NIFA NATIONAL SAFECON 2007
Manual Flight Computer Accuracy

Explanations

Note to competitor:
This will offer some basic help in solving the problems on the test. There is often more than one way to correctly solve any given problem. You will simply be offered one possible method or direction to help you find the solution. Some figures appear rounded when compared with electronically calculated answers because of the decimal place and significant digit limitations inherent to manual flight computers.

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1. Basic time-to-station problem.
   Time (minutes) / bearing change = time-to-station / 60
   11.6 / 15 = x / 60
   Time-to-station = 46.4 minutes or 46 minutes 24 seconds
   Correct Answer: C

2. Triple drift problem. For each MH draw a line on your computer that represents the amount of drift associated with it. After all three lines are drawn you will see that they form a triangle. Place a dot in the exact middle of it. This dot represents the wind dot and it now becomes a wind problem that gives a heading and not a course (wind speed read down from grommet). If you use only two readings you will not get the correct answer because it is prudent to average more readings than less. Variation is 5E, so once you find the wind direction using the dot, you must now remove variation.
   Correct Answer: A

3. DME arc problem. You flew 50° of the 360° in a circle and that 50° was 19.2 NM.
   So, 50 is to 360 as 19.2 is to the circumference: 138.
   $138 = 2\pi r$
   $r = 138 / 2\pi$ or $r = 138 / (2 \cdot 3.14)$ $r = 22$ NM
   Correct Answer: B

4. First find the radial you were on after flying 10 NM. We know circumference is 138 and radius is 22.
   10 is to 138 as x is to 360
   x = 26, so we are 26° into our arc. Starting from the 030° radial minus 26° leaves us on the 004° radial. The VOR is directly off our left wing and our nose is pointed 90° from the station, or 274°. Winds are calm so there is no WCA to worry about. VOR radials reference magnetic north, so 274° is already magnetic.
   Correct Answer: D

5. Equal time point problem.
   Find GS out (if you were to continue) and GS back (if you were to return).
   Using given winds and TC to find the two groundspeeds.
   T = D / S
   Since time will be same, we can re-write:
   Dist back / GS back = Dist out / GS out
   Let's say dist to continue to XYZ = x and dist to return to ABC = 177 – x
   $x / 101 = (177 - x) / 128$
   $128x = 17900 - 101x$
   $232x = 17900$
   $x = 78$
   Correct Answer: B

6. Convert -10°F to Celsius (-23°C). Now find pressure altitude. Subtract 29.92 from 30.32 and multiply by 1000. PA is 400' lower than the cruising altitude of 12,500'. So PA is 12,100'. In the airspeed window, align PA with OAT. Find the CAS (104 knots) on the B scale and find the answer of 122 knots opposite it on the A scale.
   Correct Answer: A

7. We know the PA and OAT. In the altitude window, align the PA (12,100’) with the OAT (-23°C). Find the calibrated altitude (12,500’) on the B scale and find the answer of 11,800’ opposite it on the A scale.
<u>Correct Answer: A</u>

8. Using a computer with a temp rise window, you will find that 430 KTAS is aligned with a temp rise of 24 C°. Since the recovery coefficient is .8, you have to multiply this figure (24) by .8 to get the answer of 19 C°.
<u>Correct Answer: C</u>

9. Wind problem. You must make sure to keep units correct. Convert the wind speed of 28 mph to 24 knots because the TAS and answers are in knots. Now it’s a basic wind problem to give GS of 209 knots.
<u>Correct Answer: D</u>

10. Wind problem. Using given data we find the winds to be 350° @ 52 kph. Answers are in knots and mph. So convert 52 to knots and mph and we find the correct answer is 350° @ 32 mph.
<u>Correct Answer: C</u>

11. Accurately mark your wind dot on the computer. Align TC under the True Index and move the slide until the dot is exactly over the WCA 5°L line. We now see the GS of 171 knots under the grommet. You will notice that being a little off on the wind dot placement will cause large GS deviations. For this reason the choices on the test were spaced apart sufficiently to account for slight deviations. You should get closest to the choice of 171 knots.
<u>Correct Answer: B</u>

12. We saw the GS under the grommet. Find the TAS under the wind dot, which is 188 knots. Answers are in mph, so convert to 216 mph. You will notice that being a little off on the wind dot placement will cause large TAS deviations. For this reason the choices on the test were spaced apart sufficiently to account for slight deviations. You should get closest to the choice of 216 mph.
<u>Correct Answer: C</u>

13. Basic wind problem that gives TH instead of TC. TC is 339°.
<u>Correct Answer: A</u>

14. Basic wind problem, but answers are in mph. So you must convert to find the answer of 092° @ 18 mph.
<u>Correct Answer: D</u>

15. First find distance to travel. We are due east and will be flying west to the VORTAC and beyond. Convert 83 km to 44.8 NM. Add this to 136 NM to find a total distance of 180.8 NM. Convert 28 liters of fuel to 6.17 Imp gal. We will burn 6.17 Imp gal at a rate of 5.6 Imp gal per hour to give a time of 66 minutes. So we cover 180.8 NM in 66 minutes. This gives a GS of 164 knots. Now mark your wind dot. We are flying due west referencing the VORTAC. VORTACs are magnetic so our MC is 270°. Winds are given in magnetic so this is compatible. Put 270° under the True Index and place the grommet under 167. We will find the TAS under the wind dot, which is 150 knots. Convert 68°F to 20°C. In airspeed window align PA of 6700’ with OAT of 20°C. Find TAS of 150 on A scale and find it aligned with the CAS of 132 on the B scale.
<u>Correct Answer: A</u>

16. Looking at the wind dot we can see the WCA is about 3° left. Note the equation:
Sin(crab) = XWC / TAS
No crab given, so use WCA instead (they should be very close anyway). We know the TAS is 150 knots.
Sin(3) = XWC / 150
XWC = 7.85, so correct choice is 8.
There are lots of ways to solve this problem. Some computers have “sin” scale, but you can use the off-course problem technique: Align 3° over 57.3 on the calculator side. Look above 150 and you should be very close to the answer of 8 knots.
<u>Correct Answer: C</u>

17. Using a computer with a temp rise window and takes into account compressibility, align .58 at the Mach Number arrow. The airspeed indicator will be displaying CAS. Find the PA of 25,000’ and note the answer of 240 knots is aligned with it.
<u>Correct Answer: D</u>

18. Be sure .58 is still over the Mach Number arrow. Align the C_T 1.0 line with the indicated temp of -30°C. You can now read the TAS of 340 knots under the line.
Correct Answer: B

19. Subtract the airspeeds to get 53 knots difference. This is how fast Roy is flying away from you. So, 35 NM at 53 knots will take 39.6 minutes. No wind so GS = TAS. So you've been flying 108 knots for 39.6 minutes to give a distance you have flown of 71.3 NM, which would make 71 NM the correct answer.
Correct Answer: B

20. Airspeed difference was 53 knots. Flying 40 NM at 53 knots takes 45.3 minutes. Roy is flying at 161 knots and after 45.3 minutes has traveled 121.6 NM. Subtract this from total distance of 230 NM to find 108.4 which would make 108 NM the correct answer.
Correct Answer: A

21. Multiple radius of action problem. Using the equation, you must find the radius of action for each altitude.
(GS out + GS back) / H = GS back / T
H = hours (or minutes) of fuel available
T = Time to turn
Interpolate given wind data to find exact winds at each cruising altitude. Find groundspeeds out and back for each altitude. Find useable endurance. VFR reserve is 30 minutes, which is 4.3 gal. Subtract it from total fuel to get 46.7 gal. Using fuel burn of 8.6 gph we find endurance of 326 minutes. Using equation, find time to turn of each altitude. Then combine it with GS out to find the distance, or radius of action. Note the following table to help compare answers.

	3500'	4500'	6500'	7500'
TAS	118 knots	121 knots	126 knots	129 knots
Winds	355° @ 12 knots	005° @ 16 knots	025° @ 23 knots	035° @ 25 knots
GS out	130 knots, WCA 0°	137 knots, WCA -1°	146 knots, WCA -5°	148 knots, WCA -7°
GS back	106 knots, WCA 0°	105 knots, WCA +1°	105 knots, WCA +5°	108 knots, WCA +7°
Total GS	236	242	251	256
Time To Turn	146.5 min	141.5 min	136.5 min	137.5 min
Radius Of Action	318 NM	323 NM	332 NM	340 NM

We see that the greatest distance is 340 NM, so 7500 will give you the greatest ROA. This table was completed using a manual flight computer. This table was cross-checked with an electronic flight computer and even though the answers didn't always match exactly, they were very close.
Correct Answer: D

22. At 3500' the WCA is 0°. So TC = TH. TC & TH is 358°. Variation is 8W, so add 8° to 358°. MH is 006°.
Correct Answer: C

23. Time to turn at 6500' is 136.5 minutes or 2:16:30. This is closest to the choice of 2 hours 16 minutes.
Correct Answer: D

24. GS back at 4500' is 105 knots. You must convert to mph to get answer of 121 mph.
Correct Answer: B

25. Find the difference between the airplane's course and wind's vector. In this case it's 37°.
cos(37) = x / 25 Where x it the tailwind component and 25 is the wind speed.
x = 20 knots.
If you don't have a cosine scale there are many other ways to solve this. Here's one other: Refer to the 7500' wind dot. Align 178° at the True Index and put the dot over the TAS of 129 knots. From the wind dot drawn a line straight over to the 0° WCA line, making sure it is perpendicular to the 0° line. Using the speed scale on the slide, measure the distance between the grommet and where your line hit the 0° line. This distance is your headwind component of 20 knots.
Correct Answer: C

26. Basic Mach number problem. Put the Mach Index at -35°C and look under 790 to find 1.32.
Correct Answer: A

27. Using a computer with a navigation grid, align 100° at the TC index. Mark a dot 10 NM up. No wind, so TC=TH. You then fly heading 010°, which is 90° to the left. Mark a dot 15 NM to the left of the first dot. You should find this dot on the 044° radial of the VORTAC. Put 044° at the TC index and place a third dot up 12 NM from the second dot. Your next heading is, again, 90° to the left. Mark a forth dot 40 NM to the left from the third dot. This final dot is measured at being 50 NM from the center.
Correct Answer: B

28. This is a complex wind problem that gives heading instead of course. Convert 48 SM to 41.7 NM. So, 41.7 NM in 11 minutes 18 seconds gives a GS of 221 knots. Remove variation from MH to get a TH of 207°. Since heading was given, mark wind dot down from grommet. Put TH of 207° under the True Index. Move slide until GS of 221 knots is under the wind dot. The dot is on the +4° WCA line. Add this 4° to the TH to get a TC of 211°
Correct Answer: B

29. To calculate Mach number we need the TAS. Look under the grommet to find the TAS is 243 knots. Align the Mach index with -5°C and look under 243 to find the Mach number of .38.
Correct Answer: A

30. Using the airspeed window, align the OAT of -5°C with the PA. Referencing the altimeter, PA is 830 below cruising altitude. PA is 5670'. Now look under the TAS of 243 knots to find the CAS of 227 knots.
Correct Answer: C

31. MAC is the mean aerodynamic chord. It is from station 58 to 88, so is 30 inches long. CG is 20% MAC. 20% of 30 is 6. So CG is 6" past station 58, or CG is at station 64. Forward limit is 12%. 12% of 30 is 3.6, so forward limit is at station 61.6. CG must move from 64 to 61.6, or -2.4.
Weight moved / total weight = CG change / (new station – old station)
x / 2750 = -2.4 / (28 – 154)
x = 52
Correct Answer: A

32. Off-course problem. Degrees to parallel = x
Sin(x) = dist off / dist flown
Using GS and time find that we have flown 85 NM. Convert 13 km to 7 NM. So…
Sin(x) = 7 / 85
x = 4.7°
Rather than using sin, many manuals have you align dist off over dist flown and look above either 57.3 or the speed index. Some have a specific off-course window. Any of these techniques would get you close to the angle of 5°. You are off course to the right, so you must correct to the left. Old CH of 115° minus 5° gives the CH to parallel of 110°.
Correct Answer: D

33. Align the OAT of -38°C with the Mach index and look above the Mach numbers to find each aircraft's TAS's. Alpha's TAS is 971 knots and Bravo's TAS is 464 knots. The difference is 507 knots. Different computers may find slightly different true airspeeds, but the difference should not be enough to concern us. Convert 37 SM to 32.2 NM. Add this to 65 NM to get a total distance change of 97.2 NM. Using the speed difference of 507 knots at a dist of 97.2 NM will give a time of just over 11.5 minutes. This makes the correct answer 11 minutes 33 seconds.
Correct Answer: B

34. Climb profile problem. Find time to climb. Subtract the altitudes to find the difference in altitude in each segment. No altimeter setting was given, so assume standard.
11,000 – 1,300 (airport) = 9,700 ft.
18,000 – 11,000 = 7,000 ft.
27,000 – 18,000 = 9,000 ft.

Take each altitude difference and divide each climb rate into them to get time.
9,700 / 1,800 fpm = 5.4 minutes
7,000 / 1,100 fpm = 6.4 minutes
9,000 / 600 fpm = 15 minutes

Add the times to get the answer of 26.8 minutes.
Correct Answer: B

35. Convert liters per minute to gallons per hour.
1.6 lpm = .423 gal per min
.423 · 60 = 25.4 gph
So you are burning 25.4 gph for 26.8 minutes, which is 11.3 gal. Subtract 11.3 from the 73 gal you started with to get 61.7 gal. Convert to 369 lbs.
Correct Answer: C

36. First use the following equation to find the groundspeed.
fpm / fpnm = GS / 60
510 / 230 = GS / 60
GS = 133 knots
Mark wind dot and put TC under True index. Put the grommet over the GS of 133 knots. You will find the TAS of 150 knots under the wind dot. On calculator side put TAS of 150 knots over CAS of 131 knots. Find 10°C in the airspeed window and it will be aligned with the answer of 8000 feet.
Correct Answer: D

37. First find PA. Standard altimeter is 1013.2 hPa.
1038.6 – 1013.2 = 25.4
Pressure reduces 33.86 hPa per 1000 feet.
(25.4 / 33.86) · 1000 = 750 feet. So PA is 750 ft. lower than cruising altitude. PA is 6750 ft.
Align PA of 6750 ft. with OAT of -20°C to find answer of 4100 ft.
Correct Answer: A

38. First find GS. Flying .9 NM in 17 seconds is 191 knots. Now, flying 146 NM at 191 knots will take 45.9 minutes. Burning fuel at 10.4 gph for 45.9 min equals the answer of 8.0 gal.
Correct Answer: D

39. Simple TSD to find speed of 144 mph.
Accepted As Correct: 143 – 145 mph

40. Simple temperature conversion to find 5°C.
Accepted As Correct: 4.5°C – 5.5°C

41. Simple conversion to find 372 pounds.
Accepted As Correct: 370 – 374 pounds

42. Refer to calculator side. Note 178 on outside scale. Turn inside scale until the same number appears under 178 and over the 10 of the inside scale. This alignment occurs twice on the scale, opposite each other: 13.34 and 42.19. Pick the one that makes sense for the given number. We know 10 · 10 = 100, so we know it's slightly more than 10. It's definitely not 42.19, so 13.34 is the correct choice. If you were asked the square root of 1780 the answer would be 42.19. The correct choice alternates back and forth as the decimal place of the given number moves.
Accepted As Correct: 13.25 – 13.45

43. There are 6076' per NM. Convert 4300 feet per minute to .71 NM per minute. Multiply this by 60 to find the answer of 42.5 knots.
Accepted As Correct: 42.2 – 42.8 knots

44. Simple weight conversion to find 109 kg.
Accepted As Correct: 108.5 – 109.5 kg

45. There are 4 quarts per gallon. There are 36 quarts which is 9 gal of oil. Convert 9 gal of oil to the answer of 67.5 pounds.
Accepted As Correct: 67.0 – 68.0 pounds