\frac{dy}{dx} = -a.\sin ax$
$y = \ln ax$	$\frac{dy}{dx} = \frac{1}{x}$
$y = e^{ax}$	$\frac{dy}{dx} = a.e^{ax}$
$y = \sec x$	$\frac{dy}{dx} = \sec x \tan x$
$y = \tan x$	$\frac{dy}{dx} = \sec^2 x$
$y = \tan^{-1} x$	$\frac{dy}{dx} = \frac{1}{1+x^2}$
$y = \frac{u}{v}$	$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$
$y = uv$	$\frac{dy}{dx} = \grave{u}v + v\grave{u}$

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$f(x)$	$\int f(x)dx$
$y = e^{ax}$	$\int y\,dx = \frac{1}{a}.e^{ax} + c$
$y = \sin ax$	$\int y\,dx = \frac{-1}{a}.\cos ax + c$
$y = \cos ax$	$\int y\,dx = \frac{1}{a}.\sin ax + c$
$y = \sec^2 ax$	$\int y\,dx = \frac{1}{a}.\tan ax + c$
$y = ax^n dx$	$\int y\,dx = \frac{ax^{n+1}}{n+1} + c\,, n \neq -1$
$y = \frac{1}{x^2 + a^2}$	$\int y\,dx = \frac{1}{a}\tan^{-1}\frac{x}{a} + c$

$$\int \frac{f'(x)}{f(x)}dx = \ln|f(x)| + c$$

Integration by substitution:

$$\int f(x)dx = \int f(x)\frac{dx}{du}du$$

Integration by parts:

$$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$$

The trapezium rule:

$$\int_a^b f(x)dx \approx \frac{1}{2}h\,\{y_0 + 2(y_1 + y_2 + \cdots + y_{n-1}) + y_n\} \quad \text{, where } h = \frac{b-a}{n}$$

Double Angles:

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

Reciprocal Functions:

$$\sec A = \frac{1}{\cos A}$$
$$\operatorname{cosec} A = \frac{1}{\sin A}$$
$$\cot A = \frac{\cos A}{\sin A}$$

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Royal Guard of Oman Technical College, Mathematics

Second Semester- First Session

Academic Year 2024/2025

Answer scheme

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
1	AO1 L	1.1	Booklet 4	☐ 1 ☐ 8 ■ 19 ☐ 21		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
2	AO1 L	2.1	85	☐ $5x^{-1}$ ☐ $5x^{-3}$ ☐ $-10x^{-1}$ ■ $-10x^{-3}$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
3	AO1 L	2.4	96	$u = x^2 \ , \quad \frac{du}{dx} = 2x$	1	1 mark for each correct term. If the student starts from this step and writes it correctly, he gets 4 marks (1 mark for each correct component)
				$v = \sin x \ , \quad \frac{dv}{dx} = \cos x$	1	
				$f'(x) = x^2 \times \cos x + \sin x \times 2x$	1+1	
				$= x^2 \cos x + 2x \sin x$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
4	AO1 L	3.1	Booklet 32	☐ $24\,x^2 + c$ ☐ $4x^2 + c$ ■ $2x^4 + c$ ☐ $32\,x^4 + c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
5	AO1 L	3.4	135	☐ $\tan^{-1}\left(\frac{x}{4}\right)+c$ ☐ $\ln\lvert x^2+16\rvert+c$ ■ $\frac{1}{4}\tan^{-1}\left(\frac{x}{4}\right)+c$ ☐ $\frac{1}{4}\ln\lvert x^2+16\rvert+c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
6	AO1 L	3.2	Booklet 37	$\int_1^3 (-10t^4 + t)\mathrm{d}t$		
				$= \left[-2\,t^5 + \frac{t^2}{2}\right]_1^3$	1	
				$= \left[-2\,(3)^5 + \frac{(3)^2}{2}\right] - \left[-2\,(1)^5 + \frac{(1)^2}{2}\right]$	1	
				$= -480$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
7	AO1 L	4.1	122 123	Mean = 34	1	
				Standard deviation = 2	1	
				Variance = 4	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
8	AO1 M	1.2	Booklet 2	$\lim_{x\to 9}\frac{x^2-81}{x-9}=$		If the student starts from this step and solves it correctly, he gets 3 marks.
				$\left.\frac{x^2-81}{x-9}\right\|_{x=9}=\frac{0}{0}$ (indeterminate)	1	
				Thus, $\lim_{x\to 9}\frac{(x-9)(x+9)}{(x-9)}$	1	
				$=\lim_{x\to 9}(x+9)$		
				$=9+9$		
				$=18$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
9	AO1 M	2.2	89	☐ $\frac{1}{x}$ ☐ $\frac{1}{x^6}$ ■ $\frac{6}{x}$ ☐ $\frac{6}{x^6}$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
10	AO1 M	2.6	104	$f'(x) = 10 \times \frac{1}{1+(3x^2+1)^2} \times 6x$	1+1+1	1 mark for each component.
				$f'(x) = \frac{60x}{1+(3x^2+1)^2}$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
11	AO1 M	3.4	138	☐ $x + e^x + c$ ☐ $e^x + c$ ■ $\ln\|e^x + 1\| + c$ ☐ $\ln\|e^x\| + c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
12	AO1 M	3.3	125	$h = \frac{2-0}{4} = \frac{1}{2}$	1	1 mark for $\frac{1}{2}\left(\frac{1}{2}\right)$ 1 mark for $\{ 0 + 2(0.15 + 0.37 + 0.50) + 0.54 \}$
				Then $\int_0^2 x^2 e^{-x}\, dx$ $= \frac{1}{2}\left(\frac{1}{2}\right)\{ 0 + 2(0.15 + 0.37 + 0.50) + 0.54 \}$	1+1	
				$= 0.645$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
13	AO1 M	4.1	120	■ A ☐ B ☐ C ☐ D		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
14	AO1 H	2.7	113	$4x + 2y\frac{dy}{dx} + 3y + 3x\frac{dy}{dx} = 0$	1+1+1	1 mark for $4x + 2y\frac{dy}{dx}$ 1 mark for $3y + 3x\frac{dy}{dx}$ 1 mark for $\frac{d}{dx}(8) = 0$
				$(2y + 3x)\frac{dy}{dx} = -3y - 4x$		
				$\frac{dy}{dx} = \frac{-3y - 4x}{2y + 3x}$ $= \frac{-(3y + 4x)}{2y + 3x}$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
15	AO1 H	3.7	144	Make the substitution $u = x^2 + 7$ Then $\frac{du}{dx} = 2x$	1	1 mark for correct u and $\frac{du}{dx}$
				$\int x\,(x^2+7)^5\ dx = \frac{1}{2}\int u^5\ du$	1	
				$= \frac{1}{12}u^6 + c$	1	
				$= \frac{1}{12}(x^2+7)^6 + c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [2]	More information
16	AO2 L	1.3	Booklet 3	$\lim_{x\to\infty} \frac{\frac{3x}{x}+\frac{1}{x}}{\frac{5}{x}-\frac{x}{x}}$	1	
				$=\frac{3+0}{0-1}$		
				$=-3$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
17	AO2 L	2.8	Booklet 6	☐ $\frac{1}{4}t^4 - 3t^3 + 5t$ ☐ $3t^2 - 18t + 5$ ☐ $3t^2 - 18t$ ■ $6t - 18$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
18	AO2 L	2.3	93	☐ 0 ☐ 1 ■ 2 ☐ 3		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
19	AO2 L	2.4	100	$u = x^2 \quad , \quad \frac{du}{dx} = 2x$	1	If the student starts from this step and writes it correctly, he gets 3 marks 1 mark for $(x+1) \times (2x)$ 1 mark for $-(x^2) \times 1$ 1 mark for $(x+1)^2$
				$v = x + 1 \ , \quad \frac{dv}{dx} = 1$	1	
				$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$		
				$= \frac{(x+1) \times (2x) - (x^2) \times 1}{(x+1)^2}$	1	
				$= \frac{2x^2 + 2x - x^2}{(x+1)^2}$		
				$= \frac{x^2 + 2x}{(x+1)^2}$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
20	AO2 L	3.5	134	☐ $\frac{1}{2}\cos 10x + c$ ☐ $\frac{1}{20}\cos 10x + c$ ■ $-\frac{1}{20}\cos 10x + c$ ☐ $-\frac{1}{2}\cos 10x + c$		

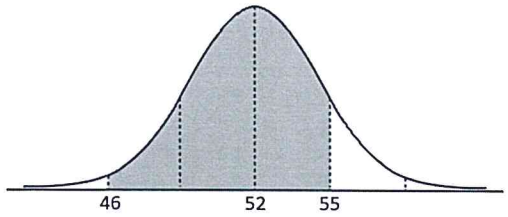
Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [5]	More information
21	AO2 L	3.6	139	Suppose $\frac{-2}{x(x-2)} = \frac{A}{x} + \frac{B}{x-2}$		
				Equate the numerators: $-2 = A(x-2) + Bx$		
				If $x = 0 \rightarrow -2 = -2A$		
				$\therefore A = 1$	1	
				If $x = 2 \rightarrow -2 = 2B$		
				$\therefore B = -1$	1	
				$\int \frac{-2}{x(x-2)}\,dx = \int (\frac{1}{x} - \frac{1}{x-2})\,dx$	1	
				$= \ln\|x\| - \ln\|x-2\| + c$	1+1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
22	AO2 M	2.10	Booklet 27	☐ $\left(1,\frac{3}{2}\right)$ ☐ $(1,2)$ ■ $\left(-1,-\frac{1}{2}\right)$ ☐ $(-1,0)$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [5]	More information
23	AO2 M	2.11	Booklet 28	$2y + 2x = 90$		
				$y = 45 - x$	1	
				$\text{Area} = xy = x(45 - x)$		
				$= 45x - x^2$	1	
				For maximum or minimum value: $\frac{dA}{dx} = 0 \implies 45 - 2x = 0$		
				$\implies x = 22.5$	1	
				$\frac{d^2A}{dx^2} = -2 < 0$, giving maximum value	1	
				The Largest Area $= 22.5 \times (45 - 22.5)$ $= 506.25\ \text{m}^2$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
24	AO2 M	3.2	131	☐ -27 ☐ 3 ■ -3 ☐ 0		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
25	AO2 M	3.1	Booklet 36	$y = -\frac{1}{2}\cos 2x - \frac{1}{2}\sin 2x + c$	1	1 mark for the correct substitution of x and y
				$y = \frac{1}{2}$ when $x = \frac{\pi}{4}$: $\frac{1}{2} = -\frac{1}{2}\cos\left(2\left(\frac{\pi}{4}\right)\right) - \frac{1}{2}\sin\left(2\left(\frac{\pi}{4}\right)\right) + c$	1	
				$c = 1$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
26	AO2 M	4.2	120 + 123	 The area is between -2 and 1 standard deviations	1	1mark to determine the area, either by drawing the curve or by writing the standard values
				$68\% + \frac{95\% - 68\%}{2}$	1+1	1mark for 68% 1mark for $\frac{95\%-6\ \%}{2}$ or 13.5%
				$= 68\% + 13.5\%$		
				$=81.5\%$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
27	AO2 H	2.5	93	$f(x) = \frac{1}{\sin x} = \sin^{-1}(x)$	1	
				$f'(x) = -(\sin x)^{-2} \cos x$	1	
				$= -\frac{\cos x}{(\sin x)^2}$		
				$= -\frac{\cos x}{\sin x} \times \frac{1}{\sin x}$		
				$= -\cot x \operatorname{cosec} x$	1	The student does not get this mark if the previous step is not written.

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
27	AO2 H	2.5	93	<u>Another solution:</u> $f(x) = \frac{1}{\sin x}$	1	
				Using the quotient rule: $f'(x) = \frac{0 \times \sin x - 1 \times \cos x}{(\sin x)^2}$	1	
				$= -\frac{\cos x}{(\sin x)^2}$		
				$= -\frac{\cos x}{\sin x} \times \frac{1}{\sin x}$		
				$= -\cot x \operatorname{cosec} x$	1	The student <u>does not</u> get this mark if the previous step is not written.

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
28	AO2 H	3.8	147	Consider the left-hand side: $\int x^2 \ln x \, dx$		1 mark for $\frac{x^3}{3}\ln x$ 1 mark for $-\int \frac{x^3}{3}\cdot\frac{1}{x}\,dx$
				Make the substitution $u = \ln x$ and $\frac{dv}{dx} = x^2$	1	
				$\frac{du}{dx} = \frac{1}{x}$ and $v = \frac{x^3}{3}$		
				Using integration by parts $\text{L.H.S} = \int x^2 \ln x \, dx$ $= \frac{x^3}{3}\ln x - \int \frac{x^3}{3}\cdot\frac{1}{x}\,dx$	1+1	
				$= \frac{x^3}{3}\ln x - \int \frac{x^2}{3}\,dx$		
				$= \frac{x^3}{3}\ln x - \frac{x^3}{3(3)} + c$	1	
				$= \frac{x^3}{3}\ln x - \frac{x^3}{9} + c = \text{R.H.S}$		

سلطنة عمان
وزارة التربية والتعليم

مركز القياس والتقويم التربوي
The Center for Educational Assessment and Measurement (CEAM)

امتحان دبلوم التعليم العام
لكلية الحرس السلطاني العماني التقنية (ثنائية اللغة)
الفصل الدراسي الثاني - الدور الثاني - للعام الدراسي ١٤٤٦ /١٤٤٧ هـ - ٢٠٢٤ / ٢٠٢٥ م

تنبيه:
- المادة: الرياضيات.
- الأسئلة في (١٣) صفحة.
- زمن الإجابة: ثلاث ساعات.
- الإجابة في الورقة نفسها.

تعليمات مهمة:

- يجب الحضور إلى قاعة الامتحان قبل عشر دقائق على الأقل من بدء زمن الامتحان.
- يجب إحضار أصل ما يثبت الهوية وإبرازها للعاملين بالامتحانات.
- يجب الالتزام بالزي (الدشداشة البيضاء والمصر أو الكمة للذكور) والزي المدرسي للطالبات ، ويستثنى من ذلك الدارسون من غير العمانيين بشرط الالتزام بالذوق العام، ويمنع على جميع المتقدمات ارتداء النقاب داخل المركز وقاعات الامتحان.
- يحظر على الممتحنين اصطحاب الهواتف النقالة وأجهزة النداء الآلي وآلات التصوير والحواسيب الشخصية والساعات الرقمية الذكية والآلات الحاسبة ذات الصفة التخزينية والمجلات والصحف والكتب الدراسية والدفاتر والمذكرات والحقائب اليدوية والآلات الحادة أو الأسلحة أياً كان نوعها وأي شيء له علاقة بالامتحان.
- يجب على الممتحن الامتثال لإجراءات التفتيش داخل المركز طوال أيام الامتحان.
- يجب على الممتحن التأكد من استلام دفتر امتحانه، مغلفاً بغلاف بلاستيكي شفاف وغير ممزق ، وهو مسؤول عنه حتى يسلمه لمراقبي اللجنة بعد الانتهاء من الإجابة.
- يجب الالتزام بضوابط إدارة امتحانات دبلوم التعليم العام وما في مستواه وأية مخالفة لهذه الضوابط تعرضك للتدابير والإجراءات والعقوبات المنصوص عليها بالقرار الوزاري رقم ٥٨٨ / ٢٠١٥.
- يقوم المتقدم بالإجابة عن أسئلة الامتحان المقالية بقلم الحبر (الأزرق أو الأسود).
- يقوم المتقدم بالإجابة عن أسئلة الاختيار من متعدد بتظليل الشكل (○) وفق النموذج الآتي:

س – عاصمة سلطنة عمان هي:

○ القاهرة ○ الدوحة
● مسقط ○ أبوظبي

ملاحظة: يتم تظليل الشكل (●) باستخدام القلم الرصاص وعند الخطأ، امسح بعناية لإجراء التغيير.

صحيح ● **غير صحيح** ▭ ◉ ◔ ☒ ☑

مُسَوَّدَة، لا يتم تصحيحها

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Instructions:

1. Time allowed is 3 hours.
2. Write all answers in the space provided in this question paper. Show all your work.
3. Programmable calculators are **not** allowed.
4. Graphs should be done on graph paper.
5. A list of formulae is provided on the final page.

1) (Shade in the bubble ⬭ next to the value of $\lim_{x\to\infty} 6(1)^x$)

⬭ 0 ⬭ 1

⬭ 6 ⬭ No limit [1]

2) $f(x) = \ln x^2$

(Shade in the bubble ⬭ next to $f'(x)$)

⬭ $\frac{1}{x}$ ⬭ $\frac{1}{x^2}$

⬭ $\frac{2}{x}$ ⬭ $\frac{2}{x^2}$ [1]

3) $y = x^4 + 3x^3 - 6x + x^{-2}$

Find $\frac{dy}{dx}$

[4]

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4) (Shade in the bubble ⬭ next to $\int \cos 4x \ \mathrm{d}x$)

⬭ $\sin 4x + c$

⬭ $\frac{1}{4} \sin 4x + c$

⬭ $-\sin 4x + c$

⬭ $-\frac{1}{4} \sin 4x + c$ [1]

5) (Shade in the bubble ⬭ next to $\int \frac{2x}{x^2 + 5} \mathrm{d}x$)

⬭ $\ln \left|x^2 + 5\right| + c$

⬭ $2 \ln \left|x^2 + 5\right| + c$

⬭ $\tan^{-1} x + c$

⬭ $2 \tan^{-1} x + c$

[1]

6) The table below gives values of the function f(x)

x	2	4	6	8
f(x)	1.73	3.87	5.92	7.94

Use the trapezium rule to estimate $\int_2^8 \mathrm{f}(x) \, \mathrm{d}x$

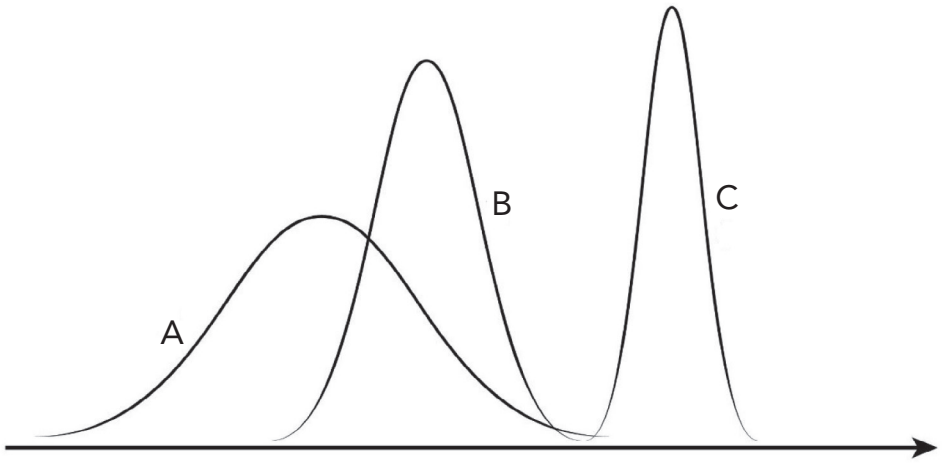
[3]

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7) The diagram below shows three normal distribution curves A, B and C



Write the letter of the curve that has the:

i) Largest mean.

ii) Largest standard deviation.

iii) Smallest variance.

[3]

8) Evaluate $\lim_{x \to 2} \dfrac{x + 2}{x^2 - 2x - 8}$

[3]

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9) $f(x) = \tan(7x - 3)$

(Shade in the bubble ○ next to $f'(x)$)

- ○ $7 \sin^2(7x - 3)$
- ○ $\sin^2(7x - 3)$
- ○ $7 \sec^2(7x - 3)$
- ○ $\sec^2(7x - 3)$

[1]

10) The distance s metres moved by a point in a time t seconds is given by $s = 3t^3 + t^2 + 2t - 1$

Find the value of the acceleration when $t = 2$ seconds.

[4]

11) (Shade in the bubble ○ next to $\int 5 \tan x \, dx$)

- ○ $-5 \ln|\cos x| + c$
- ○ $-5 \ln|\sin x| + c$
- ○ $5 \ln|\cos x| + c$
- ○ $5 \ln|\sin x| + c$

[1]

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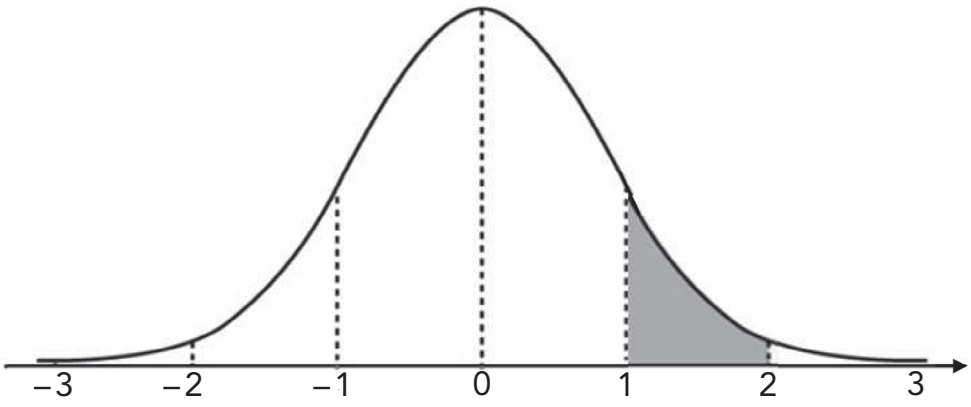
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12) Evaluate $\int_{-1}^{1} (x + 4)^2 \, dx$

[4]

13) The diagram below shows the normal distribution curve of the marks in an exam.



(Shade in the bubble ⬭ next to the percentage of the shaded area)

⬭ 13.5%

⬭ 27%

⬭ 34%

⬭ 47.5%

[1]

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14) $y = (1 - x^2)\, e^{5x}$

Differentiate y with respect to x

[4]

15) Find $\int 2\cos^2 3x \, \mathrm{d}x$

[3]

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16) Evaluate $\lim_{x \to 5} \dfrac{x^2 - 2x - 15}{x - 5}$

[2]

17) $f(x) = x^5 - 3 \sin 2x$

(Shade in the bubble ⬭ next to $f''(x)$)

⬭ $5x^4 - 6 \cos 2x$

⬭ $20x^3 - 6 \sin 2x$

⬭ $5x^4 + 6 \cos 2x$

⬭ $20x^3 + 12 \sin 2x$

[1]

18) $y = \tan^{-1} 2x$

(Shade in the bubble ⬭ next to (x , y) where the gradient is 1)

⬭ (0 , 0)

⬭ (1 , 1.1)

⬭ (0 , 1)

⬭ (1 , 0.2) [1]

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19) $y = \dfrac{x^4}{\sin x}$

Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ using the quotient rule.

[4]

20) (Shade in the bubble ⬭ next to $\int \dfrac{1}{\sqrt[5]{r^2}}\ \mathrm{d}r$)

⬭ $\dfrac{5}{3}\sqrt[5]{r^3} + c$

⬭ $\dfrac{5}{7}\sqrt[5]{r^7} + c$

⬭ $-\dfrac{2}{3\sqrt{r^3}} + c$

⬭ $-\dfrac{2}{7\sqrt{r^7}} + c$

[1]

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21) Find $\int \frac{3}{x^2 - 9x + 18}\,dx$ using a partial fraction.

[5]

22) $f(x) = x^3 - 12x$

(Shade in the bubble ⬭ next to the coordinate of the minimum point)

⬭ (2 , −16) ⬭ (2 , 0)

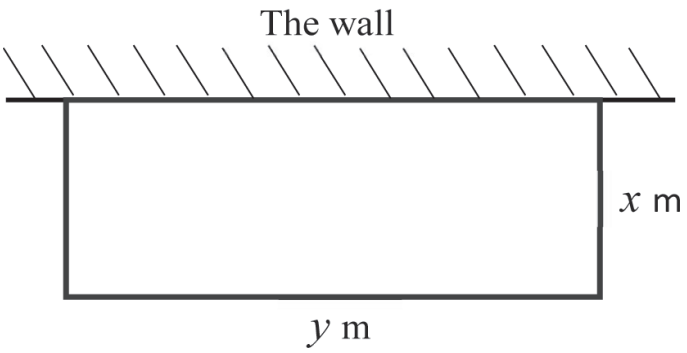
⬭ (−2 , 16) ⬭ (−2 , 0) [1]

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23) The diagram shows a rectangular garden with a fence on three of its sides and a wall on its fourth side.

The total length of the fence is 120 m and area enclosed is A m^2

Find the maximum area of the garden that is enclosed.



[5]

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24) $\int_1^b (2x - 5)\ \mathrm{d}x = 4 \quad , \quad b > 1$

(Shade in the bubble ⬭ next to the value of b)

⬭ 2 ⬭ 3

⬭ 4 ⬭ 5 [1]

25) Find $\int \ln 7x\ \mathrm{d}x$

[3]

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26) The weight in kg of grade ten students is normally distributed with a mean of 60 and standard deviation of 5

Find the percentage of students whose weight is between 50kg and 65kg.

[4]

27) The equation of a curve is $a\,x^2 + y^2 = 34$

The gradient at (3,4) is $\frac{-3}{2}$

Find the value of a

[3]

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28) Find $\int x\ e^{-x^2+3}\ \mathrm{d}x$

[4]

[End of Examination]

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List of Formulae

$f(x)$	$f'(x)$
$y = x^n$	$\frac{dy}{dx} = nx^{n-1}$
$y = \sin ax$	$\frac{dy}{dx} = a.\cos ax$
$y = \cos ax$	$\frac{dy}{dx} = -a.\sin ax$
$y = \ln ax$	$\frac{dy}{dx} = \frac{1}{x}$
$y = e^{ax}$	$\frac{dy}{dx} = a.e^{ax}$
$y = \sec x$	$\frac{dy}{dx} = \sec x \tan x$
$y = \tan x$	$\frac{dy}{dx} = \sec^2 x$
$y = \tan^{-1} x$	$\frac{dy}{dx} = \frac{1}{1+x^2}$
$y = \frac{u}{v}$	$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$
$y = uv$	$\frac{dy}{dx} = \grave{u}v + v\grave{u}$

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$f(x)$	$\int f(x)dx$
$y = e^{ax}$	$\int y\,dx = \frac{1}{a}.e^{ax} + c$
$y = \sin ax$	$\int y\,dx = \frac{-1}{a}.\cos ax + c$
$y = \cos ax$	$\int y\,dx = \frac{1}{a}.\sin ax + c$
$y = \sec^2 ax$	$\int y\,dx = \frac{1}{a}.\tan ax + c$
$y = ax^n dx$	$\int y\,dx = \frac{ax^{n+1}}{n+1} + c\,, n \neq -1$
$y = \frac{1}{x^2 + a^2}$	$\int y\,dx = \frac{1}{a}\tan^{-1}\frac{x}{a} + c$

$$\int \frac{f'(x)}{f(x)}dx = \ln|f(x)| + c$$

Integration by substitution:

$$\int f(x)dx = \int f(x)\frac{dx}{du}du$$

Integration by parts:

$$\int u\frac{dv}{dx}dx = uv - \int v\frac{du}{dx}dx$$

The trapezium rule:

$$\int_a^b f(x)dx \approx \frac{1}{2}h\{y_0 + 2(y_1 + y_2 + \cdots + y_{n-1}) + y_n\} \quad \text{,where } h = \frac{b-a}{n}$$

Double Angles:

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

Reciprocal Functions:

$$\sec A = \frac{1}{\cos A}$$
$$\operatorname{cosec} A = \frac{1}{\sin A}$$
$$\cot A = \frac{\cos A}{\sin A}$$

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Royal Guard of Oman Technical College, Mathematics

Second Semester - Second Session

Academic Year 2024/2025

Answer scheme

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
1	AO1 L	1.3	Booklet 3	☐ 0 ☐ 1 ■ 6 ☐ No limit		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
2	AO1 L	2.2	90	☐ $\frac{1}{x}$ ☐ $\frac{1}{x^2}$ ■ $\frac{2}{x}$ ☐ $\frac{2}{x^2}$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
3	AO1 L	2.1	85	$\frac{dy}{dx} = 4x^3 + 9x^2 - 6 - 2x^{-3}$	1+1+1+1	1 mark for each correct term

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
4	AO1 L	3.1	Booklet 35	☐ $\sin 4x + c$ ■ $\frac{1}{4}\sin 4x + c$ ☐ $-\sin 4x + c$ ☐ $-\frac{1}{4}\sin 4x + c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
5	AO1 L	3.4	138	■ $\ln\|x^2+5\|+c$ ☐ $2\ln\|x^2+5\|+c$ ☐ $\tan^{-1}x+c$ ☐ $2\tan^{-1}x+c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
6	AO1 L	3.3	125	$h = 2$	1	
				$\int_2^8 f(x)dx \approx \frac{1}{2}(2)\{1.73 + 2(3.87 + 5.92) + 7.94\}$	1	
				$= 29.25$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
7	AO1 L	4.1	120	i. C	1	
				ii. A	1	
				iii. C	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
8	AO1 M	1.1	Booklet 4	$\lim_{x\to 2} \frac{x+2}{x^2-2x-8}$		
				$= \frac{2+2}{(2)^2-2(2)-8}$	1+1	1 mark for $2+2$ 1 mark for $(2)^2-2(2)-8$
				$= \frac{4}{-8}$		
				$= -\frac{1}{2}$	1	If the student factorizes the bottom to cancel the top and finds the limit correctly, he gets 3 marks.

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
9	AO1 M	2.5	100	☐ $7\sin^2(7x-3)$ ☐ $\sin^2(7x-3)$ ■ $7\sec^2(7x-3)$ ☐ $\sec^2(7x-3)$		

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Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
10	AO1 M	2.8	Booklet 6	$v = \frac{\mathrm{d}s}{\mathrm{d}t} = 9t^2 + 2t + 2$	1	
				$a = \frac{\mathrm{d}^2 s}{\mathrm{d}t^2} = 18t + 2$	1	
				The acceleration after 2 seconds $= 18(2) + 2$	1	
				$= 38\ \mathrm{m}/s^2$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
11	AO1 M	3.4	138	■ $-5\ln\lvert\cos x\rvert + c$ □ $5\ln\lvert\cos x\rvert + c$ □ $-5\ln\lvert\sin x\rvert + c$ □ $5\ln\lvert\sin x\rvert + c$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
12	AO1 M	3.2	Booklet 37	$= \int_{-1}^{1} (x^2 + 8x + 16)\, dx$	1	
				$= \left[\frac{x^3}{3} + 4x^2 + 16x\right]_{-1}^{1}$	1	
				$= \left[\frac{(1)^3}{3} + 4(1)^2 + 16(1)\right] - \left[\frac{(-1)^3}{3} + 4(-1)^2 + 16(-1)\right]$	1	
				$= \frac{98}{3}$	1	
				≈ 32.667		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
13	AO1 M	4.1	119	■ 13.5% □ 27% □ 34% □ 47.5%		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
14	AO1 H	2.4	96	$u = 1 - x^2$, $\frac{du}{dx} = -2x$	1	1 mark for $(1 - x^2) \times 5e^{5x}$ 1 mark for $+ e^{5x} \times -2x$
				$v = e^{5x}$, $\frac{dv}{dx} = 5\,e^{5x}$	1	
				$\frac{dy}{dx} = (1 - x^2) \times 5\,e^{5x} + e^{5x} \times -2x$	1 +1	
				$= 5\,e^{5x}(1 - x^2) - 2x\ e^{5x}$		
				Another solution: $y = (1 - x^2)\,e^{5x} = e^{5x} - x^2\ e^{5x}$	1	
				$u = x^2$, $\frac{du}{dx} = 2x$	1	
				$v = e^{5x}$, $\frac{dv}{dx} = 5\,e^{5x}$	1	
				$\frac{dy}{dx} = 5\,e^{5x} - (x^2 \times 5\,e^{5x} + e^{5x} \times 2x)$	1	
				$= 5\,e^{5x} - 5x^2\,e^{5x} - 2x\,e^{5x}$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
15	AO1 H	3.5	134	$\int 2\cos^2 3x\,dx = \int (\cos 6x + 1)\,dx$	1	
				$= \frac{1}{6}\sin 6x + x + c$	1+1	1 mark for $\frac{1}{6}\sin 6x$ 1 mark for x
				Another solution: $\int 2\cos^2 3x\,dx = \int 2(\sin 6x + \sin^2 3x)\,dx$	1	
				$= \int 2\left(\sin 6x + \frac{1}{2}(1 - \cos 6x)\right)dx$	1	
				$= -\frac{1}{3}\cos 6x + x - \frac{1}{6}\sin 6x + c$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [2]	More information
16	AO2 L	1.2	Booklet 4	$\lim_{x\to 5}\frac{x^2-2x-15}{x-5}=\left.\frac{x^2-2x-15}{x-5}\right\vert_{x=5}$ $=\frac{0}{0}$ (indeterminate)		
				$\lim_{x\to 5}\frac{(x-5)(x+3)}{(x-5)}$	1	
				$=\lim_{x\to 5}(x+3)$		
				$=5+3$		
				$=8$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
17	AO2 L	2.1	86	☐ $5x^4 - 6\cos 2x$ ☐ $20x^3 - 6\sin 2x$ ☐ $5x^4 + 6\sin 2x$ ■ $20x^3 + 12\sin 2x$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
18	AO2 L	2.7	113	■ (0 , 0) ☐ (1 , 1.1) ☐ (0 , 1) ☐ (1 , 0.2)		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
19	AO2 L	2.4	100	If $u = x^4$ and $\frac{du}{dx} = 4x^3$	1	1 mark for $4x^3\sin x - x^4\cos x$ 1 mark for $\sin^2 x$ If the student starts from this step directly and writes it correctly, he gets 4 marks as follows: 1 mark for $4x^3\sin x$ 1 mark for $x^4\cos x$ 1 mark for $(-)$ 1 mark for $\sin^2 x$
				$v = \sin x$ and $\frac{dv}{dx} = \cos x$	1	
				$\frac{dy}{dx} = \frac{4x^3 \sin x - x^4 \cos x}{\sin^2 x}$	1+1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
20	AO2 L	3.1	Booklet 40	■ $\frac{5}{3}\sqrt[5]{r^3}+c$ ☐ $\frac{5}{7}\sqrt[5]{r^7}+c$ ☐ $-\frac{2}{3\sqrt{r^3}}+c$ ☐ $-\frac{2}{7\sqrt{r^7}}+c$		

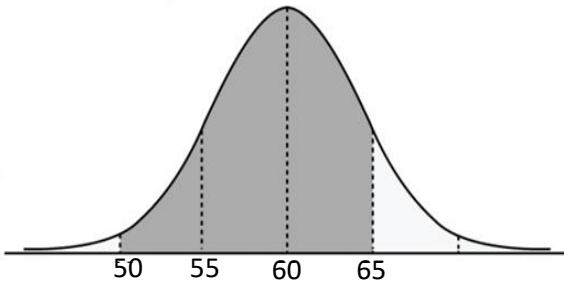
Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [5]	More information
21	AO2 L	3.6	140	$\frac{3}{x^2-9x+18} = \frac{3}{(x-3)(x-6)} = \frac{A}{x-3} + \frac{B}{x-6}$		
				Equate the numerators: $3 = A(x-6) + B(x-3)$		
				If $x = 3:\quad 3 = -3A$		
				$\rightarrow \quad A = -1$	1	
				If $x = 6:\quad 3 = 3B$		
				$\rightarrow B = 1$	1	
				$\int \frac{3}{x^2-9x+18}\,dx = \int \frac{-1}{x-3}\,dx + \int \frac{1}{x-6}\,dx$	1	
				$= -\ln\lvert x-3\rvert + \ln\lvert x-6\rvert + c$	1+1	1 mark for $-\ln\lvert x-3\rvert$ 1 mark for $\ln\lvert x-6\rvert$

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
22	AO2 M	2.10	Booklet 18	■ $(2,-16)$ ☐ $(2,0)$ ☐ $(-2,16)$ ☐ $(-2,0)$		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [5]	More information
23	AO2 M	2.11	Booklet 23	$y + 2x = 120$ $y = 120 - 2x$	1	
				$\text{Area} = xy = x(120 - 2x)$ $= 120x - 2x^2$	1	
				For the maximum or minimum value: $\frac{dA}{dx} = 0 \implies 120 - 4x = 0$		
				$\implies x = 30$	1	
				$\frac{d^2A}{dx^2} = -4 < 0$, giving the maximum value	1	
				The maximum Area $= 120 \times 30 - 2 \times 30^2$ $= 1800 \text{ m}^2$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [1]	More information
24	AO2 M	3.2	131	☐ 2 ☐ 3 ☐ 4 ■ 5		

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
25	AO2 M	3.8	147	Make the substitution $u = \ln 7x$ and $\frac{dv}{dx} = 1$	1	If the student starts from this step and writes it correctly, he gets 2 marks as follows: 1 mark for $x \ln 7x$ 1 mark for $-\int \frac{x}{x} dx$
				Then $\frac{du}{dx} = \frac{1}{x}$ and $v = x$		
				Using integration by parts $\int \ln 7x \, dx = x \ln 7x - \int \frac{x}{x} dx$	1	
				$= x \ln 7x - x + c$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
26	AO2 M	4.2	120 + 123	 The area is between -2 and 1 standard deviations. This means that the data is between -2 and $+1$ s. d	1	
				The percentage $= 68\% + \frac{95\% - 68\%}{2}$ $= 68\% + 13.5\%$	1+1	
				$= 81.5\%$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [3]	More information
27	AO2 H	2.3	113	$2ax + 2y\frac{\mathrm{d}y}{\mathrm{d}x} = 0$	1	
				$2a(3) + 2(4)(\frac{-3}{2}) = 0$	1	
				$6a - 12 = 0$		
				$a = 2$	1	

Item #	Assessment Object/ Level of demand	Learning Aims	page	Answer	Marks [4]	More information
28	AO2 H	3.7	142	Make the substitution $u = -x^2 + 3$ Then $\frac{du}{dx} = -2x$	1	1 mark for correct u and $\frac{du}{dx}$
				$\int x\ e^{-x^2+3}\,dx = -\frac{1}{2}\int e^u\,du$	1	
				$= -\frac{1}{2}e^u + c$	1	
				$= -\frac{1}{2}e^{-x^2+3} + c$	1	