

EXERCISES: Safe Endurance

Gallons x 3.8 = Litres, Litres ÷ 3.8 = gallons.

Express Gallons to 1 decimal place. Round litres to the nearest litre.

No.	Fuel on Board At Start-up	Cruise Fuel Flow	Holding Fuel Flow	10% Variable Reserve?	Fixed Reserve 45 min @ holding	Holding (@ holding FF)	Start up/Taxi Allowance	Safe Endurance (minutes)
1	46 gal	10 gph	7 gph	Yes		None	3 gal	
2	42.7 gal	11 gph	7.7 gph	Yes		30 min	3 gal	
3	223 litres	53 lph	37 lph	No		30 min	15 litres	
4	48.1 gal	12.9 gph	9 gph	No		30 min	3 gal	
5	234 litres	52 lph	36 lph	Yes		30 min	11 litres	
6	135 litres	44 lph	31 lph	No		60 min	11 litres	
7	49.1 gal	13.1 gph	9.2 gph	Yes		60 min	3 gal	
8	33.6 gal	9.8 gph	6.9 gph	Yes		None	2 gal	
9	112 litres	42 lph	30 lph	No		10 min	11 litres	
10	24.1 gal	9.5 gph	6.7 gph	No		None	2 gal	
11	97 litres	36 lph	25 lph	Yes		60 min	8 litres	
12	51.7 gal	11.5 gph	8.1 gph	No		30 min	3 gal	
13	18.8 gal	8.9 gph	6.2 gph	Yes		30 min	2 gal	
14	41.8 gal	11.9 gph	8.3 gph	Yes		None	3 gal	
15	42.4 gal	13.5 gph	9.5 gph	No		30 min	3 gal	
16	32.9 gal	12.5 gph	8.8 gph	No		None	3 gal	
17	251 litres	51 lph	36 lph	Yes		60 min	11 litres	
18	59 litres	30 lph	21 lph	No		None	8 litres	
19	139 litres	32 lph	22 lph	Yes		60 min	8 litres	
20	30.8 gal	10 gph	7 gph	No		None	3 gal	

EXERCISES: Safe Endurance – ANSWERS

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No.	Fuel on Board At Start-up	Cruise Fuel Flow	Holding Fuel Flow	10% Variable Reserve?	Fixed Reserve 45 min @ holding	Holding (@ holding FF)	Start up/Taxi Allowance	Safe Endurance (minutes)
1	46 gal	10 gph	7 gph	Yes	5.3 gal	None	3 gal	206 min
2	42.7 gal	11 gph	7.7 gph	Yes	5.8 gal	3.9 gal	3 gal	149 min
3	223 litres	53 lph	37 lph	No	28 litres	19 litres	15 litres	182 min
4	48.1 gal	12.9 gph	9 gph	No	6.8 gal	4.5 gal	3 gal	157 min
5	234 litres	52 lph	36 lph	Yes	27 litres	18 litres	11 litres	187 min
6	135 litres	44 lph	31 lph	No	23 litres	31 litres	11 litres	95 min
7	49.1 gal	13.1 gph	9.2 gph	Yes	6.9 gal	9.2 gal	3 gal	125 min
8	33.6 gal	9.8 gph	6.9 gph	Yes	5.2 gal	None	2 gal	147 min
9	112 litres	42 lph	30 lph	No	22 litres	5 litres	11 litres	106 min
10	24.1 gal	9.5 gph	6.7 gph	No	5 gal	None	2 gal	108 min
11	97 litres	36 lph	25 lph	Yes	19 litres	25 litres	8 litres	68 min
12	51.7 gal	11.5 gph	8.1 gph	No	6.1 gal	4.1 gal	3 gal	201 min
13	18.8 gal	8.9 gph	6.2 gph	Yes	4.7 gal	3.1 gal	2 gal	55 min
14	41.8 gal	11.9 gph	8.3 gph	Yes	6.2 gal	None	3 gal	149 min
15	42.4 gal	13.5 gph	9.5 gph	No	7.1 gal	4.8 gal	3 gal	122 min
16	32.9 gal	12.5 gph	8.8 gph	No	6.6 gal	None	3 gal	112 min
17	251 litres	51 lph	36 lph	Yes	27 litres	36 litres	11 litres	189 min
18	59 litres	30 lph	21 lph	No	16 litres	None	8 litres	69 min
19	139 litres	32 lph	22 lph	Yes	17 litres	22 litres	8 litres	158 min
20	30.8 gal	10 gph	7 gph	No	5.3 gal	None	3 gal	135 min

EXERCISES: Point of No Return (PNR)

No.	Safe Endurance	Wind	Track Out	Track Home	TAS	Time to PNR	Distance to PNR
1	108 min	20kt 006°M	351°M	171°M	120 kts		
2	136 min	20kt 190°M	129°M	309°M	150 kts		
3	71 min	30kt 348°M	235°M	055°M	140 kts		
4	107 min	20kt 043°M	263°M	083°M	180 kts		
5	63 min	5kt 094°M	302°M	122°M	140 kts		
6	115 min	15kt 118°M	330°M	150°M	170 kts		
7	197 min	15kt 201°M	274°M	094°M	110 kts		
8	148 min	10kt 262°M	198°M	018°M	120 kts		
9	146 min	30kt 256°M	168°M	348°M	160 kts		
10	209 min	25kt 063°M	077°M	257°M	150 kts		
11	80 min	20kt 045°M	201°M	021°M	180 kts		
12	150 min	30kt 224°M	210°M	030°M	170 kts		
13	138 min	15kt 116°M	280°M	100°M	100 kts		
14	70 min	10kt 135°M	228°M	048°M	170 kts		
15	96 min	20kt 201°M	302°M	122°M	150 kts		
16	193 min	20kt 134°M	298°M	118°M	180 kts		
17	64 min	20kt 215°M	206°M	026°M	120 kts		
18	123 min	15kt 351°M	344°M	164°M	100 kts		
19	189 min	30kt 328°M	001°M	181°M	90 kts		
20	97 min	5kt 152°M	052°M	232°M	100 kts		
21	164 min	25kt 354°M	275°M	095°M	180 kts		
22	183 min	15kt 111°M	140°M	320°M	170 kts		
23	167 min	30kt 229°M	046°M	226°M	100 kts		
24	171 min	20kt 116°M	071°M	251°M	110 kts		
25	110 min	5kt 171°M	114°M	294°M	150 kts		
26	103 min	10kt 147°M	181°M	001°M	140 kts		
27	144 min	10kt 160°M	227°M	047°M	150 kts		
28	188 min	30kt 054°M	277°M	097°M	130 kts		
29	87 min	30kt 098°M	032°M	212°M	140 kts		
30	121 min	20kt 261°M	043°M	223°M	90 kts		

EXERCISES: Point of No Return (PNR) – ANSWERS

No.	Safe Endurance	Wind	TAS	Groundspeed Out	Groundspeed Home	Time to PNR	Distance to PNR
1	108 min	20kt 006°M	120 kts	101 kts	139 kts	63 min	106 nm
2	136 min	20kt 190°M	150 kts	140 kts	160 kts	73 min	170 nm
3	71 min	30kt 348°M	140 kts	152 kts	128 kts	32 min	81 nm
4	107 min	20kt 043°M	180 kts	195 kts	165 kts	49 min	159 nm
5	63 min	5kt 094°M	140 kts	144 kts	136 kts	31 min	74 nm
6	115 min	15kt 118°M	170 kts	183 kts	157 kts	53 min	162 nm
7	197 min	15kt 201°M	110 kts	106 kts	114 kts	102 min	180 nm
8	148 min	10kt 262°M	120 kts	116 kts	124 kts	76 min	147 nm
9	146 min	30kt 256°M	160 kts	159 kts	161 kts	73 min	193 nm
10	209 min	25kt 063°M	150 kts	126 kts	174 kts	121 min	254 nm
11	80 min	20kt 045°M	180 kts	198 kts	162 kts	36 min	119 nm
12	150 min	30kt 224°M	170 kts	141 kts	199 kts	88 min	207 nm
13	138 min	15kt 116°M	100 kts	114 kts	86 kts	59 min	112 nm
14	70 min	10kt 135°M	170 kts	171 kts	169 kts	35 min	100 nm
15	96 min	20kt 201°M	150 kts	154 kts	146 kts	47 min	121 nm
16	193 min	20kt 134°M	180 kts	199 kts	161 kts	86 min	285 nm
17	64 min	20kt 215°M	120 kts	100 kts	140 kts	37 min	62 nm
18	123 min	15kt 351°M	100 kts	85 kts	115 kts	71 min	101 nm
19	189 min	30kt 328°M	90 kts	65 kts	115 kts	121 min	131 nm
20	97 min	5kt 152°M	100 kts	101 kts	99 kts	48 min	81 nm
21	164 min	25kt 354°M	180 kts	175 kts	185 kts	84 min	245 nm
22	183 min	15kt 111°M	170 kts	157 kts	183 kts	98 min	256 nm
23	167 min	30kt 229°M	100 kts	130 kts	70 kts	58 min	126 nm
24	171 min	20kt 116°M	110 kts	96 kts	124 kts	96 min	154 nm
25	110 min	5kt 171°M	150 kts	147 kts	153 kts	56 min	137 nm
26	103 min	10kt 147°M	140 kts	132 kts	148 kts	54 min	119 nm
27	144 min	10kt 160°M	150 kts	146 kts	154 kts	74 min	180 nm
28	188 min	30kt 054°M	130 kts	152 kts	108 kts	78 min	198 nm
29	87 min	30kt 098°M	140 kts	128 kts	152 kts	47 min	100 nm
30	121 min	20kt 261°M	90 kts	106 kts	74 kts	50 min	88 nm

EXERCISE - ETA Planning

No.	Scenario (See Appendix for Figures 18 and 19)
1	Refer to Fig. 19. Your aircraft is cruising with a TAS of 100 kts but after covering 80 nm (D1), you find you are already 3 minutes late. If your original ETA was 1112, what will be your new ETA at the destination, another 80 nm (D2) along track?
2	Refer to Fig. 18. Your aircraft is cruising with a TAS of 90 kts but after covering 30 nm (D1), you find you are already 9 minutes late. If your original ETA was 1626, what will be your new ETA at the destination, another 40 nm (D2) along track?
3	Refer to Fig. 19. Your aircraft is cruising with a TAS of 100 kts but after covering 120 nm (D1), you find you are already 3 minutes late. If your original ETA was 0737, what will be your new ETA at the destination, another 60 nm (D2) along track?
4	Refer to Fig. 18. Your aircraft is cruising with a TAS of 140 kts but after covering 30 nm (D1), you find you are already 6 minutes late. If your original ETA was 1932, what will be your new ETA at the destination, another 40 nm (D2) along track?
5	Refer to Fig. 19. Your aircraft is cruising with a TAS of 150 kts but after covering 150 nm (D1), you find you are already 6 minutes late. If your original ETA was 0808, what will be your new ETA at the destination, another 90 nm (D2) along track?
6	Refer to Fig. 19. Your aircraft is cruising with a TAS of 100 kts but after covering 150 nm (D1), you find you are already 9 minutes late. If your original ETA was 2300, what will be your new ETA at the destination, another 150 nm (D2) along track?
7	Refer to Fig. 18. Your aircraft is cruising with a TAS of 120 kts but after covering 80 nm (D1), you find you are already 6 minutes late. If your original ETA was 2306, what will be your new ETA at the destination, another 100 nm (D2) along track?
8	Refer to Fig. 18. Your aircraft is cruising with a TAS of 90 kts but after covering 40 nm (D1), you find you are already 9 minutes late. If your original ETA was 1614, what will be your new ETA at the destination, another 100 nm (D2) along track?
9	Refer to Fig. 19. Your aircraft is cruising with a TAS of 100 kts but after covering 60 nm (D1), you find you are already 9 minutes late. If your original ETA was 1529, what will be your new ETA at the destination, another 60 nm (D2) along track?
10	Refer to Fig. 18. Your aircraft is cruising with a TAS of 140 kts but after covering 40 nm (D1), you find you are already 3 minutes late. If your original ETA was 1622, what will be your new ETA at the destination, another 50 nm (D2) along track?
11	Refer to Fig 19. Your aircraft is cruising with a TAS of 90kt but after covering 40nm (D1) you find that you are already 4 minutes late. If your original ETA was 1143, what will be your new ETA at the destination 30nm (D2) along track?
12	Refer to Fig 18. Your aircraft is cruising at a TAS of 90kt but after covering 20nm (D1) at B, you find that you are 1 minute late. If your original ETA was 1914, what will be your ETA at the destination C, if D2 is 40nm?
13	Refer to Fig 18. Your aircraft is cruising at a TAS of 120kt but after covering 30nm (D1) at B, you find that you are 2 minutes late. If your original ETA was 0830, what will be your ETA at the destination C, if D2 is 60nm?
14	Refer to Fig 19. Your aircraft is cruising at a TAS of 130kt but after covering 50nm (D1) at X, you find that you are 2 minutes late. If your original ETA was 1224, what will be your ETA at the destination C, if D2 is 25nm?
15	Refer to Fig 19. Your aircraft is cruising with a TAS of 110kt but after covering 60nm (D1) you find that you are already 4 minutes late. If your original ETA was 1152, what will be your new ETA at the destination 30nm (D2) along track?

No.	EXERCISE - ETA Planning - ANSWERS
1	If you have already lost 3 minutes after travelling 80 nm (D1), you are getting 1 minute later every 27 nm. Therefore, after travelling another 80 nm (D2), you will lose another 3 minutes. Your new ETA will be 6 minutes later than the original ETA of 1112. Your revised estimate is 1118.
2	If you have already lost 9 minutes after travelling 30 nm (D1), you are getting 1 minute later every 3 nm. Therefore, after travelling another 40 nm (D2), you will lose another 12 minutes. Your new ETA will be 21 minutes later than the original ETA of 1626. Your revised estimate is 1647.
3	If you have already lost 3 minutes after travelling 120 nm (D1), you are getting 1 minute later every 40 nm. Therefore, after travelling another 60 nm (D2), you will lose another 2 minutes. Your new ETA will be 5 minutes later than the original ETA of 0737. Your revised estimate is 0742.
4	If you have already lost 6 minutes after travelling 30 nm (D1), you are getting 1 minute later every 5 nm. Therefore, after travelling another 40 nm (D2), you will lose another 8 minutes. Your new ETA will be 14 minutes later than the original ETA of 1932. Your revised estimate is 1946.
5	If you have already lost 6 minutes after travelling 150 nm (D1), you are getting 1 minute later every 25 nm. Therefore, after travelling another 90 nm (D2), you will lose another 4 minutes. Your new ETA will be 10 minutes later than the original ETA of 0808. Your revised estimate is 0818.
6	If you have already lost 9 minutes after travelling 150 nm (D1), you are getting 1 minute later every 17 nm. Therefore, after travelling another 150 nm (D2), you will lose another 9 minutes. Your new ETA will be 18 minutes later than the original ETA of 2300. Your revised estimate is 2318.
7	If you have already lost 6 minutes after travelling 80 nm (D1), you are getting 1 minute later every 13 nm. Therefore, after travelling another 100 nm (D2), you will lose another 8 minutes. Your new ETA will be 14 minutes later than the original ETA of 2306. Your revised estimate is 2320.
8	If you have already lost 9 minutes after travelling 40 nm (D1), you are getting 1 minute later every 4 nm. Therefore, after travelling another 100 nm (D2), you will lose another 23 minutes. Your new ETA will be 32 minutes later than the original ETA of 1614. Your revised estimate is 1646.
9	If you have already lost 9 minutes after travelling 60 nm (D1), you are getting 1 minute later every 7 nm. Therefore, after travelling another 60 nm (D2), you will lose another 9 minutes. Your new ETA will be 18 minutes later than the original ETA of 1529. Your revised estimate is 1547.
10	If you have already lost 3 minutes after travelling 40 nm (D1), you are getting 1 minute later every 13 nm. Therefore, after travelling another 50 nm (D2), you will lose another 4 minutes. Your new ETA will be 7 minutes later than the original ETA of 1622. Your revised estimate is 1629.
11	Point X is 40nm from A so you have lost 4 minutes in 40nm. You have 30nm to go so you will lose another 3 minutes from X to C. Your original ETA was 1143 and you will be 7 minutes late when you arrive at C. Your revised ETA at C will be $1143 + 7 = 1150$.
12	Point B is 20nm from A so you have lost 1 minutes in 20nm. You have 40nm to go so you will lose another 2minutes from B to C. Your original ETA was 1914 and you will be 3 minutes late when you arrive at C. Your revised ETA at C will be $1914 + 3 = 1917$.
13	Point B is 30nm from A so you have lost 2 minutes in 30nm. You have 60nm to go so you will lose another 4 minutes from B to C. Your original ETA was 0830 and you will be 6 minutes late when you arrive at C. Your revised ETA at C will be $0830 + 6 = 0836$.
14	Point X is 50nm from A so you have lost 2 minutes in 50nm. You have 25nm to go so you will lose another 1 minutes from X to C. Your original ETA was 1224 and you will be 3 minutes late when you arrive at C. Your revised ETA at C will be $1224 + 3 = 1227$.
15	Point X is 60nm from A so you have lost 4 minutes in 40nm. You have 30nm to go so you will lose another 2 minutes from X to C. Your original ETA was 1152 and you will be 6 minutes late when you arrive at C. Your revised ETA at C will be $1152 + 6 = 1158$.