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MATHEMATICS

MATERIAL FOR GRADE 12

Probability

MEMORANDA

QUESTION 1

1.1.1	Three places to fill by 4, 7 or 9 and each time a digit is used, there is an opportunity to use it again. There are 3 possibilities to fill 3 places each time, hence there are $3 \times 3 \times 3 = 27$ ✓ possible ways to create the code.	✓ Answer (1)																
1.1.2	$3 \times 2 \times 1 = 3!=6$ ways	✓ Answer (1)																
1.2	• 6 Mathematics books can fill six places • 5 Physical Sciences books can fill 5 places • Books cannot occupy more than 1 place • Both Mathematics and Physical Sciences books can be put together hence there are two ways to make the arrangements. The arrangements of books on the shelf are ... $6! \times 5! \times 2! = 172\,800$ ✓	✓ $6! \times 5!$ ✓ $2!$ ✓ Answer (3)																
1.3	<table><tr><td></td><td>Positive</td><td>Not Positive</td><td></td></tr><tr><td>Male</td><td>7</td><td>48</td><td>55</td></tr><tr><td>Female</td><td>3</td><td>42</td><td>45</td></tr><tr><td></td><td>10</td><td>90</td><td>100</td></tr></table>		Positive	Not Positive		Male	7	48	55	Female	3	42	45		10	90	100	
	Positive	Not Positive																
Male	7	48	55															
Female	3	42	45															
	10	90	100															
1.3.1	$P(M \cap P^+) = \frac{7}{100}$ ✓	✓ Answer (1)																
1.3.2	$n(M \cap P^+) = \frac{7}{100} \times 5\,000\,000 = 3\,500\,000$ no of possible infected males	✓ Method $P(M \cap P^+) = \frac{7}{100}$ ✓ (2)																
1.3.3	$P(P^+ \setminus F) = \frac{3}{45} = \frac{1}{15}$ ✓ ✓	Answer (2)																
1.3.4	$P(M \setminus P^+) = \frac{P(M \cap P^+)}{P(M)} \times \frac{7}{10} = \frac{7}{10}$ ✓ ✓	Answer (3) [13]																

QUESTION 2

2.1		$P(A \text{ and } B) = P(A) \times P(B)$ $= 0,4 \times 0,5$ $= 0,2$	✓ ✓	subst. into formula answer	(2)
2.2		$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ $= 0,4 + 0,5 - 0,2$ $= 0,7$	✓ ✓	subst. into formula answer	(2)
2.3		$P(\text{not } A \text{ and not } B) = 1 - P(A \text{ or } B)$ $= 1 - 0,7$ $= 0,3$	✓ ✓ ✓	formula subst. into formula answer	(3)
					[7]

QUESTION 3

3.1		$7! = 5040$	✓ ✓	$7!$ answer	(2)
3.2		Girls seated together in $4!$ ways. With the girls as one unit they can all enter in $4! 4!$ ways = 576	✓ ✓ ✓	$4!$ ways for girls $4!$ ways for others with girls as unit answer	(3)
3.3		$\frac{576}{5040} = 0,11428 = 11,43\%$	✓	0,11 or 11,43%	(1)
3.4		The girls can sit in $4 \times 3 \times 2 \times 1$ ways. The boys can sit in $3 \times 2 \times 2$ ways the group can sit in $4 \times 3 \times 3 \times 2 \times 2 \times 1 \times 1 = 144$ ways. Probability $= \frac{144}{5040} = 0,028571 = 2,86\%$	✓ ✓ ✓	$4!$ ways $3!$ ways answer	(3)
					[9]

QUESTION 4

4.1.1	$P(\text{boy, tennis or squash})$ $= \frac{18}{120} + \frac{20}{120}$ $= \frac{19}{60}$ $= 0,32$	$\checkmark \frac{18}{120} + \frac{20}{120}$ $\checkmark \frac{19}{60} \text{ or } 0,32$ (2)
4.1.2	$P(\text{learner, tennis}) = \frac{41}{120}$ $= 0,34$	$\checkmark \frac{41}{120} \text{ or } 0,34$ (1)
4.1.3	$P(\text{girl}) = \frac{50}{120} = \frac{5}{12} = 0,42$	$\checkmark \frac{50}{120} \text{ or } \frac{5}{12} \text{ or } 0,42$ (1)
4.2	$P(\text{boy and golf}) = \frac{32}{120} = \frac{4}{15} = 0,27$ $P(\text{boy}) \cdot P(\text{golf}) = \frac{70}{120} \cdot \frac{44}{120} = \frac{77}{360} = 0,21$ $\therefore 0,27 \neq 0,21$ $\therefore \text{Not independent}$	$\checkmark \frac{32}{120} \text{ or } \frac{4}{15} \text{ or } 0,27$ $\checkmark \frac{70}{120} \cdot \frac{44}{120}$ $\checkmark \frac{77}{360} \text{ or } 0,21$ $\checkmark \text{not independent}$ (4) [8]

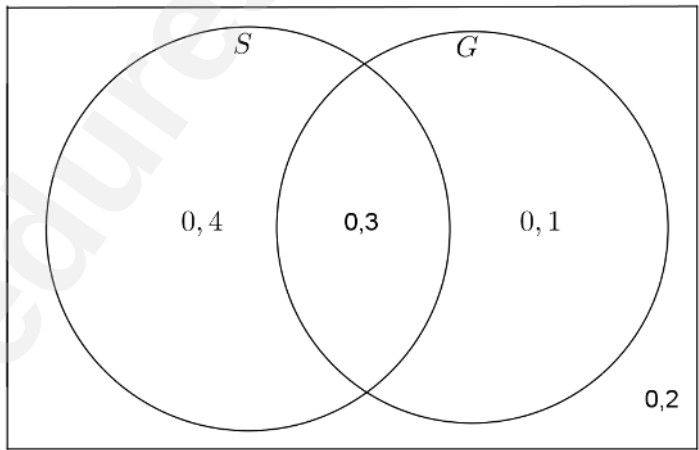
QUESTION 5

5.1.1	$14! = 8,72 \times 10^{10}$	$\checkmark 14! \text{ or } 8,72 \times 10^{10}$ (1)
5.1.2	$4! 5! 3! 4! 2! = 829\,440$	$\checkmark 4! 5! 3! 4! 2!$ $\checkmark 829\,440$ (2)
5.2.1	PROBABILITY $\frac{11!}{2! 2!} = 9\,979\,200$	$\checkmark 11!$ $\checkmark 2! 2!$ $\checkmark \text{answer}$ (3)
5.2.2	$\frac{10!}{2! 2!} = 907\,200$	$\checkmark \frac{10!}{2! 2!}$ $\checkmark 907\,200$ (2) [8]

QUESTION 6

6.1.1	$P(A \text{ or } B) = \frac{3}{8} + \frac{1}{4} = \frac{5}{8}$	$\checkmark \frac{5}{8}$	(1)
6.1.2	$P(A \text{ and } B) = \frac{3}{8} \times \frac{1}{4} = \frac{3}{32}$ $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) = \frac{3}{8} + \frac{1}{4} - \frac{3}{32} = \frac{17}{32}$	$\checkmark P(A \cap B) \text{ or } P(A \text{ and } B) = \frac{3}{32}$ $\checkmark P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $\checkmark \frac{17}{32}$	(3)
6.2.1	Tree diagram showing probabilities for two car selections (VW and BMW) without replacement. Initial probabilities: $\frac{14}{32}$ for VW, $\frac{18}{32}$ for BMW. Conditional probabilities for the second selection: - If first is VW: $\frac{13}{31}$ for VW, $\frac{18}{31}$ for BMW. - If first is VW;BMW: $\frac{14}{31}$ for VW, $\frac{17}{31}$ for BMW. Final probability for two BMWs: $P(\text{both BMW}) = \frac{18}{32} \times \frac{17}{31} = \frac{153}{496} \approx 0,31$	$\checkmark \checkmark$ Tree diagram (branches) $\checkmark \frac{18}{32} \times \frac{17}{31}$ $\checkmark \frac{153}{496} \approx 0,31$	(4)
6.2.1	$P(\text{BMW ... VW}) = \frac{18}{32} \times \frac{14}{31} = \frac{63}{248} \approx 0,25$	$\checkmark \frac{18}{32} \times \frac{14}{31}$ $\checkmark \frac{63}{248} \approx 0,25$	(2)
6.3.1	$n(E) = 7.13!.6$ $n(S) = 15!$ $P(E) = \frac{n(E)}{n(S)} = \frac{7.13!.6}{15!} = \frac{1}{5}$	$\checkmark n(E) = 7.13!.6$ $\checkmark n(S) = 15!$ $\checkmark \frac{1}{5}$	(3)
6.3.2	$n(E) = 8! 7!$ $n(S) = 15!$ $P(E) = \frac{n(E)}{n(S)} = \frac{8! 7!}{15!} = \frac{1}{6435}$	$\checkmark n(E) = 8! 7!$ $\checkmark P(E) = \frac{n(E)}{n(S)} = \frac{8! 7!}{15!}$ $\checkmark \frac{1}{6435}$	(3)
			[16]

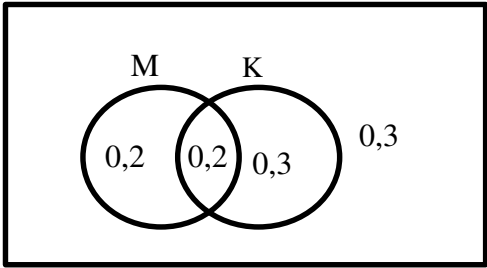
QUESTION 7

7.1.1	$8^8 = 167770216$ ways	MERAFONG	$\checkmark \checkmark 8^8$ (2)
7.1.2	$P(R...N) = \frac{1 \times 6 \times 1!}{8!}$ $= \frac{6!}{8!}$ $= \frac{1}{56}$ $P(R...N) = \frac{1 \times 6^6 \times 1!}{8^8}$ $= \frac{1 \times 6^6 \times 1!}{8^8}$ $= \frac{729}{262144}$ OR $P(R...N) = \frac{1}{8} \times \frac{1}{7} = \frac{1}{56}$	$\checkmark \frac{1! \times 6! \times 1!}{8!}$ $\checkmark \frac{1}{56}$ $\checkmark \frac{1}{8} \times \frac{1}{7}$ $\checkmark \frac{1}{56}$ (2)	
7.1.3	$P(a, e, o) = \frac{3! \times 6!}{8!}$ $= \frac{3}{28}$ OR $P(a, e, o) = \frac{3! \times 5! \times 6}{8!}$ $= \frac{3}{28}$	$P(a, e, o) = \frac{3! \times 6^6}{8^8}$ $= 0,02$ $\checkmark 3!; \checkmark 6! \checkmark \frac{3}{28}$ $\checkmark 3! \checkmark 6^6 \checkmark 0,02$ (3)	
7.2.1		$\checkmark P(S \text{ and } G) = 0,3$ $\checkmark P(S \text{ not } G) = 0,4$ $\checkmark P(G) = 0,1$ $\checkmark U / (S \text{ or } G) = 0,2$ (4)	
7.2.2 a)	$P(S') = 0,3$	$\checkmark$ answer (1)	
b)	$P(S \text{ and } G)' = 0,7$	$\checkmark$ answer (1)	
c)	$P(S \text{ or } G) = 0,8$	$\checkmark$ answer (1)	
		[14]	

QUESTION 8

8.1.1	150	A✓answer	(1)
8.1.2(a)	$P(\text{Male}) = \frac{70}{150} = \frac{7}{15}$	A✓answer	(1)
8.1.2(b)	$P(\text{Eating Chocolate}) = \frac{80}{150} = \frac{8}{15}$	A✓answer	(1)
8.1.3	$P(\text{Male eating chocolate}) = \frac{45}{150} = 0,3$ $P(\text{Male}) \times P(\text{Eating chocolate})$ $= \frac{70}{150} \times \frac{80}{150} = \frac{56}{225} = 0,249$ $P(\text{Male and Eating chocolate}) \neq P(\text{Male}) \times P(\text{Eating chocolate})$ Events are not independent	A✓P(male eating chocolate) CA✓ P(Male) x P(eating chocolate) value CA✓conclusion	(3)
8.2.1	$6 \times 7 \times 7 \times 7 = 2058$	A✓ $6 \times 7 \times 7 \times 7$ A✓2058	(2)
8.2.2	$6 \times 6 \times 5 \times 4 = 720$	A✓ $6 \times 6 \times 5 \times 4$ A✓720	(2)
8.2.3	Four digit codes divisible by 5:- $6 \times 7 \times 7 \times 1 = 252$ Probability of a four-digit code divisible by 5 $= \frac{252}{2058} = \frac{6}{49} = 0,1224 = 12,24 \%$	A✓ $6 \times 7 \times 7 \times 1$ A✓252 CA✓answer	(3)
			[13]

QUESTION 9

9.1	9.1.1	 $P(M) = 0,4$	✓ ✓ ✓ ✓	P (M and K) correctly placed/ Placing P (not M and not K) correctly placing 0,3 for P (K only) calculating P(M)	(4)
	9.1.2	$P(M) \times P(K) = 0,4 \times 0,5 = 0,2$ $= P(K \text{ and } M)$ so the events are independent	✓ ✓ ✓	$P(M) \times P(K) = 0,2$ $P(K \text{ and } M) = P(M) \times P(K)$ Conclusion	(3)
9.2	9.2.1	$7! = 5040$	✓✓	answer	(2)
	9.2.2	Koketso and Marvin can sit together in $2!6!$ ways they will not sit together in $7! - 2!6!$ ways/ $= 3600$	✓✓ ✓ ✓	$2!$ $6!$ $7! - 2!6!$ answer	(4)
	9.2.3	$\frac{1}{6}$	✓✓	answer	(2)
					[15]

QUESTION 10

10.1		First event: ✓ M 4/7; TM 3/7 Second event: ✓ M: ET 5/10; MT 3/10; CT 2/10 ✓ TM: ET 4/10; MT 5/10; CT 1/10 ✓ outcomes (4)
10.2.1	$P(\text{TM and MT}) = \frac{3}{7} \cdot \frac{5}{10}$ $= \frac{3}{14}$	✓ $\frac{3}{7} \cdot \frac{5}{10}$ ✓ $\frac{3}{14}$ or 0,21 (2)
10.2.2	$P(\text{ET}) = \frac{4}{7} \cdot \frac{5}{10} + \frac{3}{7} \cdot \frac{4}{10}$ $= \frac{16}{35} = 0,46$	✓ $\frac{4}{7} \cdot \frac{5}{10}$ ✓ $\frac{3}{7} \cdot \frac{4}{10}$ ✓ $\frac{16}{35}$ or 0,46 (3) [9]

QUESTION 11

11.1.1	$10^6 = 1\,000\,000$	✓ 10^6 or 1 000 000 (1)
11.1.2	$(8)(7)(6)(5)$ $= 1680$ OR ${}_8P_4$ $= 1680$	✓ $(8)(7)(6)(5)$ ✓ 1680 (2) ✓ ${}_8P_4$ ✓ 1680 (2)
11.2	$10! - (9!)(2!)$ $= 3\,628\,800 - 725\,760$ $= 2\,903\,040$	✓ 10! ✓ $(9!)(2!)$ ✓ answer (3) [6]

QUESTION 12

#	SUGGESTED ANSWER	DESCRIPTORS	Ma
12.1.1	$P(\text{female and}/\cap \text{ green eyes}) = \frac{147}{540} = \frac{49}{180} = 27,22\%$	$\frac{147}{540}$ or $\frac{49}{180}$ or 27,22% ✓✓ Answer	(2)
12.1.2	For events to be independent: $P(\text{female and}/\cap \text{ green eyes})$ $= P(\text{green eyes}) \times P(\text{female})$ $P(\text{green eyes}) \times P(\text{female}) = \frac{330}{540} \times \frac{240}{540} = \frac{22}{81}$ $= 0,27$ $P(\text{female and}/\cap \text{ green eyes}) = \frac{147}{540} = \frac{49}{180} = 0,27$ $\therefore P(\text{female and}/\cap \text{ green eyes})$ $= P(\text{green eyes}) \times P(\text{female})$ Events are independent and the learner is correct. Alternative For events to be independent: $P(\text{male and}/\cap \text{ green eyes})$ $= P(\text{green eyes}) \times P(\text{male})$ $P(\text{green eyes}) \times P(\text{male}) = \frac{330}{540} \times \frac{300}{540} = \frac{55}{162} = 0,34$ $P(\text{male and}/\cap \text{ green eyes}) = \frac{183}{540} = \frac{61}{180} = 0,34$ $P(\text{male and}/\cap \text{ green eyes})$ $= P(\text{green eyes}) \times P(\text{male})$ Events are independent and the learner is correct.	✓ P(green eyes) = 330/540 ✓ P(female) = 240/540 ✓ 0,27 ✓ P(female and/∩ green eyes) = 0,27 ✓ Deduction ✓ P(green eyes) = 330/540 ✓ P(male) = 300/540 ✓ 0,34 ✓ P(male and/∩ green eyes) = 0,34 ✓ Deduction	(5)

12.2.1	$n(S) = \frac{10!}{2! \times 2! \times 3!} = 151200$	✓ Numerator ✓ Denominator ✓ Answer	(3)
12.2.2	$n(E) = \frac{8!}{2! \times 2!} = 10080$ $\therefore P(E) = \frac{10080}{151200} = \frac{1}{15}$	✓ $\frac{8!}{2! \times 2!}$ ✓ 10080 ✓ $P(E) = \frac{10080}{151200}$ ✓ Answer	(4)
			[14]