

# Permutations and Combinations Exam Questions (From OCR 4732)

## Q1, (Jun 2005, Q7)

(i) ${}^{18}C_7$ or $\frac{18!}{(11! \times 7!)}$ = 31824	M1 A1	2	cao
(ii) ${}^5C_2 \times {}^6C_2 \times {}^7C_3$ or 5250 $\div 31824$ = 875/5304 or 5250/31824 oe or 0.165 (3 sfs)	M2 M1 A1	4	M1: 1 correct " $C_r$ " or mult any three " $C_r$ s" Divide by their (i). Indep If cancelled, must be clear have $\div 31824$ $\frac{5 \times 4 \times 6 \times 5 \times 7 \times 6 \times 5 \times 7!}{18 \times 17 \times 16 \times 15 \times 14 \times 13 \times 12 \times 2!^2 \times 3!}$ Correct 7 fractions mult: M1 x 7! : M1 $\div (2!^2 \times 3!)$ : M1 } both dep any 7 fracts mult
(iii) 5 from W & 2 from (G + H) ${}^7C_5 \times {}^{11}C_2$ or 1155 $\div 31824$ = 385/10608 or 1155/31824 oe or 0.0363 (3 sfs)	M1 M1 M1 A1	4	Seen or implied, eg by combs or list Divide by their (i). Indep $\frac{7 \times 6 \times 5 \times 4 \times 3 \times 11 \times 10 \times 7!}{18 \times 17 \times 16 \times 15 \times 14 \times 13 \times 12 \times 5! \times 2!}$ Correct 7 fractions mult: M1 x 7! : M1 $\div (5! \times 2!)$ : M1 } both dep any 7 fracts mult
(iv) (2, 2, 3) or (2, 3, 2) or (3, 2, 2) ${}^5C_2 \times {}^6C_2 \times {}^7C_3 + {}^5C_2 \times {}^6C_3 \times {}^7C_2$ $+ {}^5C_3 \times {}^6C_2 \times {}^7C_2$ ( $\div 31824$ ) = 175/442 or 12600/31824 oe or 0.396 (3 sfs)	M1 M2 A1	4	Any one. Seen or implied eg by combs M1: one correct product. NOT ${}^5C_2 \times {}^6C_2 \times {}^7C_2$ (No mk for $\div 31824$ ) Equiv method: ((ii) + etc) can imply M mks $\frac{5 \times 4 \times 6 \times 5 \times 7 \times 6 \times 7!}{18 \times 17 \times 16 \times 15 \times 14 \times 13 \times 2!^2 \times 3!}$ Correct 6 fractions mult: M1 x 7! : M1 $\div (2!^2 \times 3!)$ : M1 } both dep any 6 fracts mult Complement method: Triple with total 7, incl at least one 0 or 1 or (0, 7) or (1, 6) seen or implied: M1 One correct prod seen, eg ${}^5C_0 \times {}^6C_2 \times {}^7C_5$ M1 Full correct method, incl "1 -" M1
14			

**Q2, (Jan 2006, Q6)**

6(i)	${}^4C_3 \times {}^7C_4$ $= 140$	M1M1 A1 3	M1 either comb. 140/330: M1M1
(ii)	${}^3C_2 \times {}^6C_4$ or $\frac{{}^3C_2}{{}^4C_3}$ or $\frac{{}^6C_4}{{}^7C_4}$  $\frac{{}^3C_2 \times {}^6C_4}{\text{"140"}}$ or ${}^3/4 \times (1 - {}^4/7)$ $= {}^9/_{28}$ oe or 0.321 (3 sfs)	M1  M1  A1 3	or ${}^3C_2(x...)/\text{"140"}$ or $(...x){}^6C_4/\text{"140"}$ or $({}^3C_2 + {}^6C_4)/\text{"140"}$ or $(3+15)/\text{"140"}$ or ${}^3/4$ or $1 - {}^4/7$ seen all correct
(iii)	${}^3C_2 \times {}^6C_4$ (or i x ii) or $({}^3C_3 \times {}^7C_4)$ or 45 or 35 or ${}^1/4 \times {}^4C_3 \times {}^7C_4$ or ${}^3/4 \times {}^4C_3 \times {}^6C_4$  ${}^3C_2 \times {}^6C_4 + ({}^3C_3 \times {}^7C_4)$ or "140" $- {}^3C_2 \times {}^6C_3$ $= 80$	M1  M1 A1ft 3	1 correct prod or "140" – any prod  or ${}^1/4 \times {}^4C_3 \times {}^7C_4 + {}^3/4 \times {}^4C_3 \times {}^6C_4$ ft only "140"
<b>Total</b>		<b>9</b>	

**Q3, (Jun 2006, Q3)**

3(i)	$\frac{7!}{3! \times 2(!)}$ $= 420$	M1M1 A1 3	M1: $7!/(a \text{ factorial})$ ; or $... \div (3! \times 2(!))$ M1: all correct
(ii)	$\frac{5!}{2(!)}$ $= 60$	M1 A1 2	M1: $5!$ seen (not part of a C) or $5 \times 4!$ or 120 seen or $... \div 2(!)$ alone
(iii)	$1 - {}^4/7 \times {}^3/6$ or $1 - {}^4C_2 / {}^7C_2$ or $1 - {}^4P_2 / {}^7P_2$ or ${}^3/7 \times {}^2/6 + {}^3/7 \times {}^4/6 + {}^4/7 \times {}^3/6$ oe or ${}^3C_2 / {}^7C_2 + {}^3C_1 \times {}^4C_1 / {}^7C_2$  $= {}^5/7$ or 0.714 (3 sfs)	M1M1   A1 3	M1: 1 – prod or $1 - ... / {}^7C_2$ or $1 - {}^4C_2 / ..$ (or Ps) or add 3 prods or add 2 correct prods or ${}^3C_2 / {}^7C_2$ or ${}^3C_1 \times {}^4C_1 / {}^7C_2$ or add $\geq 5$ out of 7 correct prods M1: all correct
<b>Total</b>		<b>8</b>	

**Q4, (Jan 2007, Q3)**

i	120	B1 1	not just 5!
ii a	$3 \times 4!$ or 72 ( $\div 5!$ ) ${}^3/5$ oe	M1 A1 2	oe, eg ${}^{72}/_{120}$
b	Starts 1 or 21 (both)  ${}^1/5 + {}^1/5 \times {}^1/4$ $= {}^1/4$ oe	M1  M1 A1 3	12,13,14,15, ( $\geq 2$ of these incl 21, or allow 1 extra) can be implied by wking or $5 \times 3!$ or $4! + 3!$ ( $\div 5!$ ) complement: full equiv steps for Ms

**Q5, (Jun 2007, Q3)**

i	${}^{15}C_7$ or ${}^{15!}/_{7!8!}$ 6435	M1 A1 2	
ii	${}^6C_3 \times {}^9C_4$ or ${}^6!/_{{}^{3!}3!} \times {}^9!/_{{}^{4!}5!}$  2520	M1  A1 2	Alone except allow $\div {}^{15}C_7$ Or ${}^6P_3 \times {}^9P_4$ or ${}^6!/_{{}^{3!}3!} \times {}^9!/_{{}^{4!}5!}$ Allow $\div {}^{15}P_7$ NB not ${}^6!/_{{}^{3!}3!} \times {}^9!/_{{}^{4!}5!}$ 362880

**Q6, (Jan 2008, Q1)**

ia	$5!$ or ${}^5P_5$ $= 120$	M1 A1 2	
b	$4!$ or ${}^4P_4$ seen $4! \times 2$ 48	M1 M1dep A1 3	or $2 \times 3!$ or $2! \times 3!$ or $2! \times {}^3P_3$ $2 \times 3! \times 4$
ii	${}^{1/5}C_2$ or ${}^{1/5} \times {}^{1/4} \times 2$ or $0.4 \times 0.25$ or ${}^{2/5}P_2$ $= {}^{1/10}$	M1 A1 2	Allow M1 for ${}^5C_2$ or ${}^{1/5} \times {}^{1/4}$ or ${}^{1/20}$ or ${}^{1/5} \times {}^{1/5} \times 2$ or ${}^{2/25}$ oe

**Q7, (Jun 2008, Q2)**

(i)	$\frac{{}^7C_2 \times {}^8C_3}{{}^{15}C_5}$  $= \frac{56}{143}$ or $\frac{1176}{3003}$ or 0.392 (3 sfs)	M1 M1  A1 3	${}^7C_2 \times {}^8C_3$ or 1176 : M1 (Any C or P)/ ${}^{15}C_5$ : M1 (dep < 1)  or $\frac{7}{15} \times \frac{6}{14} \times \frac{8}{13} \times \frac{7}{12} \times \frac{6}{11}$ or 0.0392: M1 $\times {}^5C_2$ or $\times 10$ : M1 (dep $\geq 4$ probs mult)  if 2 $\leftrightarrow$ 3, treat as MR max M1M1
(ii)	$3! \times 2!$ or ${}^3P_3 \times {}^2P_2$ not in denom $= 12$	M1 A1 2	BABAB seen: M1  120-12: M1A0 NB ${}^{4!}_{2!} = 12$ : M0A0

**Q8, (Jan 2009, Q6)**

6 (i) (a)	$8!$ $= 40320$	M1 A1 2	Allow ${}^4P_4$ & ${}^3P_3$ instead of 3! & 4! thro'out Q6
(b)	$\frac{4!}{8} \times \frac{4!}{7} \times \frac{3!}{6} \times \frac{3!}{5} \times \frac{2!}{4} \times \frac{2!}{3} \times \frac{1!}{2}$ $\times 2$  $= \frac{1}{35}$ or 0.0286 (3 sfs)	M1 M1dep  A1 3	$4! \times 4! \div 8!$ $\times 2$  allow 1 – above for M1 only oe, eg $\frac{1152}{40320}$
(ii)(a)	$4! \times 4!$ $= 576$	M1 A1 2	allow $4! \times 4! \times 2$ : M1
(b)	$\frac{1}{16}$ or 0.0625	B1 1	
(c)	Separated by 5 or 6 qus stated or illus  $\frac{1}{4} \times \frac{1}{4} \times 3$ or $\frac{1}{16} \times 3$ ( $\frac{1}{4} \times \frac{1}{4}$ or $\frac{1}{16}$ alone or $\times(2$ or $6)$ : M1)  $\frac{3}{16}$ or 0.1875 or 0.188	M1  M2  A1 4	allow 5 only or 6 only or (4, 5 or 6) can be impl by next M2 or M1  $3! \times 3! \times 3$ ( $3! \times 3!$ alone or $\times(2$ or $6)$ ; or $(3! + 3!) \times 3$ : M1) ( $\div 576$ )  correct ans, but clearly B, J sep by 4: M0M2A0  1- P(sep by 0, 1, 2, 3, (4)) M1 $1 - (\frac{1}{4} + \frac{1}{4} + \frac{1}{4} \times \frac{3}{4} + \frac{1}{4} \times \frac{1}{2})$ or $1 - (\frac{1}{4} \times \frac{1}{4} + \frac{1}{2} \times \frac{1}{4} + \frac{3}{4} \times \frac{1}{4} + 1 \times \frac{1}{4} + \frac{3}{4} \times \frac{1}{4})$ M2 (one omit: M1)
Total		12	

**Q9, (Jan 2010, Q8)**

(i)	$\frac{5!}{2}$ = 60	M1 A1 2	Allow 5P3
(ii)	4! = 24	M1 A1 2	Allow 2×4!
(iii)	$\frac{2}{5} \times \frac{3}{4}$ or $\frac{3}{5} \times \frac{2}{4}$ × 2 = $\frac{3}{5}$ oe	M1 M1 A1 3	allow M1 for $\frac{2}{5} \times \frac{3}{5} \times 2$ or $\frac{12}{25}$ or $(6 \times 3!) \div (i)$ M2 or $3! \div (i), 6 \div (i), (6+6) \div (i), 6k \div (i)$ or $6 \times 6$ or 36 or 1-correct answer M1 (k, integer ≤ 5)
<b>Total</b>		<b>[7]</b>	

**Q10, (Jun 2009, Q7)**

7i	${}^8C_3$ = 56	M1 A1 2	
ii	${}^7C_2$ or or ${}^7P_2 / {}^8P_3$  $\div ({}^8C_3 \text{ or "56"})$ only = $\frac{3}{8}$	$\frac{1}{8}$ not from incorrect  × 3 only or $\frac{1}{8} + \frac{7}{8} \times \frac{1}{7} + \frac{7}{8} \times \frac{6}{7} \times \frac{1}{6}$  6	${}^8C_1 + {}^7C_1 + {}^6C_1$ or 21 or $8 \times 7 \times 6$ or $\frac{1}{8} \times \frac{1}{7} \times \frac{1}{6}$  indep, dep ans < 1  1 – prod 3 probs
iii	${}^8P_3$ or $8 \times 7 \times 6$ or ${}^8C_1 \times {}^7C_1 \times {}^6C_1$ or 336  $1 \div {}^8P_3$ only = $\frac{1}{336}$ or 0.00298 (3 sf)	M1  M1 A1 3	$\frac{1}{8} \times \frac{1}{7} \times \frac{1}{6}$ only M2  If × or ÷: M1 $(\frac{1}{8})^3$ M1
<b>Total</b>		<b>8</b>	

6i	$7! \div 3!$ $\div 2!$ $= 420$	$7! \div 2!$ $\div 3!$	M1 M1dep A1 3	But NOT ${}^7P_4$ or $7!/(7-4)!$ if seen $\frac{7!}{3!+2!}$ : M1M0 $\frac{7!}{3! \times n!}$ any $n$ : M1M0
iiia	${}^5C_3$ or ${}^{10}C_4$ seen ${}^5C_3 \times {}^{10}C_4$ $= 2100$		M1 M1 A1 3	or 10 or 210 $\frac{{}^5C_3 \times {}^{10}C_4}{\text{anything}}$ M1M1A0 ${}^5P_3 \times {}^{10}P_4$ or $60 \times 5040$ or $302400$ : SC B1
b	${}^4C_2 \times {}^9C_4$ or ${}^4C_3 \times {}^9C_3$ or 756 or 336 ${}^4C_2 \times {}^9C_4 + {}^4C_3 \times {}^9C_3$ or 1092 $\div 2100$ or $\div$ (iia) dep $\geq$ one M1 scored $= \frac{13}{25}$ or 0.52  “2100” – ( ${}^4C_3 \times {}^9C_4$ or ${}^4C_2 \times {}^9C_3$ ) or “2100” – (504 or 504) M1 “2100” – ( ${}^4C_3 \times {}^9C_4 + {}^4C_2 \times {}^9C_3$ ) M1 $\div$ “2100” or (iia) dep $\geq$ M1 M1	M1 M1 M1dep A1 4	$\frac{3}{5}$ or $\frac{4}{10}$ oe $\frac{3}{5} \times (1 - \frac{4}{10})$ or $(1 - \frac{3}{5}) \times \frac{4}{10}$ $\frac{3}{5} \times (1 - \frac{4}{10}) + (1 - \frac{3}{5}) \times \frac{4}{10}$ $= \frac{13}{25}$  $\frac{3}{5}$ or $\frac{4}{10}$ oe M1 $\frac{3}{5} + \frac{4}{10} - \frac{3}{5} \times \frac{4}{10}$ M1 $\frac{3}{5} + \frac{4}{10} - \frac{3}{5} \times \frac{4}{10} - \frac{3}{5} \times \frac{4}{10}$ M1 $= \frac{13}{25}$ A1	Not from incorrect wking SC $\frac{1}{5} \times \frac{9}{10}$ or $\frac{4}{5} \times \frac{1}{10}$ M1 $\frac{1}{5} \times \frac{9}{10} + \frac{4}{5} \times \frac{1}{10}$ M1 $(= \frac{13}{50}$ A0)  Not from incorrect wking ie P(WA or GA or both) Must be correct figures ie P(WA or GA but not both) Must be correct figures  SC: ${}^4P_2 \times {}^9P_4 + {}^4P_3 \times {}^9P_3$ : M1 $\div$ (iia) M1dep  Careful: 336 or 756 can be obtained by incorrect methods.
<b>Total</b>			<b>10</b>	

**Q12, Jun 2011, Q6)**

ia	5040	B1 1		
b	6! or 5!×6 or 720	M1	$\frac{1}{7} \times \frac{1}{6}$ M1*	NOT 6! in denom
	÷ 7! or ÷ “5040” or 1440 or (5! or 6!) × 2	M1	Any ÷ 7! or “5040” but NOT any × 2	eg $\frac{6!}{5040}$ or $\frac{1}{7}$ or 0.143 or $\frac{1}{21}$ (3 sfs): M1M1A0
	= $\frac{2}{7}$ oe or 0.286 (3 sf)	A1 3		
ia	3! × 4! alone or 144	M1	$\frac{4! \times 3!}{6 \times 5 \times 4 \times 3 \times 2} \text{ oe } \frac{1}{7C3 \text{ or } 7C4}$	Not 3! × 4! × ... (eg not 3! × 4! × 5)
	(÷ 7! or “5040”)			not $\frac{1}{3! \times 4!}$ , not $\frac{1}{144}$
	= $\frac{1}{35}$ oe or 0.0286 (3sf)	A1 2		NB no mark for ÷ 7! or “5040” in this part
b	5 seen or 5! seen	M1		or GGGBBBB, BGGGBBB, BBGGGBB, BBBGGGB, BBBBGGG
	3! × 4! × 5 or 5! × 3! or 720 or 5 × 144	M1	or $5 \times \frac{3! \times 2! \times 1!}{6 \times 5} (\times \frac{4! \times 3! \times 2!}{2}) \text{ oe: M2}$	
			or $5 \times \frac{1}{7C3 \text{ or } 7C4}$ : M2	NB no mark for ÷ 7! or “5040” in this part
	(÷ 7! or “5040”)		or 5 × “(ia)” : M2	
	= $\frac{1}{7}$ oe or 0.143 (3 sf)	A1 3		
<b>Total</b>		<b>9</b>		



**Q13, (Jan 2012, Q9)**

(i)	(a)	${}^9P_4$ or ${}^9!/5!$ or ${}^9C_4 \times 4!$ = 3024	M1 A1 [2]	alone	oe eg ${}^9C_1 \times {}^8C_1 \times {}^7C_1 \times {}^6C_1$ or $9 \times 8 \times 7 \times 6$
(i)	(b)	${}^8P_3$ or $8 \times 7 \times 6$ oe or ${}^8C_3 \times 3!$ $\times 5$ (or ${}^5C_1$ ) = 1680	M1 M1 A1 [3]	Allow $\times \dots$ or $\div \dots$ Correct $\times 5$ or ${}^8C_3 \times 5$ (or ${}^5C_1$ ) Not ISW, eg ${}^{1680}/{}_{3024}$ : M1M1A0	or $({}^9P_4$ or "3024") $\times {}^5/9$ M2
(ii)	(a)	${}^5C_3 \times {}^4C_1$ or ${}^5C_4$ oe ${}^5C_3 \times {}^4C_1 + {}^5C_4$ oe correct method so far (= 45) $\div {}^9C_4$ Allow anything $\div {}^9C_4$ = ${}^5/_{14}$ or 0.357 (3 sfs) oe, eg ${}^{35}/_{98}$ or ${}^{45}/_{126}$	M1 M1 M1 A1 [4]	SC: consistent use of with replacement in (i) (or if only (a) or (b) attempted) (ia) M0A0 (ib) $999 \times 5$ or 4995 M1 M0A0	${}^5/9 \times {}^4/8 \times {}^3/7 \times {}^4/6$ Allow $\times$ or $+$ ... $\times 4$ correct method so far  ${}^5/9 \times {}^4/8 \times {}^3/7 \times {}^2/6$ Allow $\times$ or $+$ ... or: ${}^5/9 \times {}^4/8 \times {}^3/7 \times {}^4/6$ or ${}^5/9 \times {}^4/8 \times {}^3/7$ M1 ${}^5/9 \times {}^4/8 \times {}^3/7 \times {}^4/6 \times 3 + {}^5/9 \times {}^4/8 \times {}^3/7$ M1 NB ${}^5/9 \times {}^4/8 \times {}^3/7 \times 3 = {}^5/_{14}$ M0M0M0A0
				Marks must come from one method, not mixture of two methods	
(ii)	(b)	9, 8, 7, 4 or 9, 8, 6, 5 No mark yet  $2$ $\div {}^9C_4$ oe Must be (1 or 2 or 4) $\div {}^9C_4$  = ${}^1/_{63}$ oe or 0.0159 (3 sfs)	M1 M1 A1 [3]	${}^1/9 \times {}^1/8 \times {}^1/7 \times {}^1/6$ : ${}^4/9 \times {}^3/8 \times {}^2/7 \times {}^1/6$ Allow $\times$ or $+$ ... $\times 4! \times 2$ : $\times 2$ fully correct method  NB Marks from one method only, not mixed methods	$4! + 4!$ or $2 \times 4!$ oe $\div {}^9P_4$ or $\div$ (i)(a) oe Must be $(96 \text{ or } 48 \text{ or } 24) \div {}^9P_4$  ${}^2/9 \times {}^2/8 \times {}^1/7 \times {}^1/6$ allow $\times$ or $+$ ... M1 $\times 4!/4 \times 2$ fully correct method M1
				SC: consistent use of with replacement in (ii), (or if only (a) or (b) attempted) (iia) $({}^5/9)^4$ M1 $+ {}^4C_3 ({}^5/9)^3 ({}^4/9)$ (= 0.400) M1 M0A0 (iib) $({}^1/9)^4$ (=0.000152) M1 attempt find no of gps M1A0	$1 - (({}^4/9)^4 + 4({}^4/9)^3 ({}^5/9) + {}^4C_2 ({}^4/9)^2 ({}^5/9)^2)$ M2 One term missing or extra or wrong M1

**Q14, (Jan 2013, Q4)**

<b>(i)</b>	<b>(a)</b>	6	<b>B1</b> <b>[1]</b>		
<b>(i)</b>	<b>(b)</b>	$3 \times 3 \times 3$  $= 27$	<b>M1</b>  <b>A1</b> <b>[2]</b>	$3! + 7 \times 3$ $3 + 3 \times 6 + 6$ $3! \times 4 + 3$ Complete correct method. Allow methods equiv to these.  Only allow other methods if they appear correct	(Explanation for $3! \times 4 + 3$ : 123: $3!$ , 112 & 122: $3!$ , 223 & 233: $3!$ , 331 & 311: $3!$ 111, 222, 333: 3   Candidates need not include this)
<b>(i)</b>	<b>(c)</b>	<b>(i)(b) – 3</b>  If answer is not 24, this method must be explicitly stated in order to give M1A1ft  $= 24$ ft their <b>(i)(b)</b>	<b>M1</b>  <b>A1ft</b> <b>[2]</b>	or $3! + 6 \times 3$ or $3! + 3! \times 3$ or $6 + 3! \times 3! \div 2!$ or $3! \times 4$ Complete correct method. Allow methods equiv to these.  Only allow other methods if they appear correct	or $8 \times 3$ (Explanation: there are 8 possible orders starting with 1. Candidates need not include this)
<b>(ii)</b>		eg 1123: $\frac{4!}{2!} \times 3$ alone allow M1 for $\frac{4!}{2!} \times 3!$ alone  eg 1122: $\frac{4!}{2!2!} \times 3$ alone allow M1 for $\frac{4!}{2!2!} \times 3!$ alone  Total = 54	<b>M2</b>  <b>M2</b>  <b>A1</b> <b>[5]</b>	$3! \times {}^4C_1 \times 3$ or $3! \times 12$ <b>M1</b> $\div 2$ <b>M1dep (= 36)</b>  $3! \times {}^4C_2$ <b>M1</b> $\div 2$ <b>M1dep (= 18)</b>  Allow methods equiv to these, eg correctly listing cases Only allow other methods if they appear correct.  NB $3 \times 3 \times 2 \times 2 = 36$ & $3 \times 3 \times 2 \times 1 = 18$ are incorrect methods unless clear justification given	This method only scores if $3 \times 3 \times 3 \times 3 - \dots$ is used: No. with 4 rep'ns = 3 <b>M1</b>  No. with 3 rep'ns = $\frac{4!}{3!}$ <b>M1</b> $\times 6$ (= 24) <b>M1</b> or $8 \times 3$ <b>M2</b>  81 – ('3' + '24') or 81 – 27 <b>M1</b> (allow 81 – 3 or 81 – 24)  18, 36 only score if a correct method seen,, or eg: 18 orders listed starting with "1" or 18 orders listed with two repetitions



**Q15, (Jun 2014, Q8)**

(i)		${}^5C_2$ oe seen anywhere or num= 10 alone  $\frac{{}^5C_2}{{}^8C_4}$ oe or $\frac{{}^5C_2 \times 4!}{{}^8P_4}$ oe all correct  $= \frac{1}{7}$ or 0.143 (3 sf)	M1  M1  A1  <b>[3]</b>	$\frac{1}{8} \times \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5}$ or $\frac{20}{1680}$ or $\frac{1}{84}$ oe seen  $\frac{1}{8} \times \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5} \times {}^4C_2 \times 2$ or $\frac{1}{8} \times \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5} \times 4! \div 2$ oe or $\frac{1}{8} \times \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5} \times 12$ oe all correct  Correct ans scores M1M1A1 regardless of method.	alone or $\times \dots$ eg $\frac{2}{8} \times \frac{1}{7} \times \frac{5}{6} \times \frac{4}{5}$ M1  $\frac{4}{8} \times \frac{3}{7} \times \frac{4}{6}$ oe all correct M2 NB <u>incorrect</u> ${}^8C_4$ does not score
(ii)		$6! \times 2$ alone or $5! \times 6 \times 2$ alone oe  $= 1440$	M2  A1  <b>[3]</b>	M1 for $6!$ or $5! \times 6$ or ${}^6P_5$ or 720 seen NB $5!$ scores M0 unless $5! \times 6$ or $5! \times 12$	M1 for $7! \times 2$ alone NB $7!$ scores M0 unless $7! \times 2$ alone
(iii)		$6! \times 4$ alone or $6! \times 2 \times 2$ alone  $= 2880$	M2  A1  <b>[3]</b>	M1 for $6!$ or ${}^6P_5$ or 720 seen or $5! \times 6$ seen but NOT from $5! \times 3!$	$5!$ : M0 unless $5! \times 6$ or $5! \times 12$ or $5! \times 24$

**Q16, (Jun 2015, Q6)**

(i)		$7!$ or 5040 or ${}^7P_7$ seen $1 \div \frac{7!}{2}$ or $\frac{2}{7!}$ $= \frac{1}{2520}$ or 0.000397 (3 sf)	M1 M1 A1 <b>[3]</b>	or $5! \times ({}^6C_2 + 6)$ NOT $5! \times {}^6C_2$ $\frac{1}{5! \times ({}^6C_2 + 6)}$ or $\frac{2}{5040}$ oe	or $\frac{2}{7} \times \frac{1}{6} \times \frac{1}{5} \times \frac{1}{4} \times \frac{1}{3} \times \frac{1}{2}$ alone M2 or $\geq 5$ correct fracs mult: or 6 correct fracs mult $\times \dots$ M1
(ii)	(a)	5	B1 <b>[1]</b>	Ignore any working seen	
(ii)	(b)	${}^5C_2$ alone (or $\times {}^2C_2$ ) or ${}^6C_3 \div 2(!)$ or $\frac{2}{7} \times {}^7C_3$ or ${}^5P_2 \div 2$ $= 10$	M1 A1 <b>[2]</b>	alone, eg NOT ${}^5C_2 \times \dots$ or ${}^5C_2 + \dots$	But allow ${}^5C_2$ as denom of prob M1A0
(ii)	(c)	$"5" + "10" + {}^5C_3$ $= 25$	M1 A1f <b>[2]</b>	or ${}^6C_3 + "5"$ or ${}^7C_3 - "10"$ or ${}^7C_3 - {}^5C_2$ ft (a) &/or (b) only if working seen	Allow as denom of a prob M1A0