Sheet 42

MA180/MA186/MA190/MA132, Ronan Egan and Götz Pfeiffer, Semester 2 2019/20

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This Problem Sheet 4(b) is designed to help you with the first algebra question and first calculus question on the end of module exam paper. Please do ask your staff tutor for help with the problems. Submitted answers will form part of your continuous assessment.

1	Evaluate $\int_0^{\sqrt{3}} \frac{4x}{\sqrt{x^2+1}}\,dx$.	_____
2	Evaluate $\int_0^{\pi/4} x\sin 2x\,dx$. Enter your answer as a fraction in its simplest terms.	_____
3	Evaluate $\int_0^{\pi/2} 3\cos x \sin^2 x\,dx$.	_____
4	Find the value of C in the expression for $\frac{3x^2+17x}{x^3+3x^2-6x-8}$ in the form $\frac{A}{x+1}+\frac{B}{x-2}+\frac{C}{x+4}$	_____
5	Evaluate $\int_1^{\infty} \frac{1}{x^5}\,dx$ Enter your answer as a fraction in its simplest terms.	_____
6	Use symbols to write down the logical form of each of the following arguments. Decide whether it correctly applies a valid (VAL) argument structure (like modus ponens, modus tollens, elimination, transitivity, specialization, division into cases, generalization, ...) or whether the argument is invalid (INV) (e.g., a converse fallacy, an inverse fallacy).	
	If logic is easy then I am a monkey's uncle. I am not a monkey's uncle $\therefore$ Logic is not easy.	◯ VAL / ◯ INV
	If this number is larger than 2 then its square is larger than 4. This number is not larger than 2. $\therefore$ The square of this number is not larger than 4.	◯ VAL / ◯ INV
	Padraig speaks Spanish. $\therefore$ Padraig speaks Russian or Spanish.	◯ VAL / ◯ INV
7	Which of the following statements are true? (You must tick *all* the *true* statements and *none* of the *false* ones to score your point.)	
	Suppose A and B are sets defined by $A=\{3,7,\{3,7\}\}$ and $B=\{3,0,3,5,7\}$. A. The set $\{3,7\}$ is not an element of B. B. The set $\{3,7\}$ is a subset of B. C. A is a subset of B. D. The union of A and B has 4 elements.	☐ A / ☐ B / ☐ C / ☐ D

8	For each of the following relations decide whether it is reflexive (R), symmetric (S), or transitive (T). A question is answered correctly if ALL the correct answers are ticked, and NONE of the wrong answers.	
	The relation R on the set $A = \{1,2,3,4,5,6,7,8\}$ given by $R = \{(1,1),\ (1,2),\ (1,4),\ (1,8),\ (2,1),\ (2,2),\ (2,4),\ (2,8),\ (3,3),\ (3,6),\ (4,1),\ (4,2),\ (4,4),\ (4,8),\ (5,5),\ (6,3),\ (6,6),\ (7,7),\ (8,1),\ (8,2),\ (8,4),\ (8,8)\}$.	☐ R / ☐ S / ☐ T
	The relation R on the integers $\mathbb{Z}$ given by $R = \{(a,b) \in \mathbb{Z} \times \mathbb{Z} : a \geq b\}$.	☐ R / ☐ S / ☐ T
	The relation R on the power set $P = P(S)$ of the set $S = \{1,2,5\}$ given by $R = \{(A,B) \in P \times P : A \cap B \neq \varnothing\}$.	☐ R / ☐ S / ☐ T
9	The following relations from a domain X to a codomain Y are functions: true (T) or false (F)?	
	$\{(1,2),(3,1)\} \subseteq X \times Y$, where $X = Y = \{1,2,3\}$.	◯ T / ◯ F
	$\{(1,a),(2,a),(3,c),(4,b)\} \subseteq X \times Y$, where $X = \{1,2,3,4\}$ and $Y = \{a,b,c,d\}$.	◯ T / ◯ F
10	For each of the following functions check whether they are injective (I), surjective (S), both (B) or none of the above (N). (Note that whether f is injective or surjective can depend on the domain X and the codomain Y of f.)	
	$f = \{(1,5),(2,4),(3,3),(4,2)\} \subseteq \{1,2,3,4\} \times \{2,3,4,5\}$.	◯ (I) / ◯ (S) / ◯ (B) / ◯ (N)
	$f\colon \{1,2,3,4,5\} \to \{1,2,\ldots,25\}$, $f(x) = x^2$.	◯ (I) / ◯ (S) / ◯ (B) / ◯ (N)
	$f\colon \{2,3,4,5,6\} \to \{4,6,8,10,12\}$, $f(x) = 2x$.	◯ (I) / ◯ (S) / ◯ (B) / ◯ (N)
	$f = \{(3,0),(4,1),(5,2),(6,0),(7,1)\} \subseteq \{3,4,\ldots,7\} \times \{0,1,2\}$.	◯ (I) / ◯ (S) / ◯ (B) / ◯ (N)
	$f\colon \{1,2,3,4\} \to \{5,6,\ldots,9\}$, $f(1) = 5$, $f(2) = 8$, $f(3) = 6$, $f(4) = 5$.	◯ (I) / ◯ (S) / ◯ (B) / ◯ (N)
You can resubmit your answers any time up to the deadline.		