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I. THE ULTIMATE INTRODUCTION

- Preparing for your interview
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A. Preparing for Your Interview

Congratulations! Your application for an interview has been accepted and you have an interview date. You know that you are responsible for all of the material in all of the classes on your transcript, but where should you begin? Your first step should be to talk to the submarine LT. He will set up interviews with you and hook you up with a copy of this guide, Schaum’s Calculus and Physics Outlines, and a copy of the Magical White Binder Notes. Read the introduction to this guide and start working through the problems and Schaum’s Outlines.

In addition to the mock interviews with the submarine LT, at some point, you will have an interview with CAPT Rubenstein. He will ask you some pretty tough questions and gauge how much preparation you need to be ready. Overall, expect to have at least 3 interviews between the LT and the CAPT. These mock interviews will be very much like the real thing, and you will quickly learn how to properly set up and present solutions.

B. Lodging

A couple of weeks before your interview, you need to make hotel arrangements in D.C. There are two primary options. You can stay at the Marriott Courtyard – Navy Yard. This is hotel is only two or three blocks from the Navy Yard and only a block from the Metro. The primary advantage is that you can simply walk to the Navy Yard, which means you don’t have to mess with the Metro and you don’t have to wake up as early. The primary disadvantage is that you will have to take the Metro to get some real food. Although the hotel does have a quasi-restaurant, the food there is more appropriate for relaxing the night before your interview, not for celebrating your successful accession into the Nuke Program.

Your second option is the Marriott Courtyard – Crystal City. The primary advantage here is that it is within walking distance of a lot of restaurants. The primary disadvantage is that you will have to deal with the Metro in the morning before your interview. In addition, the roads leading out of Crystal City are HOV only in the wrong direction, so don’t plan on a quick getaway the day of your interview if you stay here.

Of course, there are more than two hotels in Washington, D.C. Regardless of where you stay, make sure you plan your commute to the Navy Yard. Visit the D.C. Metro’s website (http://www.wmata.com/) to look up train schedules and fares and to help plan the trip. Use the map on the following page to help select a hotel and plan your commute (the red star denotes the Navy Yard).

BOOK EARLY! Hotels in the area tend to fill up quickly, so don’t wait until the last minute to get a room.

C. Driving to D.C.

Most people from Tech drive up the day before their interview and also stay the night after their interview. The Navy will reimburse you for the room (including parking) up to the per diem rate in addition to paying you for the mileage you drive, so there is no financial incentive to rushing back immediately following your interview. It
is recommended that you take your time getting up to D.C. the day before your interview, enjoy your success after the interview, and return safely the next day.

D. Getting on the Yard

The main entrance to the Navy Yard is located on M Street. Present your military ID and orders, and the guards will let you through the checkpoint. Ask the gate guards if you are unsure in what building the interviews are located.

E. Orders and the Travel Claim

You will be travelling on orders to your interview. They will have to be endorsed by NR when you are at your interview, so don’t forget them! After you return from your interview, you will need to fill out a travel claim in order to be reimbursed for your hotel. Keep all of your receipts! You will need to have copies of your hotel receipts and any other receipts for incidental expenses (such as parking). Get everything together and see the Admin Officer to fill out the claim. Remember, the sooner you submit your claim, the sooner you get reimbursed.

F. The Interview Day

Your orders will say that you need to report to appropriate building by 0700 – so don’t be late! If you are still in the Corps, you will be wearing Dress B. If you are a 5th Year or OC, you will be wearing SDBs, or you can wear your old Dress B if you really want to. There is only one gate that enters onto the Yard from the main street and the
building where you need to be is not too far from the gate. Ask the guards where you
need to be for your interview and they will point you in the right direction.

Once you get to the correct building, check in with security. They will take you
to a small office where you will deposit your cell phone, receive a visitor badge, and meet
an escort. The escort will take you and several other interviewees up to the conference
room. This conference room is the interviewees’ sanctuary. You can study, relax, chat,
eat a snack, read the paper, etc. in this room. This is also where you will return after your
interviews and lunch, so take note of where it is.

You will soon learn that your day is a lot of hurry up and wait. When you first get
to the conference room, you will meet the rest of the interviewees and wait for the
Pensacola representative to arrive. The rep is an O-3 sub or SWO(N), and once he
arrives, he will introduce himself and explain how the day is going to work.

After a little more waiting, the rep will give notice that the interviews are about to
begin. Everyone will receive a slip of paper with the name of an engineer and the
engineer’s office. He will also assign interviewees as partners (sometimes a group of 3).
Pay attention to who your partner is – he or she will be interviewing with the engineer
with whom you will be interviewing later and vice versa. Following your interview, you
and your partner can swap gouge about the next interview. Once the interviews begin,
everyone will pile out of the conference room to his or her first interview. Find the office
number listed on your slip of paper and wait outside. An engineer will come out of the
office, bring you into his or her personal office, and begin the interview.

Following your interview, you will head back to the conference room. Swap
gouge and your interview slip with your partner and try to relax before the next interview.
When it is time for the second round of interviews, you will head to the next office as
before.

After the second interview, everyone will return to the conference room…and
wait. At this point, the notes from your interviews are being compiled and reviewed in
order to determine whether or not you will need a third interview. The rep will receive a
series of phone calls informing him the status of each interviewee. If you do not require a
third interview, you will be free to go to lunch. If you require a third interview, the rep
will give you the necessary instructions. People who only have two interviews get the
luxury of at least a two hour lunch. Don’t worry – even people who have three
interviews have plenty of time for lunch.

Most people who only have two interviews have done well enough to pass. Third
interviews are given to people who have one bad interview or are on “the bubble” for
passing. If you do extremely poorly in both of your interviews, however, you won’t be
given a third interview and you won’t pass.

Following lunch, everyone will meet up in the conference room. You will kill
time with the Pensacola rep until an NR rep arrives. The NR rep will spend about an
hour briefing you on how the interview with the Admiral will work. Pay careful attention
to this brief and follow the directions on the sheets they give you!

After waiting for a little while longer, the Admiral interviews will begin. Your
interview with the Admiral will not last long (he is a busy man). You will find out if you
passed within a minute of walking out of the Admiral’s office. If you pass, you will
return to the conference room, fill out some important paperwork, and grab some Nuke
School prep materials. After that, you’re done!
G. Interview Day Preparation Tips and Suggestions

- **Study well in advance.** If you begin studying early, you can spread out the effort and avoid cramming at the last minute. In addition, you will be much more prepared and comfortable with the material.
- **Plan your movements in advance.** Book your hotel early and plan out how you will be getting to the interview. You don’t want to be stressing about that detail the night before your interview.
- **Get your uniform ready before you go to D.C.** If your uniform is ready before you go to D.C., you have one less thing to worry about the night/ morning before your interview. In addition, double and triple check that you have all of your components, and ask if you are unsure how to put SDBs together.
- **Relax the night before your interview and get a good night’s sleep.** You won’t retain anything you try to cram the night before your interview, so use that time to try to relax and get a full night’s rest.
- **Get up reasonably early the day of your interview.** Don’t sleep in so late that you miss your train or you have to rush to the Yard. With a good plan and plenty of time, you can eliminate a little more stress from the day.

H. Technical Interview Tips and Suggestions

- **Relax!** Many people who fail an interview do so because they were too nervous. Take a deep breath and answer each question to the best of your knowledge.
- **Be thorough and methodical.** The whole point of the interview is test whether you can make it at Nuke school. Therefore, displaying knowledge in an accurate, methodical way is better than simply regurgitating formulas.
- **Be courteous and respectful.** This should go without saying, but some smart people have failed their interview because they were arrogant or abrasive.
- **Answer each question to the best of your ability.** If you get stuck on a question, explain as much of the set up and theory as you possibly can. NEVER say “I don’t know how to do this.”
- **Ask for constants or equations if you forget.** If you know that you need a particular constant or equation and just had a brain freeze, do not hesitate to ask. However, be sure to preface your request by saying you know what you are talking about. For example, “I know I need to use the equation for the potential energy of a spring for this next step, but I just had a brain freeze.”
- **Don’t BS the interviewer.** Don’t attempt to talk about something you don’t know. If you try to impress the interviewer by spewing out random information or by pretending you really enjoy X, the interviewer will call your bluff and ask for the details.

I. Admiral’s Interview Tips and Suggestions

- **Relax!** Although it is intimidating to talk to the Admiral, being nervous only complicates things and makes it harder to regurgitate the standard introduction you need to memorize.
Follow the instructions. You will get an hour long brief about the logistics of interviewing with the Admiral. Pay attention and don’t be the MIDN who botches procedures.

Think before you speak. The Admiral will ask some really tough questions. Make sure you take a second to think about your answer before you say something stupid.

Prepare to discuss past performances. If you had a bad semester or have been in trouble, the Admiral WILL ask what happened. Be prepared to have an honest response to tough questions about discipline problems and bad grades.

Be honest and take responsibility for past performances. This ties in with the last point. If the Admiral asks about bad grades or bad decisions, the wrong answer is to blame your professors or your friends. Talk about what you did wrong and what steps you have taken to correct the issue(s).

Be prepared to talk about the interviews. If you had a bad interview, expect a question from the Admiral about it.

Know why you want to go subs or SWO(N). The Admiral may ask you why you want to go subs or SWO(N), or why you don’t want to do one or the other. Be sure to have a strong response for either question.

Know why you are interviewing. The accession bonus is not an appropriate answer for this question. Again, have a strong response for this question.

J. About the Ultimate Guide

The Ultimate Guide is a compilation of the actual questions Hokies have faced throughout the years. Some of the questions are repetitive, some of the original numbers have been lost, but all of the questions will help you get ready for your interview. The Guide is organized by subject matter as best as possible. You can look through the table of contents for the subjects in which you need practice, or you can just work problems from cover to cover.

You will get the most out of this guide by working the problems without the solutions. This approach will better prepare you for the interview, and will help you identify the areas in which you need to study harder. Working the problems with the solutions will give you a false sense of your knowledge and capabilities.

When you finish a problem, or if you get completely stuck, look up the solution in the accompanying solutions guide. Pay particular attention to the way in which the solutions are presented. These solutions demonstrate the detailed level of knowledge and methodology needed to pass the interview with flying colors.

As this is a living document, new problems are continually added. Because the solutions require a great deal of effort to prepare, some problems don’t have solutions just yet. If you have issues with one of these problems, see the submarine LT or one of VT’s awesome Nuke Ensigns for assistance.
II. THE ULTIMATE PROBLEMS

- Physics
- Fluids
- Calculus and Trigonometry
- Chemistry
- Thermodynamics
- Electrical
- General Reasoning
- Chemical Engineering
- Mechanical Engineering
- Questions from the Admiral
A. Physics

1. Find the period:

2. a) Which sphere hits the ground first? Why?
   b) Which sphere bounces up the furthest? Why?

3. How far up the ramp does the ball travel? What happens if we include friction?
4. How far does the spring depress?

5. If the mass of block A is 1000 kg and rests on a frictionless incline, what is the mass of block B so that the system stays in equilibrium? What if the incline is NOT frictionless?

6. a) Find the speed of the ball at impact
   b) Will the speed of the ball at impact change if it is thrown with an up or down angle? Why or why not?
7. a) Find the magnitude and direction of Ball 2 after the collision. Assume $M_1 = M_2$
b) What percentage of kinetic energy is lost during the collision?

![Diagram of Ball 1 and Ball 2 before collision]

BEFORE

Ball 1: 2 m/s to the right
Ball 2: at rest

![Diagram of Ball 1 and Ball 2 after collision]

AFTER

Ball 1: 1 m/s at 45° to the right
Ball 2: at rest

8. A rocket with mass $M$ is sitting motionless in space. The rocket is powered by steam with velocity $V_S$ and mass per time $C = \frac{dm}{dt}$. Write an equation for rocket acceleration in terms of $M$, $V_S$, and $C$.

9. a) Find the magnitude and direction of Dude #2 after the collision.
b) Using your answer from a) and given the same $M_2$ and $K_{SPRING}$, find the spring displacement if Dude #2 completely stops after hitting the spring. Draw and label the free-body diagram.

![Diagram of Dude #1 and Dude #2 before collision]

BEFORE

Dude 1: $V_{1(I)}$ to the right
Dude 2: at rest

![Diagram of Dude #1 and Dude #2 after collision]

AFTER

Dude 1: $V_{1(F)}$ at 60° to the right
Dude 2: at rest
10. Find the acceleration of the 3 kg block:

11. Find a) the tension in the rope and b) the acceleration of \( M_2 \) if both masses are known. What happens if friction is NOT neglected? Assume \( M_2 \) hangs freely.

12. You are 110 yards from the hole. Do you want the 8-iron or the 9-iron?
13. If the ball lands 4 seconds after launch, what is the maximum height the ball reaches?

![Ball Trajectory Diagram]

14. Find $V_o$ so that the cart stays on the track.

![Cart on Track Diagram]

15. Find the relationship between $\mu_k$ and $\theta$.

![Coefficient of Friction Diagram]

16. Derive the angle that a projectile must be launched at in order to attain maximum horizontal distance.

17. What happens to a ball spinning horizontally on a string when the string breaks?
18. Given the following half-pipe, how many times can the skateboarder go back and forth until he stops? Assume the pipe is frictionless, except for the red length that has $\mu_k = 0.1$.

![Half-pipe diagram]

19. Find the minimum initial velocity needed to clear the fence.

![Fence diagram]

20. How fast must the bat swing in order to hit the ball 78 m/s? Let 100% of the momentum be transferred.

![Bat diagram]
B. Fluids

1. Find the horizontal distance the water travels as it first begins to drain from the tank.

2. a) What is the pressure at the bottom of each tank and why?
   b) Which tank has the larger outlet velocity and why?

3. a) If the yellow boxes represent cinder blocks, in which tank will the water level be highest?
   b) What happens if the yellow boxes represent foam blocks?
4. What are the criteria for the cone to float level with the water?

5. If the yellow block is thrown overboard and it sinks, does the water level rise, fall, or stay the same?
C. Calculus and Trigonometry

1. a) Find the area bounded by the blue curve, y = 0, y = 1, and the x-axis
   b) Find the area bounded by the blue curve, x = 1, x = 2, and the y-axis
   c) Revolve the area defined in part a) around the x-axis and find the volume
   d) Revolve the area defined in part a) around the y-axis and find the volume

2. a) Find the area of the shaded region
   b) Revolve the area of the shaded region around the x-axis and find the volume
   c) Revolve the area of the shaded region around the y-axis and find the volume

3. Given: \( y(x) = \frac{1}{3}x^3 + \frac{5}{2}x^2 + 6x + 3 \)
   Graph: a) \( y(x) \)
   b) \( y'(x) \)
   c) \( y''(x) \)
4. Given the following graph, sketch the first and second derivative:

5. Find the volume of the solid formed when the following area is rotated around the x-axis:
6. Given the following neutron equation: \( N(t) = 10 + 6t + 2t^2 \)
   a) Graph neutrons vs. time
   b) Find neutron increase between 10s and 11s
   c) Find neutron production rate at 10.5s
   d) What is the relationship between b) and c)?

7. Find the following limit:

\[
\lim_{{X \to \pi}} \frac{\pi^2 - \pi X + \sin X}{-\sin X}
\]

8. Integrate to find the area:

9. Find the area of the shaded region:
10. Find the volume of the solid formed by revolving the shaded area around the x-axis.

11. A truck is at a crossroads. It can travel 50 mph on the road but only 14 miles off-road.
   a) What is the maximum area the truck can cover in 10 minutes?
   b) At what point should the truck leave the road in order to minimize the travel time to a destination located at (X,Y)?

12. Derive the equation for a circle.

13. A rectangle has an area = L x W = 50 in² = constant. If L is increasing at a rate of 2 in. per minute,
   a) What is the rate of change of the perimeter?
   b) What are the dimensions when the perimeter ceases to change?

14. If water is entering the conical tank at the rate of 3 m³ per minute, what is the rate of change of the radius of the water when h = 2?
15. Solve for X:
\[ \log_4(x + 1) - \log_4(x - 1) = \frac{1}{2} \]

16. Calculate the following (or at least describe HOW to solve it):
\[ 3.4^{2.1} \]

17. Solve for the line connecting the following two points: (4, 1) and (-1, -3)

18. Given: \( f(t) = \sin(\theta t) \)
   a) Differentiate
   b) Integrate for the following shaded region:

19. a) Find the equations of both curves
    b) Find the area between the curves

20. Given: \( y(x) = (x - 3)^2 \)
    a) Graph the function
    b) Find the volume of the solid formed by revolving the area bounded by the function, \( x = 1 \), and \( y = 4 \) around the x-axis.

21. a) Draw \( \cos(x) \) from 0 to \( 2\pi \).
    b) Draw \( \sin(2x) \) from 0 to \( 2\pi \).
    c) Find the area bounded by a) and b).
22. Solve the following:
\[ \int \sin^3(x) \cdot \cos^2(x) \, dx \]

23. Solve the following:
\[ \int \sin^5(x) \cdot \cos^2(x) \, dx \]

24. If RS is parallel to UV, find angle TVU

25. Find the area of the shaded region.

26. Find the relationship between the radius and height of a cylinder that maximizes volume and minimizes surface area.
27. Given the following cup and a ruler, determine the cup’s volume in ounces. Pretend that you measured the cup, and found the top diameter to be 9 cm, the bottom diameter to be 6 cm, and the vertical height to be 15 cm.

28. a) Find the equations of both curves
b) Find the area between the curves
D. Chemistry

1. Given Glucose (C₆H₁₂O₆), determine:
   a) the atom percentage of hydrogen in the molecule.
   b) the weight percentage of hydrogen in the molecule.
E. Thermodynamics

1. Given an equation and enthalpies of formation, determine if the process is endothermic or exothermic.

2. If the initial temperature of the water is 20 deg. C, what is the temperature of the water after 1 hour?

![Diagram of a circuit with 10 V power source, 5 Ohms resistor, and 10 kg of water]

3. Define entropy.

4. Define enthalpy.
F. Electrical

1. Find the currents through each resistor.

2. Find the currents through each resistor in terms of R and V.
3. Explain as much as you can about the following circuit. Pay particular attention to what the current in the circuit and the charge across the capacitor look like over time following closing of the switch.
G. General Reasoning and Problem Solving

1. List the number of white and black beads hidden behind the cloud:

2. From the following diagram, determine the value of $S$ when $N = 10$. $[[\text{diff.} = 2N+1]]$
3. You need to find the difference in height (X) between points A and B on the uneven floor pictured below (exaggerated of course). Unfortunately, you only have the following materials at hand:
   - Clear, flexible plastic tube
   - 2 Rulers
   - Water
   - Any help you need
How would you find X?

4. Two types of machines can be used to complete a job. By itself, Machine A completes the job in 5 hours. By itself, Machine B completes the job in 7 hours. How long will it take to complete the job using 2 A Machines and 3 B Machines?
H. Statics/Deforms/Strength of Materials

1. If $M_B$ and $\mu$ between block B and the incline are known, what is the maximum possible mass of block A before the block begins to slide?

2. What is the difference between stress and strain on engineering materials? Be sure to graph the relationship.
I. Major Specific – Chemical Engineering

1. How do we separate Uranium from other compounds and elements in a liquid?

2. What materials should pipes be made of in order to pump Uranium and Hydrofluoric Acid?

3. Questions specific to your Senior Design project.
J. Major Specific – Mechanical Engineering

1. Discuss your Senior Design project. What did you do? How did you pick your topic? What was the outcome?

2. Discuss specific courses related to your focus/concentration (automotive, robotics, nuclear engineering, etc.)

3. Discuss courses you’ve taken that relate to what your interviewer does (i.e. discuss a Nuclear Materials course with an engineer from the Nuclear Materials Division…)

4. “Are there any questions I should have asked?”

5. Be able to discuss any class on your transcript in detail.

6. Draw and explain the Otto and Diesel Cycles.

7. Be able to explain how 2-stroke and 4-stroke engines work.

8. Draw the temperature gradient from the center of a UO\(_2\) fuel pellet to the cooling water (reference the diagram if you haven’t taken any of the Nuke tech electives):
K. Questions from the Admiral

1. Why was your GPA so low this particular semester?

2. Why did you decide to go to Virginia Tech?

3. Tell me about the Virginia Tech Corps of Cadets.

4. How did you think your interviews went?

5. a) Are you aware of the NR program? Why do you want to do subs/SWO(N)? What if I make you go NR?
   b) Why do you want to go NR? If you don’t screen for NR, would you be willing to go subs/SWO(N)?

6. Why did you do so well/not so well in school?